Bath & West Community Energy

Flex Community Final Report

Funded by Power to Change's
Next Generation Programme
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Acknowledgements

This report has been written by Alison Turnbull, Peter Capener and Nick Bird (BWCE).

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Any errors in the report remain the responsibility of the authors.

Contents

Tables

Figures

1 Executive Summary

BWCE's community energy vision is to supply local, renewable energy direct to local people and so reduce the demand for high carbon electricity generation delivered via a congested electricity network. To help deliver this vision, BWCE wanted to explore the potential for establishing a community of participants able to offer flexibility to the electricity grid – a 'flex community'.

To underpin long term sustainability, a key aim of the Flex Community project was to design, test and refine a flex community business model. If successful, this could help expand the community energy model beyond just the ownership of community renewables to embrace revenue from facilitating or aggregating flexibility services for the local community. By expanding the community energy role, the project looks to strengthen the long-term viability of the community energy sector post FIT subsidy and help increase the benefits of community energy.

To test this approach, the key elements of the Flex Community project were to:

1. support the electrification of heat and transport in the domestic sector by recruiting households willing to install key energy technologies I.e., heat pumps (HP), electric vehicle charging points (EVCP) and to switch to electric water heating.
2. facilitate demand side response (DSR) by remotely monitoring and controlling electricity demand of the identified energy technologies, incorporating supply at the domestic level from existing installed PV;
3. test the role of a community aggregator by working with a smart platform provider to act as an interface between the participating householders and the local grid;
4. prepare and test a community aggregator business model from the quantitative and qualitative data generation and learning from the project.

The project was able to recruit householders that were willing to install technologies, but the delays faced by the project and the barriers householders faced around installation of new technology, meant that the majority of these participants have not yet progressed. As a result, the project had to rely on householders that already had low carbon energy technology installed.

Otherwise, the project did deliver outcomes against the other three elements, but not at the scale originally envisaged.

The experience of this project and the partnerships that have been established were instrumental in securing three-year funding from the EU as part of a European consortium to extend Flex Community within communities in Croatia, Italy and Spain, as well as here in the UK. This EU funded research project is called ReDREAM.

The early intention of this project was to also explore the potential for peer-to-peer trading at the community level as a means of motivating demand shifting. However, this element of the project was carried over to the EU project with the potential to carry out a longer-term analysis of this area of activity.

The key findings of the Flex Community project to date include:

1. **The Community Role:** the project confirmed the value of the intermediary role that community energy can play, generating interest and building on local trust and credibility to address participant concerns and retain enthusiasm and confidence in a long project that didn't always go to plan and faced a number of challenges during delivery
2. **Delays in project delivery were unavoidable**: project delays during Covid, an inability to rely on cloud-to-cloud data transfer and the resulting need for additional smart devices that required significant development time to deal with unreliability issues, and

the difficulty in achieving compatibility with heat pump and EV charge point technology, significantly reduced the number of participants and level of data that could be collected during the project.

3. **The business model:** analysis of the business model hypothesis, and validation with data that the project was able to collect, emphasised the importance of cloud-to-cloud communications, the need for scale, multiple revenue streams (rather than just from trading flexibility), and/or increased market value to creating a financially sustainable community business strategy
4. **Recruiting participants:** the concept of flexibility is complex so clear messaging and a more nuanced approach to targeting that draws in participants that are not already effectively flexing their demand or whose needs do in fact match the level of flexibility service being offered, is required to successfully recruit households to a flex community;
5. **Supply chain:** good quality installers of both energy technologies and smart devices are limited, are exceptionally busy and have limited capacity to focus on new approaches, so good working relationships establishing clear expectations on both sides around workflow and non-standard installations where necessary is essential
6. **Learning:** given the rapidly developing flexibility market and the significant hurdles that exist in recruiting household participants, learning from the analysis of qualitative data is as important as the analysis of quantitative data.

The project has identified further work required and a range of learning outcomes, see section 10.3, to be integrated into the follow-on EU funded extension of Flex Community. In summary, further work focusses on the need for further research at greater scale, getting more out of the data generated, understanding more about the relationship between flexibility and demand reduction, targeting and communications within participant recruitment, liaison with installers and the use of smart control devices. Learning has also been integrated within a Flex Toolkit (section 9) that may be of interest to community energy groups looking to work in this area.

Recommendations to the wider energy sector include:

- Ensure all new heat pumps are flex enabled and adopt compatible standards for cloud-to-cloud communications, as has happened with EV charge points and the adoption of Open Charge Point Protocols
- Rapidly reduce the costs for smart control devices if required to control 'dumb' energy technologies, to improve the financial viability of the business model
- Increase the compatibility of flexibility services offered by both national and regional markets to maximise the potential to stack revenue streams
- Speed the adoption across all Distribution Service Operators of standardised systems, expectations, and services with regards flexibility
- Improve smart meters such that data can be recorded at a level of resolution that will facilitate flexibility at a domestic level, or adapt domestic flexibility services to rely on lower resolution data (e.g., WPD's Sustain-H)
- Adapt electricity supply regulations such that the sale of electricity to local consumers can be recognised within the market and value can be attributed to the reduction in distribution and transmission costs
- Explore the sourcing of capital, if required, through community finance
- Provide training and market development opportunities for community energy groups and the supply chain on flexibility and the implications for doing business in this area
- Increase the potential for knowledge transfer between the energy and community sectors through maximising partnerships in innovation projects, secondments and university led programmes

2 Introduction

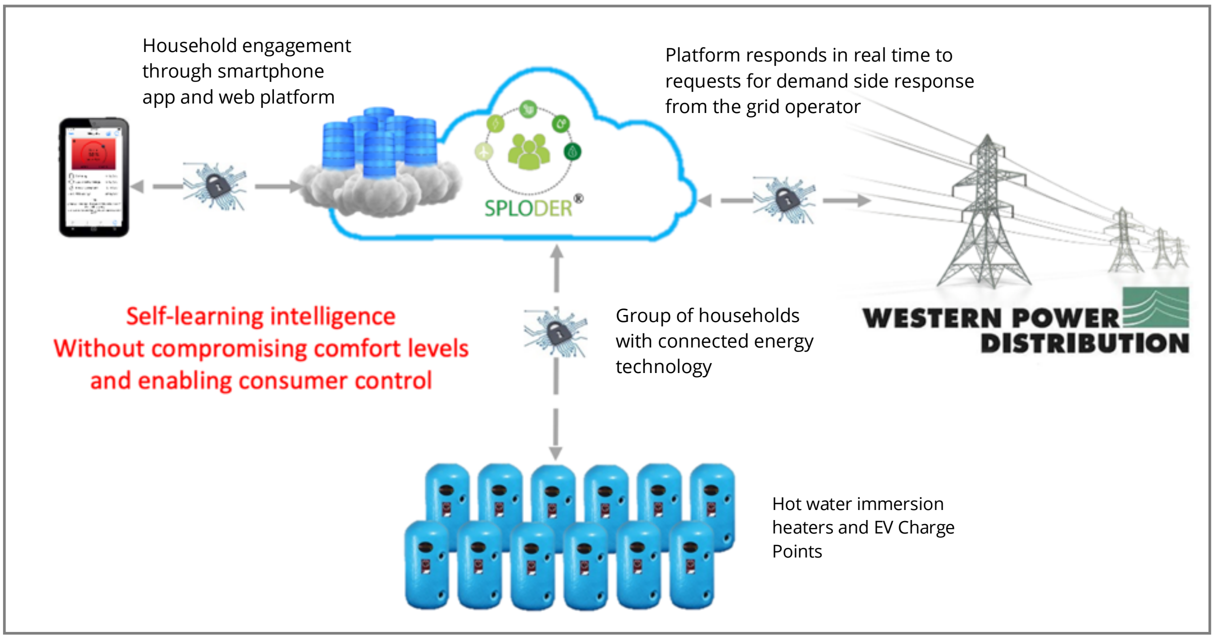
Two of the big challenges to be faced in addressing the climate crisis, will be the electrification of heat and transport. The resulting growth in electricity demand will place further pressure on an already stretched electricity network, as well as increase the demand for renewable electricity generation to ensure we meet carbon reduction targets.

Increasing distributed renewable energy generation to match demand at a local level could help reduce pressure on the electricity network. This requires a planned approach to electrification that can aggregate both the installation of equipment (to monitor the increase more easily in demand on the local system) and the shifting of electricity demand away from peak times or times of grid constraint.

Flex Community is a project designed to test the provision of community aggregated flexibility from domestic consumers with specific energy technologies, namely hot water immersion heaters, heat pumps and EV charge points. To do this, BWCE worked in partnership with Stemy Energy to:

- develop the Flex Community Portal to facilitate the electrification process by providing links between flex-interested householders and potential energy technology installers; and,
- utilise their smart cloud-based platform, SPLODER to enable demand side response through the automatic control of key energy technologies i.e., for space and water heating and EV charging, see Figure 1 below.

Figure 1: Providing Flexibility through Stemy Energy's Cloud Based Platform



The project's geographical scope included Bath and the surrounding area, an area that falls outside of the Constraint Management Zones through which WPD establishes its local flexibility markets. As a result, Stemy utilised a profile of DSR requests from the nearest Constraint Management Zone to then control energy technologies in participating households. The Flex Community project could then mirror the financial trading generated by this interaction based on real data from controlling energy technologies in real time.

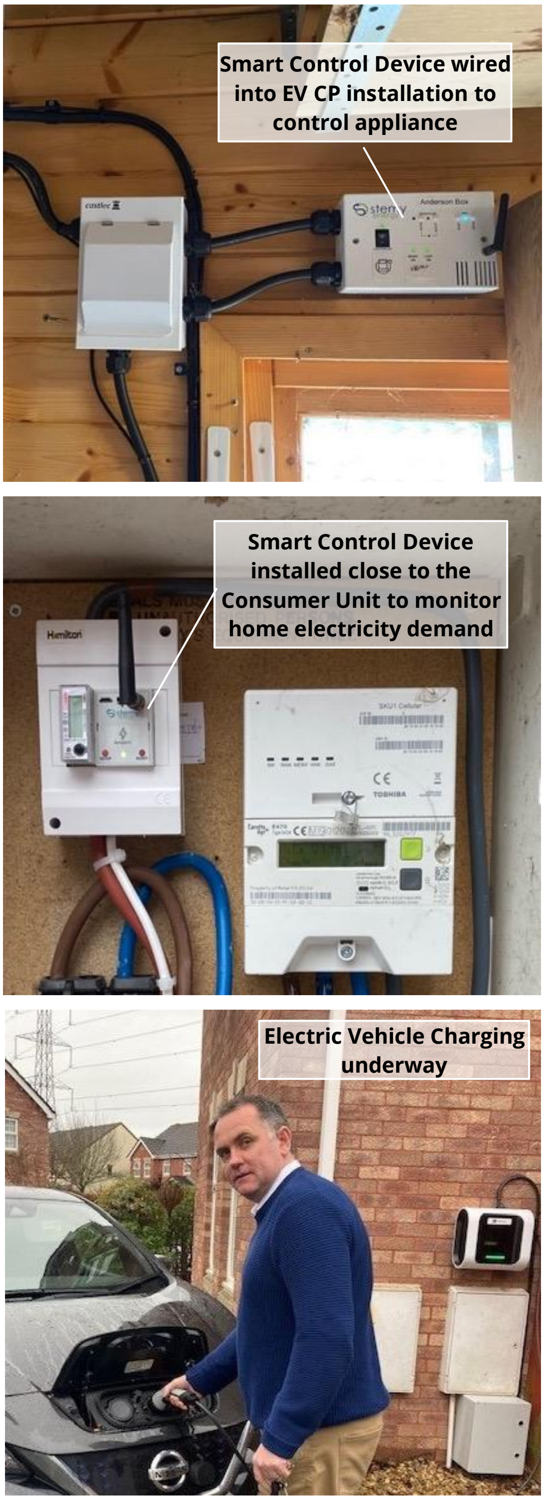
BWCE, as an existing community enterprise with a strong local track record and local presence, was ideally placed to promote the opportunity for households to get involved in the Flex

Community. BWCE's trust and credibility with local communities helped to offset the uncertainty of new technologies and helped explain the complex messaging of flexibility.

To create the Flex Community and to test whether this would be a viable business opportunity for community energy organisations, BWCE needed to:

- Recruit householders as 'pioneers' to participate in the Flex Community trial by either offering existing installed eligible energy technologies i.e., heat pumps (HPs), electric vehicle charging points (EVCPs) or immersion heaters for hot water (IH), or who were willing to have these energy technologies installed,
- Where direct cloud to cloud communication between technology in the home and Stemy Energy's platform was not possible, install innovative smart control devices to provide that link
- Householders were recruited in two phases. The first linked to just the control of hot water heating. The second phase also included households with EV ChargePoints.
- Recruit energy technology installers who were willing to engage with the pioneer households to install new energy technologies and become installers of the Stemy smart devices for controlling the energy technologies.
- With Stemy Energy, develop the web-based Flex Community Portal to on-board recruited householders and installers to facilitate the installation of energy technologies and smart devices, thus bringing together the whole Flex Community.
- Liaise with WPD to learn their demand side response request procedure from their Flexible Power portal.
- With Stemy Energy, and based on WPD's flex requirements, simulate demand side response signals as the household catchment area is outside the WPD Constraint Management Zone.
- Gather all the data generated by the automated management of the energy technologies (within pre-defined and ultimately over-rideable customer comfort limits) in offering flex to the local grid.
- Use the data generated from the simulated flex offering to test the viability of a facilitator/aggregator community business and to assess its potential for replicability and scalability.

Figure 2: Example EV ChargePoint Installation



In addition to testing the Flex Community business model, BWCE also provided the interface with local communities by:

- Promoting the Flex Community project via its membership and local networks in a small number of targeted communities in the project catchment area i.e., Bath and North East Somerset and adjoining parts of Wiltshire and South Gloucestershire.
- Acting as liaison with the recruited householders during the installation of Stemy smart devices and the operation of demand side response activities.
- Evaluating and monitoring the success of consumer engagement and experience (testing user behaviour and responses to the DSR platform) and any community benefit arising from the Flex Community trial.

BWCE identified three key sources of income generation to be tested in the business model:

- a share of the potential income generated from offering flexibility to WPD within their Constraint Management Zones via the aggregation of domestic demand side response; and,
- householder subscriptions to secure energy bill savings from participation in the scheme
- referral fees from energy technology manufacturers/supplier or installers for the take up of heat pumps and EV charging points.

For householder and installer subscriptions it will be necessary to evidence potential energy savings and a reliable workflow of installations before being able to properly test these potential revenue streams. However, the project did look to make a start on generating evidence of energy bill savings and the potential interaction between optimising for energy bill savings and optimising for flexibility.

Through Flex Community, BWCE has captured the qualitative learning from the project experience in a Flex Toolkit. This Flex Toolkit provides guidance and support for other community energy organisations interested in exploring the development path for engaging with flexibility markets.

3 Business Model

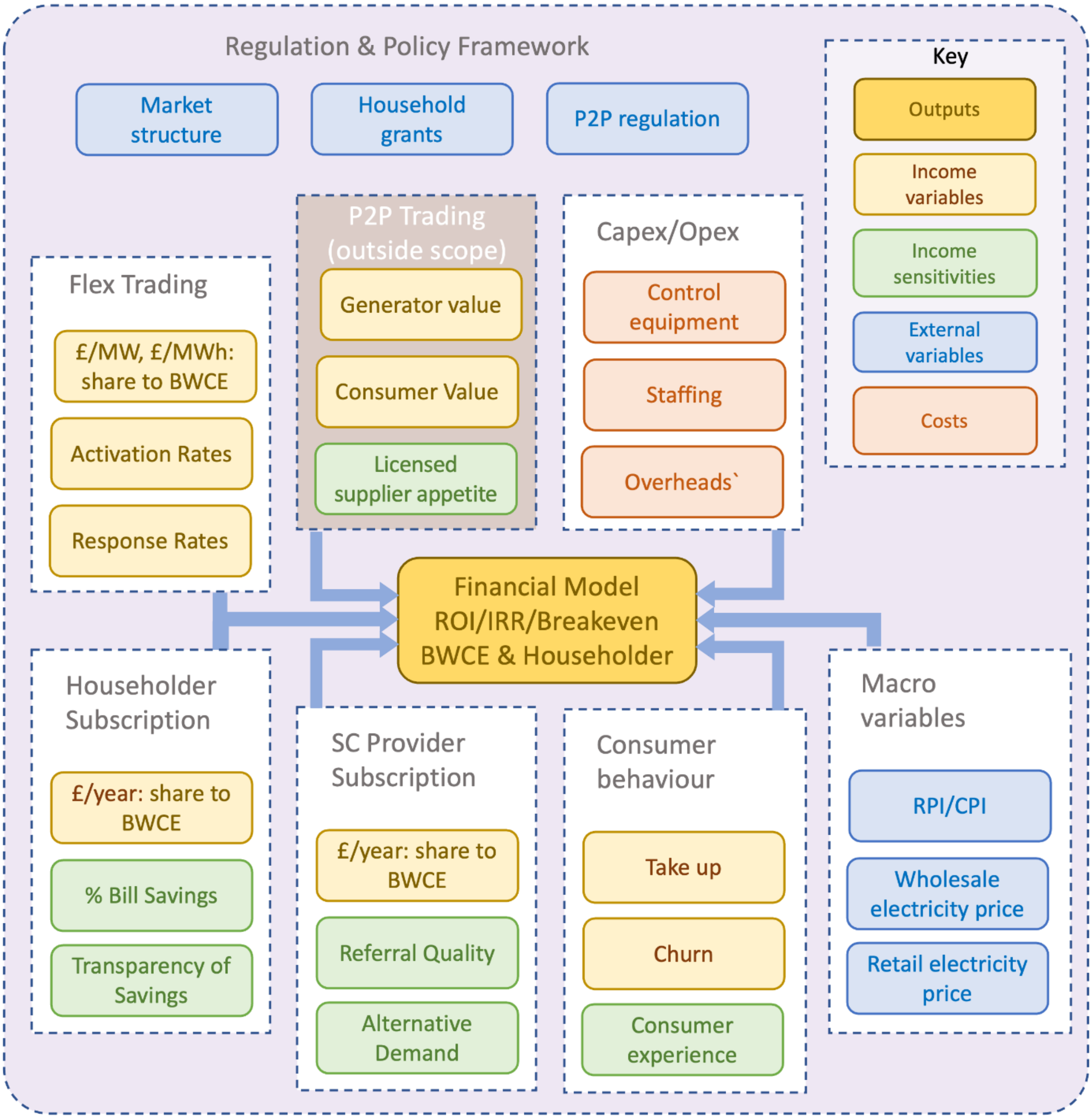
3.1 Business Model Hypothesis

BWCE's overarching community energy vision is for the supply of community power direct to local consumers, fostering a link for consumers between supply and demand and motivating demand shifting to minimise peak demands and maximise the community self-consumption of local renewables.

Our aim in this project was to design, test and refine a viable business model that will over time enable BWCE and other community energy businesses to expand their role beyond the installation of community renewables towards this wider vision.

The structure of a business model hypothesis, designed with this wider vision in mind, is shown in Figure 3 below.

Figure 3: Business Model Structure



A key element of this business model is the direct supply of electricity from local generators to local consumers, or Peer to Peer trading. This approach is restricted by regulation in the UK and falls outside the scope of this project due to time constraints. However, BWCE will be testing Peer to Peer trading and its ability to motivate demand flexibility within an extension of this project funded by the EU.

Objectives within this project were then:

- to support the electrification of heat and transport in the domestic sector;
- to facilitate demand side response (DSR) by remotely monitoring electricity demand at the domestic level;
- to lay the foundations for testing Peer to Peer Trading in a follow-on project
- to test the role of a community aggregator.

The approach to delivering these objectives involved building on our existing partnership with Stemy Energy and their cloud-based platform (SPLODER) which is designed to aggregate Demand Side Response (DSR). Stemy Energy have successfully tested their platform in Spain working with Spanish utilities and were looking to adapt their platform for the UK market.

The business model hypothesis assumes that community energy organisations can offer value into DSR markets by increasing take up and retention through more effective engagement, based on trust and local accountability.

The success of this business model will depend on the maturity and growth of the DSR markets and the allocation of risk, the scope of responsibility of each stakeholder and the resulting allocation of reward between platform, community energy group and householder.

During this project, quantitative and qualitative data has been used to test our business model hypothesis with assumptions analysed in the following section.

3.2 Business Model Financial Analysis

Table 1: Simple financial analysis of the business model hypothesis operating at scale

	Baseline		Scenario 1		Scenario 2	
BWCE Income	Value	Per Household	Value	Per Household	Value	Per Household
Available flex (kW)	3,750	-	3,750	-	1,875	-
Flex revenue	£57,000	£57	£57,000	£57	£45,167	£90
Householder subs revenue	£46,750	£47	£46,750	£47	£23,375	£47
BWCE Expenditure						
Capex	£430,000	£430	£107,500	£108	£0	£0
Annual financing cost	(£55,687)	(£56)	(£13,922)	(£14)	£0	£0
Staffing	(£70,380)	(£70)	(£70,380)	(£70)	(£52,785)	(£53)
Overhead	(£17,595)	(£18)	(£17,595)	(£18)	(£13,196)	(£13)
BWCE Profit / (Loss)	(£39,912)	(£40)	£1,853	£2	£2,560	£3
Stemy Profit / (Loss)	£17,050	£17	£17,050	£17	£25,192	£50

Table 1 above summarises three scenarios, assuming:

- forecast flexibility income, based on estimates from partner Everoze, see Appendix.
- forecast householder subscriptions, based on a share of potential savings estimated from Stemy Energy experience
- baseline cost assumptions, extrapolated from experience in the Flex Community project

These figures are used to give a sense of what scale that might need to be achieved to deliver a financially sustainable business model. In section 8.2 the revenue figures outlined here are tested against the data collected as part of the project.

3.2.1 Baseline Assumptions

Table 2: Assumptions utilised with the baseline scenario analysed in Table 1

	Data		Comments
No of households	**1,000**		Assumes all participating households have all technologies, heat pump, EV ChargePoint, electric hot water heating and solar PV
Technical capacity (kW)	3	PV	
	7	EV	
	5	HP	
	3	HW	
Available Flex (kW)	0	PV	
	1.8	EV	
	1.3	HP	
	0.8	HW	
	3.75	TOTAL	
	3750	**TOTAL portfolio**	
Potential Flex Revenue	£171	Income/hsld	BWCE revenue based on three-way split of income with household & Stemy. Assumes medium risk/return revenue strategy. See appendix for more details.
	£171,000	TOTAL portfolio	
	£57,000	**TOTAL BWCE/yr**	
Potential Optimisation Revenue	£187	Bill reduction/hsld	Household retains 50% of reduction, balance split with Stemy. Potential savings based on Stemy experience.
	£187,000	TOTAL portfolio	
	£46,750	**TOTAL BWCE/yr**	
Equipment cost	£430/hsld		Includes installation. Based on Stemy control equipment costs doesn't include cost of the low carbon energy technology.
Cost of capital	5%		10 year repayment term may be too tough to achieve given the nature of the equipment
Repayment term	10 years		
Staffing capacity	2.0 FTE		Assumes project management, marketing & client liaison capacity - But 2 FTE will be tight in terms of capacity
Average salary	£35,190		Includes a higher salary for more senior staff and includes NI and pension
Overhead cost	25%		Low %, needs to be more like 50%, even when organisation operates on a virtual basis

3.2.2 Scenario 2 Assumptions

The assumptions made in scenario 2 are as outlined for the baseline in Table 2, plus a 75% cut in the control equipment cost

3.2.3 Scenario 3 Assumptions

The assumptions made in scenario 3 are as outlined for the baseline in Table 2, plus:

- A reduction to 500 households,
- A 25% reduction in staffing capacity/costs
- A reliance on cloud-to-cloud communication only for appliance control, avoiding need for capital expenditure
- Revenue increased by 25-30% per household, either through (a) a higher risk revenue strategy (b) integration of value from carbon reduction within flexibility markets (c) a significant long-term increase in electricity bills increasing potential savings (d) additional income from referral fees/subscription from installers/contractors, or some mixture of all four.

3.3 Sensitivities and Risks

Table 3: Business model sensitivities and risks

Risk	Detail	Impact on Analysis	Mitigation
Participant profile	The analysis assumes that all participants have all technologies installed. In reality, there will be a mix of profiles of technology and also different levels of demand.	• Integrating a range of participant profiles will reduce the overall income per household and increase the pressure on numbers of participants required to break even and/or the need for a higher risk flex revenue strategy or greater market value. • Significantly higher risk strategy for flex revenue may not however be compatible with a community finance model.	• The analysis doesn't take into account the recent significant increase in retail electricity tariffs. • It's not clear how long this will last and whether tariffs will ever return to levels seen pre crisis. • Clearly if these increases are long term it will increase consumer motivation to engage with increased savings also offering the potential for an increased revenue share from household subscriptions. • Nor does the analysis include potential supply chain income. This element will require increased scale in order to test with installers on the back of evidence of significant workflow.
Revenue	In addition to the issues outlined above, the revenue figures are based on assumptions outlined in the appendix and are drawn from a market review carried out by Everoze for BWCE.	• Without greater validation through real world testing its difficult to comment on how accurate these estimates are. • The evidence from the Flex Community project so far doesn't imply that they are significantly adrift from what might be seen in practice.	• These results will need to be reviewed following further real-world testing as the Flex Community project develops. • Including a more detailed quarterly analysis of income and expenditure will enable consideration of seasonal and inflationary factors over time and as the Flex Community project increases its scale of operation.

Equipment costs	The baseline assumptions for equipment costs are based on actual figures provided by Stemy. Scenario 3 assumes that the control of household appliances is carried out via cloud-to-cloud communication between the platform and the technology in the home.	• Equipment costs have a significant impact on the viability of the model. • But they also introduce an added step required to on board participants, increasing complexity of the offer, the time taken to get participants involved and adding a point of weakness in the system that could increase downtime and operational costs.	• The reduction in equipment costs in Scenario 2 will only be possible through significant hardware development and scaling by Stemy, the use of existing commercially available equipment, if compatible with Stemy's platform or assuming that some of the households use cloud to cloud communication to control technology instead. • Increasing the proportion of households that utilise cloud to cloud communications to 100% as assumed within scenario 3 will require harmonisation of standards and protocols employed by heat pump and EV charge point technologies.
Financing capital costs	Where equipment costs for control technology need to be met, then both the cost of capital and the repayment term for capital raised become key variables.	• The cost of capital at 5% is reasonable for community finance now, though inflationary pressures may reduce the attractiveness of this figure over time. • Interest payments on community finance will need to be in line with the risk appetite of community investors and align with regulatory restrictions on interest payments associated with community businesses • Debt will be difficult to attract with limited options for providing security • The analysis assumes a 10 year repayment profile which should perhaps be more like 5 years given the nature of the equipment employed.	• If community shares become difficult to raise at 5% then it could be possible to issues community bonds that can be placed with a lower interest rate. • Though bonds will reduce flexibility around discretionary payments and increase risk if revenue targets are not met. • Lower cost finance might be able to be secured through partnership with local authorities able to secure investment through the Public Works Loan Board. Though this is untested for investment in this sort of project. • A 10 year repayment profile could be difficult to achieve with unsecured debt but is more achievable when considering community finance that provides a route to more patient capital
Staffing costs	Staffing costs are based on an average of salaries required for differing roles in delivering the project, together with a percentage contribution to overheads.	• Salaries may vary depending on the geographical region • The capacity required in all scenarios assumes streamlined systems following pilot testing and development. Though the figures are of course just an estimate at this stage based on the experience of delivering the pilot to date. • The 25% overhead contribution could be low for many organisations, depending on their scale and set up.	• The requirement to install control equipment rather than utilise cloud to cloud communications has a significant impact on staff time and so cost. • Moving as close as possible to scenario 3 and removing the need to additional control equipment would reduce risk and cost significantly.

3.4 Conclusions from Analysis of the Business Model Hypothesis

A target of 1,000 households to break even in scenario 2 is a major undertaking and will require significant up-front investment to get to that scale of operation.

500 households is still challenging but is more achievable, particularly without the need for additional control equipment, reducing hassle and transaction cost per household and speeding up take.

However, the smaller target for participating households will require higher revenue per participant to achieve, bringing implications for strategy and/or market development.

So, in summary, to be profitable, as well as increasing scale significantly, smart control device costs need to fall by 75% at least, (though preferably be removed totally through the use of cloud to cloud communication) and income needs to increase by 25-30%.

However, staffing levels and indirect cost assumptions are also tight. So, in reality the target required to secure profitability could well be higher.

Section 8 summarises the results from the analysis of the data secured from the flexibility trial and uses this to test the business model assumptions outlined here.

4 Development of the Flex Community Portal

4.1 Portal Overview

Stemy Energy, in collaboration with BWCE, developed the Flex Community Portal ('electrification web pages') which is the website that enables householders and installers to join and participate in Flex Community. In brief, the Flex Community Portal enables householders to:

1. Upload information on their energy use to build up a comprehensive smart energy profile.
2. Apply to install Stemy smart devices to enable any compatible energy technology already installed to provide flexibility to the electricity grid (known as a 'Flex Plan').
3. Apply to install new energy technology (e.g., heat pump, EV charge post) PLUS Stemy smart devices enabling them to provide flexibility to the electricity grid (known as a 'HP Plan' or 'EVCP Plan').
4. Arrange site surveys with potential installers and choose which one they wish to proceed to installation with.
5. Arrange an installation date.

Once the householder has arranged an installation date (5) they go outside the Portal to complete the installation process by liaising directly with the installer to make the necessary contractual arrangements.

Having passed BWCE's due diligence check (see section 5.6) invited installers can join the Flex Community by accessing the Portal which enables them to:

1. Upload information about their company, team members and information on their energy technology installation capabilities.
2. Apply to be a Stemy smart devices installer.
3. Receive an invitation to quote for the installation of an energy technology and/or Stemy smart device following an application from a householder i.e., the approval by Stemy and BWCE of a householder's Flex Plan, HP Plan and/or EVCP Plan.
4. Arrange site surveys/telephone calls with the potential householder customer to inform the quote preparation process.
5. Arrange an installation date.

Once the installation date has been arranged, the installer liaises directly with the householder to make the necessary contractual arrangements and carry out the installation.

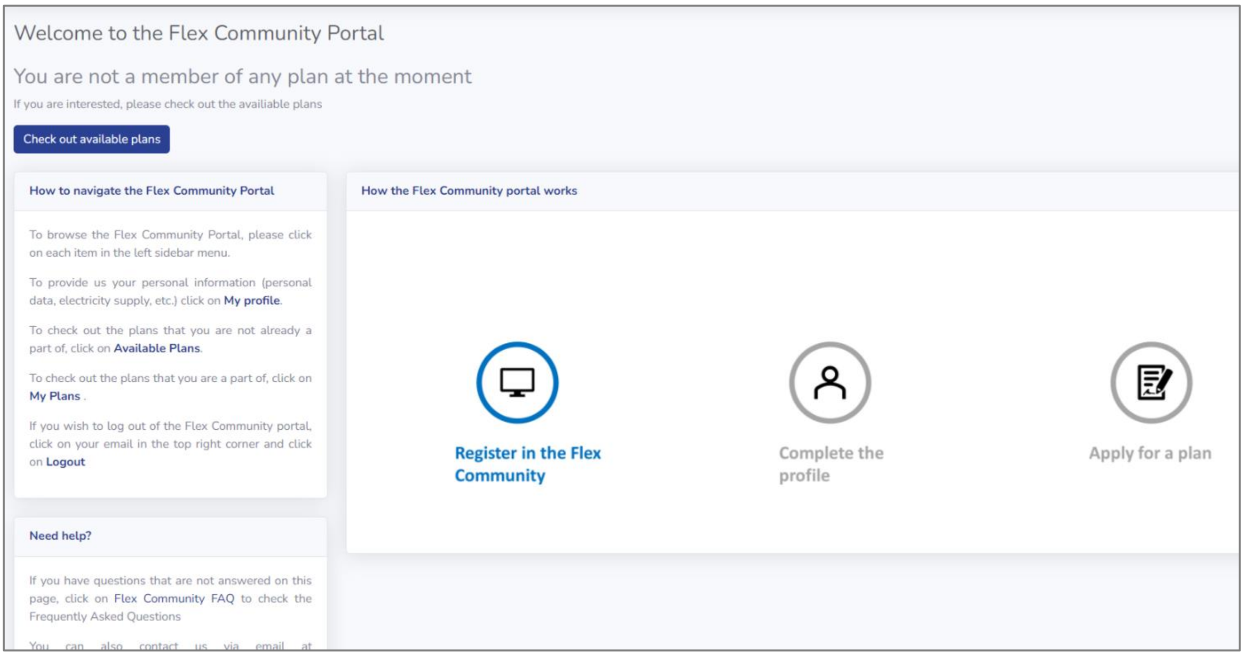
The Flex Community Portal underwent several versions based on feedback from BWCE, Flex Community users and external organisations. This testing process took much longer than had originally been anticipated and was partly due to the fact that the Portal had only a basic architecture when the Flex Community project commenced. Several iterative testing procedures were required before it could be made available for householders to use to join the Flex Community. Earlier versions of the Portal were trialled by the hot water controller pilot households who provided valuable feedback to help shape successive versions of the Portal.

4.2 Registering and Using the Portal

4.2.1 Welcome to the Flex Community portal

Householders who complete an Expression of Interest to join the Flex Community are invited by BWCE to access the portal via a dedicated link. Householders create their unique password-protected account and by registering, they are agreeing to the Terms and Conditions for the Use of Portal, with its associated Privacy Policy. Once logged-in, householders are taken to the Welcome to the Flex Community Portal screen (Figure 4) which informs them to firstly complete their details under 'My Profile' (Figure 5) and then to apply for the plan they are interested in under 'Available Plans' (Figure 6). The available plans are an HP Plan and an EVCP Plan for those householders looking to install these as new energy technologies or a Flex Plan for those householders that already have an energy technology installed and are seeking an assessment for suitability to provide flex to the local grid.

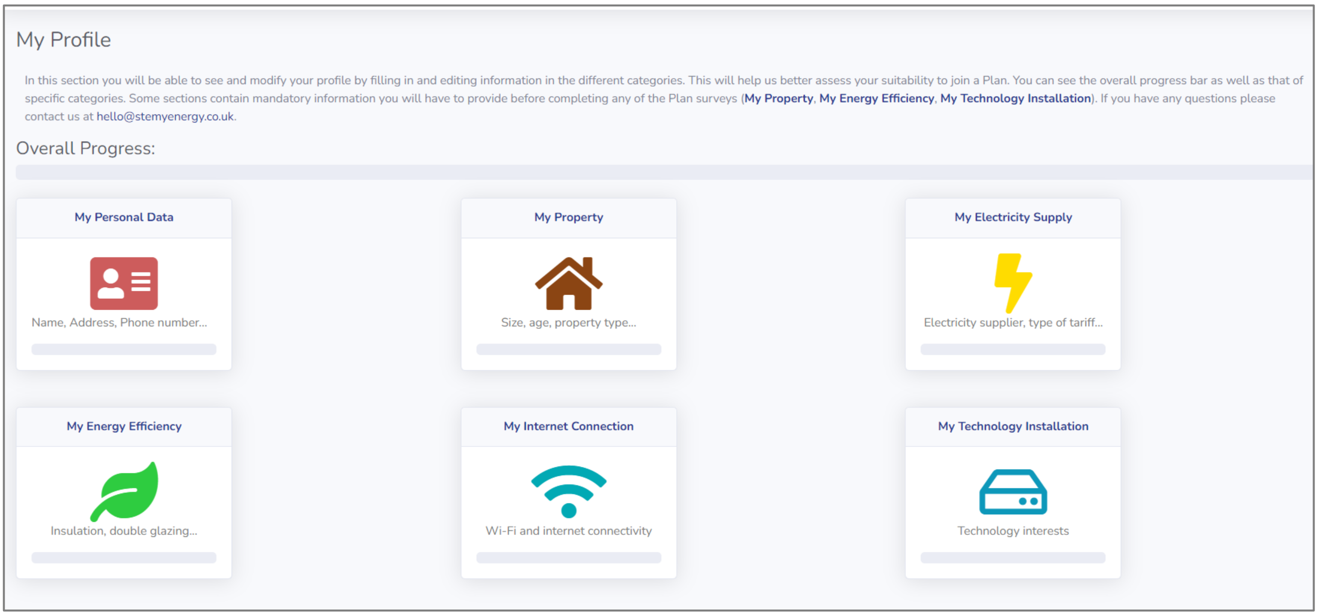
Figure 4: Portal Page - Welcome Page for Participants



4.2.2 My Profile

The first step for all users is to submit information on their property, energy supply, energy efficiency, internet connection and technology interests via their My Profile page (Figure 5).

Figure 5: Portal Page - My Profile



To successfully complete the My Profile page, participants will need to have certain pieces of Information (e.g., an EPC if they have one) to hand. This is detailed in the Portal Guidelines[1] the householders receive prior to accessing the Portal, so they know what information they need to have ready to hand.

4.2.3 Available Plans

The following Plans are available on the Portal:

- Heat Pump Plan – to install a heat pump plus Stemy technology to provide flexibility.
- EV charge point plan - to install an EV charge point plus Stemy technology to provide flexibility.
- Flexibility Plan – if the householder wants to offer flexibility from an existing energy technology i.e. a HP, EVCP, or primary source IH

To apply for a Plan, they need to complete a questionnaire. The introduction to each Plan Survey details the information they will need to have ready to hand to complete the questionnaire.

Figure 6: Portal Page – Available Plans

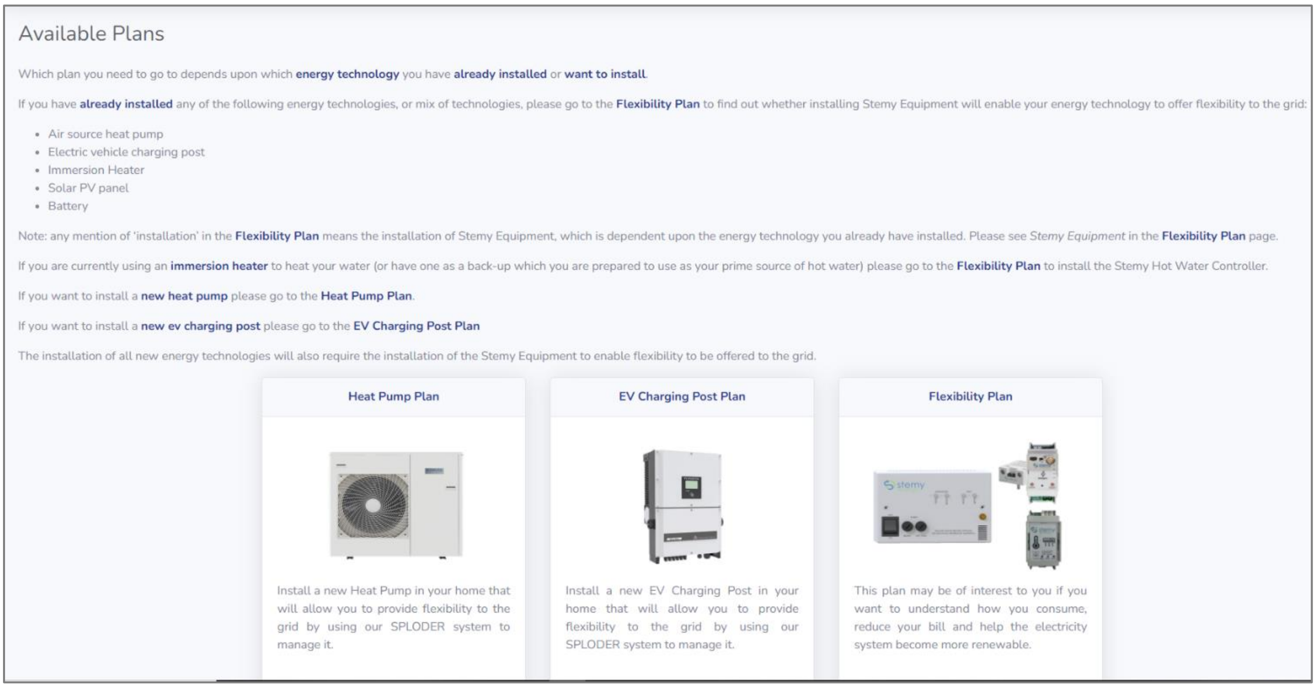
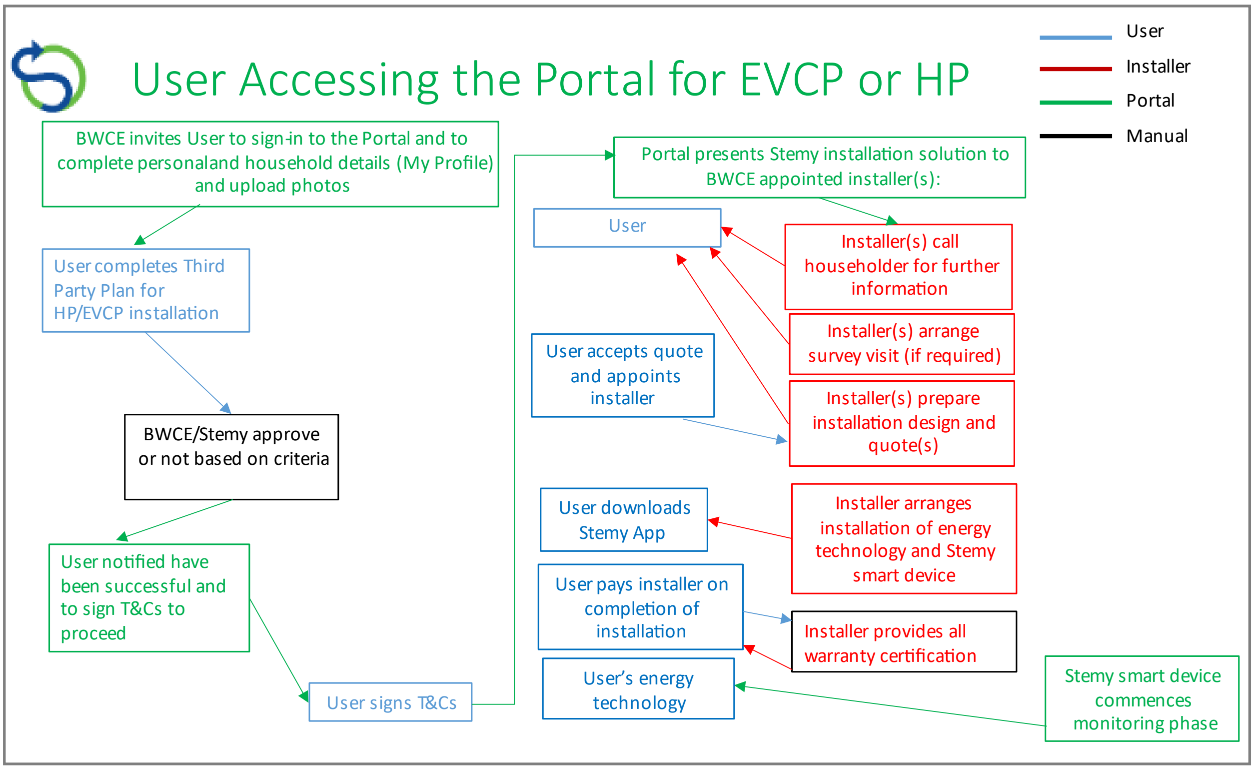


Figure 7 below summarises the main steps for a HP or EVCP Plan Applicant

[1] *Guidance on using the Flex Community Portal (August 2021)*

Figure 7: Summary of Participant Interaction with the Portal



4.3 Supporting Documentation

4.3.1 Terms and Conditions with associated Privacy Policies

Participation by the householder in the Flex Community project involved accessing the Stemy Flex Community Portal to:

- upload information on their energy use to build up a comprehensive smart energy profile;
- apply to install Stemy smart devices to enable any compatible energy technology already installed to provide flexibility to the electricity grid.
- apply to install new energy technology (e.g., heat pump, EV charge post) PLUS Stemy smart devices enabling them to provide flexibility to the electricity grid.

Because the relationship for these activities is between Stemy and the householder, Stemy produced the Terms and Conditions and their associated Privacy Policies to govern these activities. These Terms and Conditions are:

- Portal Use Terms and Conditions[2]
- Flex Plan Terms and Conditions[3]
- Third Party Providers plans Terms and Conditions[4]

Householders are required to read the Portal Use Terms and Conditions when registering to use the Portal. This is accessed by a button on the registration screen. However, if the householder does not click on the link i.e., an assumption of the T&Cs having been read, they are not prevented from continuing to use the Portal. If the householder is offering an existing energy technology i.e., HP, EVCP or IH as the primary source of water heating, for flex, then they are also required to read and importantly, upload a signed version of, the Flex Plan Terms and

[2] *Flex Community Portal Use Terms and Conditions FINAL 17.03.22*
[3] *Flex Community Flex Plans Terms and Conditions FINAL 17.03.22*
[4] *Flex Community Third Party Providers Plans Terms and Conditions FINAL 17.03.22*

Conditions. These Terms and conditions are accessed at the relevant point in the Customer Journey on the Portal and have the facility of inserting an electronic signature, date and name of the householder for convenient uploading to the Portal. BWCE is notified if the householder has not signed and uploaded the correct version of the Terms and Conditions, although the householder is not prevented from continuing their Customer Journey.

If the householder is seeking the installation of a new energy technology i.e. HP or EVCP (IH are not being installed as part of this trial) in order to participate in the Flex Community project, then they are also required to read and importantly, upload a signed version of, the Third Party Plan Terms and Conditions. Again, these Terms and conditions are accessed at the relevant point in the Customer Journey on the Portal and have the facility of inserting an electronic signature, date and name of the householder for convenient uploading to the Portal. BWCE is notified if the householder has not signed and uploaded the correct version of the Terms and Conditions, although the householder is not prevented from continuing their Customer Journey.

Importantly, whilst the Flex Community facilitates the bringing together of householders who wish to participate in the flex trial and installers who wish to be notified of potential customers, the Flex Community Portal is not involved with the provision of any contractual arrangements between the householder and the installer. Once a householder accepts a quote from an installer for the installation of an energy technology and/or Stemy smart device and the installation date is arranged, all liaison between the householder and the installer is outside the Portal and follows the normal procedure for making the necessary contractual arrangements.

The participating Flex Community installers are also required to read the Installer Terms and Conditions:

- Installer Terms and Conditions[5]

Because the Terms and Conditions were directly between the householder or installer with Stemy, BWCE was not party to these Terms and Conditions. However, BWCE recognised the value of securing RECC review of these Terms and Conditions (and associated Privacy Polices) and arranged this. This was an extremely valuable exercise as it provided guidance on making both the wording clearer and improving compliance with consumer codes.

4.3.2 Stemy Devices and Testing Protocol

Although it was Stemy's original intention to establish a direct connection between their platform, SPLODER and the energy technology, participation in Flex Community still required the installation of a Stemy device. Because of potential access and data protection issues, Stemy did not expect to access householder data from a smart (SMETS2) meter. As such, it was not a pre-requisite to have a smart meter installed to be able to participate in Flex Community. Instead, to obtain whole house electricity consumption data, Stemy planned to install a smart (wi-fi enabled) device it had developed called an Ampere. All households, whether offering existing installed energy technologies or installing new energy technologies, were required to have an Ampere installed near to their fuse box.

BWCE and Stemy spent a considerable amount of time in identifying and liaising with a number of market leaders for both HPs and EVCPs to ascertain their product suitability for a successful direct communication with SPLODER. Whilst many manufacturers were interested, the majority were not in a position to participate at that time in the Flex Community project, largely due to:

- their unwillingness to allow Stemy access to the software within their EVCP or HP as to do so would mean disconnecting product connection with their own software platforms; and,

[5] *Flex Community Installer Terms and Conditions FINAL 17.03.22*

- the pursuit of their commercial plans to ultimately operate in the emerging flex market themselves.

Because the direct connectivity option was not readily available across the energy technology industry during the Flex Community project, Stemy developed smart devices that could be installed as an intermediary controller to switch the energy technology on and off without requiring direct access to the internal controls of the HP or EVCP. Details of these smart devices, plus their testing protocol, are available to the participants via the Portal.

4.3.3 FAQs

To support the householder on their journey through the Portal, BWCE and Stemy prepared a set of FAQs.

4.4 Portal User Feedback

Feedback from participants on their experience of using the Portal is shown below.

Table 4: Feedback on Use of the Portal and Actions Taken

User Feedback	Stemy/BWCE Action
The "My Profile" dashboard showing progress through profile set up is clear and useful	None needed
The "Available / "My Plan" sections are well laid out and easy to understand	None needed
It's really useful to share a summary of the information needed to complete the Plans at the top of the Survey pages The section FAQ is clear and informative	None needed
The "Welcome to the Flex Community Portal" needs to have a "Steps" section	Stemy have added this
A graphic illustration of all of the steps of the process from beginning to end of the user journey, showing which steps occur inside the Portal and which outside may be helpful	Stemy have added this once the householder has applied for a Plan
Clarity is required under the "My Energy Efficiency" tab in "My Profile" on cavity wall insulation (which is a pre-requisite for a HP installation	Stemy revised the questions in the Plan to more accurately capture this information
Under the "My Energy Efficiency" tab in "My Profile", it was proposed that there is further information (or a link) for householders on to how to apply for a new EPC	Whilst the value of this was recognised, it was agreed that the Portal should not have any commercial links at this stage
It would be very useful to be able to upload an existing EPC in pdf format rather than an image file	Stemy has amended this to allow for different types of files that can be uploaded
To sign up for a Plan it might be good to know more about the "suite" of possible HPs/EVCPs that could potentially be installed (whilst understanding that an evaluation survey would be required to confirm this)	Given the very limited availability of eligible products currently and coupled with not being able to provide commercial 'endorsement' this was not acted on; it may be something that will be addressed in the future
Perhaps users could access some case studies of previous installations	This was deemed a good idea and could be factored into later version of the Portal

Would want to know a bit more about the pool of approved installers i.e. how many are there, what type of businesses do they run, how local are they	This was deemed a good idea and could be factored into later version of the Portal
A bit more information in the Portal on the Stemy devices may increase confidence	Stemy have added downloadable documents of their smart devices that would need to be installed depending upon which Plan has been applied for

4.5 Stemy App

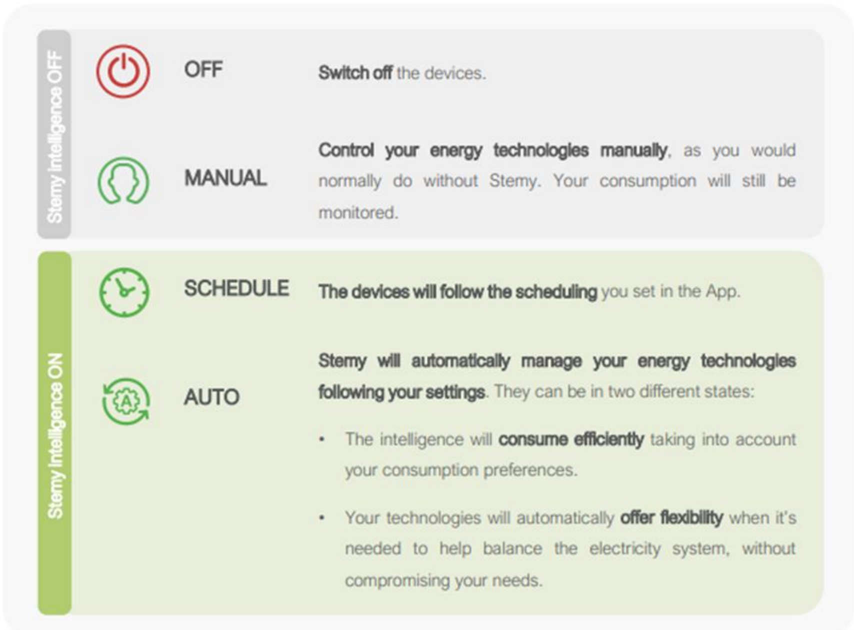
To facilitate householder control of the Stemy smart devices, Stemy developed a Flex Community App which is easy to download to either IOS or Android mobile phones or tablets. However, all of our installers of Stemy smart devices were on hand to help the householder download the App (after the installation of the Stemy device) and register the details of that device on their app so they can easily control it.

The app allows the householder to put the Stemy device into one of four modes:

- 'OFF' when the Stemy device is switched off
- 'MANUAL' where the householder controls their energy technology to meet their needs; in this mode, Stemy is monitoring the energy technology's electricity consumption, but it is not learning about the user's behaviour i.e. the 'intelligence' is off
- 'SCHEDULE' where the householder can use the app to pre-set or schedule the use of their energy technology by programming the Stemy devices to switch the energy technology on and off; Stemy's platform SPLODER is learning about their preferences i.e. the 'intelligence' is on but there is no remote control by Stemy in this mode
- 'AUTO' where Stemy will remotely control their energy technology; in doing so, it will either optimise their energy technology use or it will offer flex to the grid if it receives signals from the grid operator to do so.

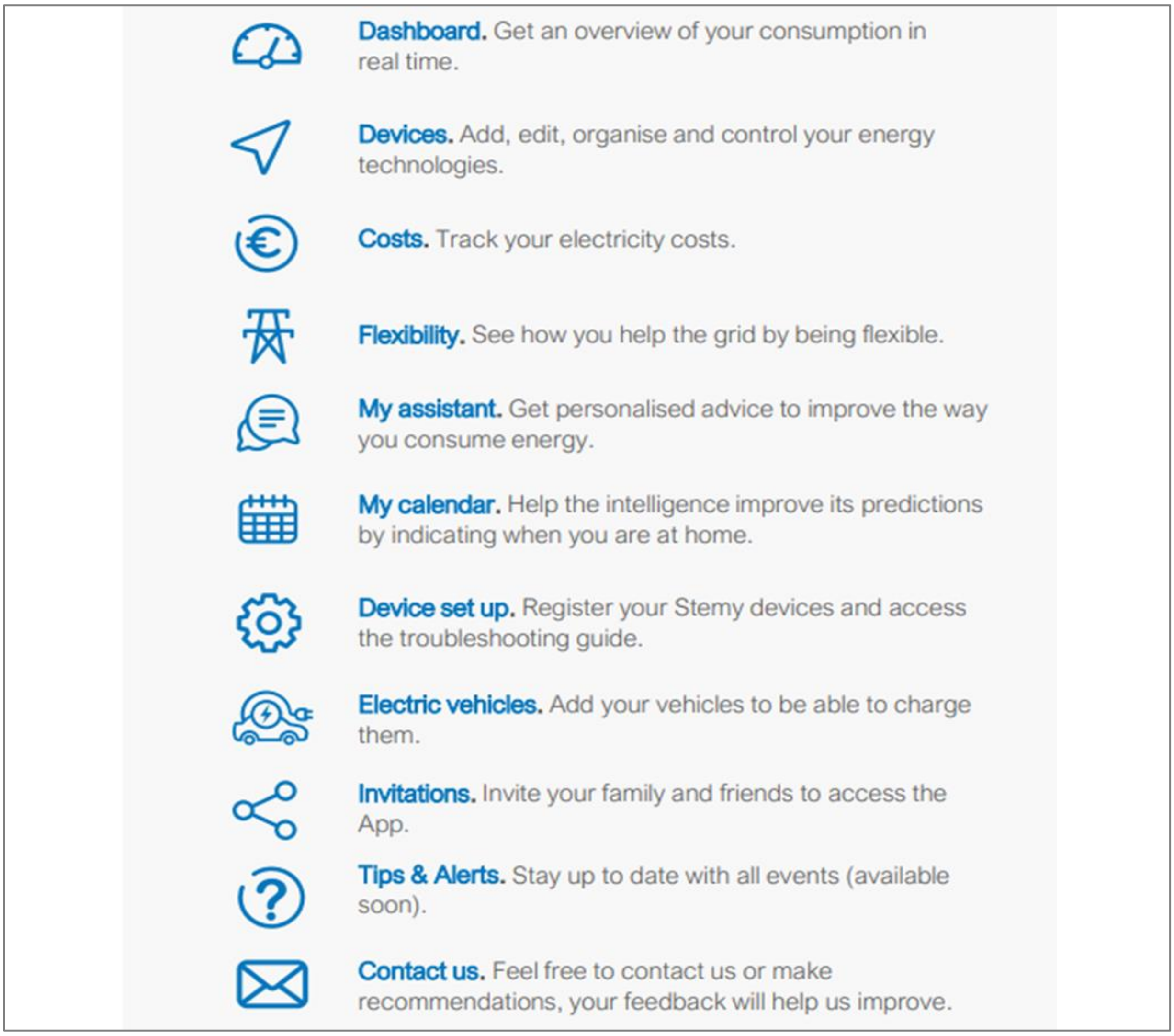
These modes are illustrated below.

Figure 8: Smartphone App Modes of Operation



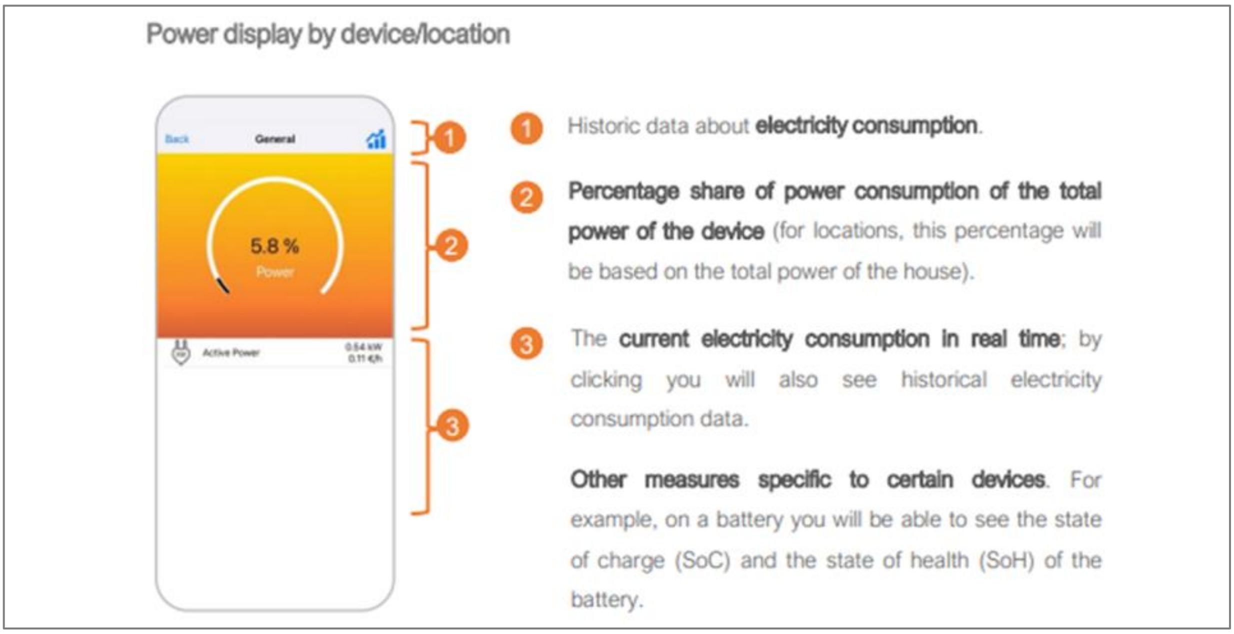
Once the Stemy smart device has been set-up and the app put into the chosen mode, the household can navigate the app via the menu illustrated below.

Figure 9: Smartphone App Menu



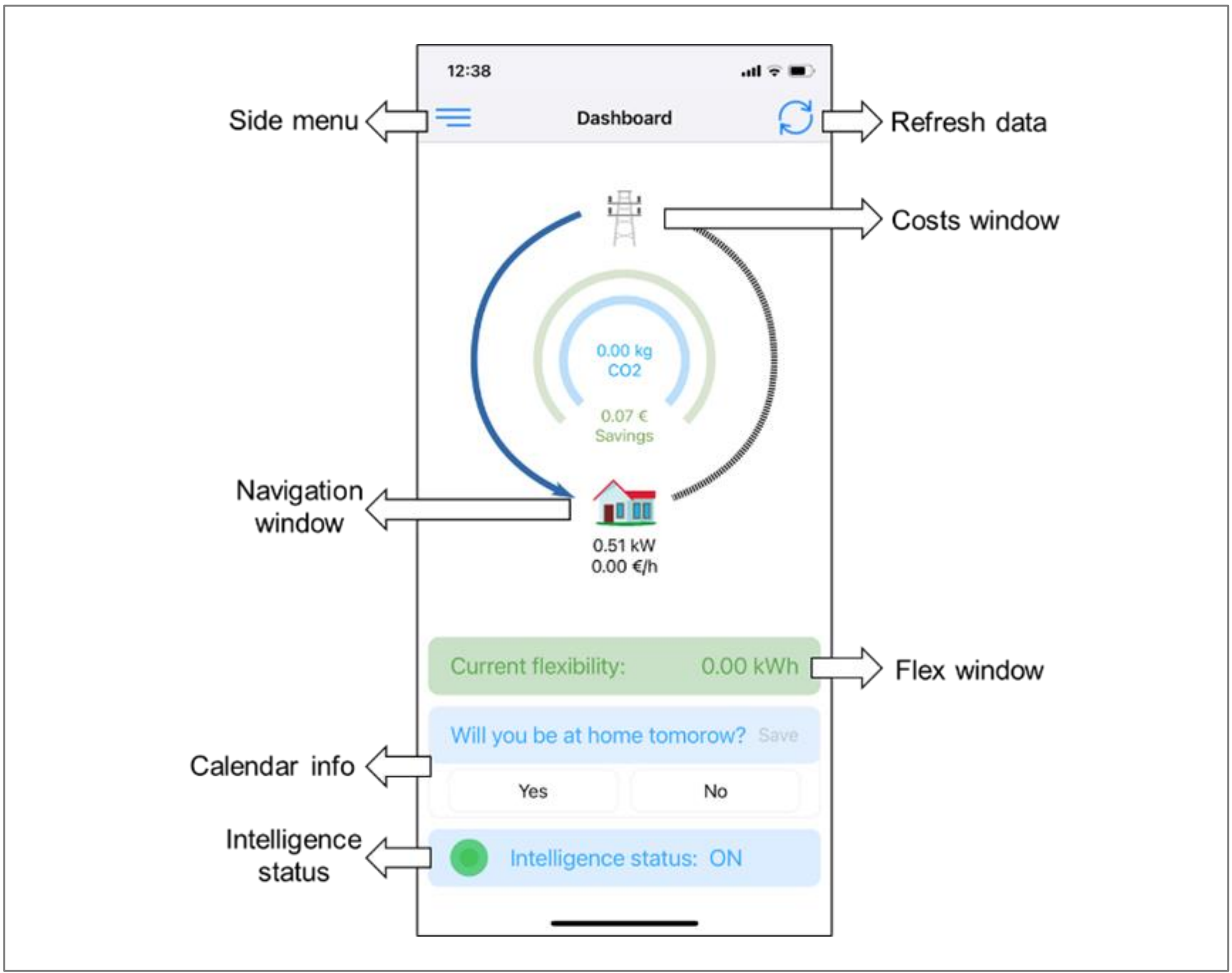
The householder can see the power performance of each device.

Figure 10: Monitoring Appliance Power Performance



The dashboard (see Figure 11 below) shows the householder an overview of the performance of their home. Savings may be generated from Stemy's platform either having optimised the performance of their energy technology and/or by offering flex to the grid. The CO2 savings functionality is currently being tested.

Figure 11: Smartphone App Dashboard



The householder was given both a Reference Manual and a Quick Guide for using the App.

5 Recruiting Households, Installers and Manufacturers

5.1 Householder Promotional Materials

For the initial phase of flexibility trading, the focus was on involving households prepared to offer just their hot water heating for flexibility (phase 1 trading in section 8.1). Within this phase our messaging focussed on posing three questions:

- Do you want to do something about the climate crisis?
- Do you use an electric immersion heater to heat your water (either as your main source or as a back-up)?
- Can you help us to test a new approach to reducing household energy costs and carbon emissions?

Promotional materials included a description of flexibility but didn't expressly term it as such (i.e., we were looking for volunteers who use immersion heaters, to test a smart app that helps shift your electricity demand away from peak times to reduce carbon emissions and the cost of maintaining the local network). This was because the concept of flexibility would be explained in more detail at a number of face-to-face events BWCE held in Bath. The opportunity to explain in more detail with small group discussions was an effective method of conveying a complex message. Following three of these events, BWCE had received expressions of interest to join the hot water pilot from 30 households. However, in Spring 2020, just as the Flex Community project commenced, the Covid pandemic struck, and we were in a national lockdown. The consequences of this were that:

- we were unable to complete the installation of hot water controllers as planned, due to restrictions on our electrician to undertake non-essential domestic works and a reluctance from some households to let tradespeople into their home;
- we were unable to host face-to-face events to recruit new householders, both for the installation of hot water controllers but also for HPs and EVCPs.
- the pandemic dominated people's focus, leaving less space for new ideas like flexibility

This had a significant impact on the promotion of the Flex Community project to recruit households willing to install a HP and/or EVCP.

Due to the set-back of being unable to undertake face-to-face recruitment promotional activity was refocussed on-line. Promotional materials were also updated following the need to focus more on households with energy technologies already installed and without cloud-to-cloud connectivity, so needing additional smart control devices to be installed (see section 5.2). The appointment of an experienced and dedicated Marketing and Communications officer was valuable in helping to reshape our recruitment campaigns.

This new recruitment campaign linked to the second phase of flexibility trading (phase 2 trading in section 8.1) involved:

- developing an improved BWCE web site landing page; including an animation[6]
- rolling-out a social media campaign[7]
- updating a Customer Briefing[8]
- hosting twice weekly Zoom calls[9]

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[6] *https://youtu.be/vVvble45bBo*
[7] *BWCE Facebook Ad Campaign September 2021*
[8] *Introduction to Flex Community BWCE and Stemy (August 2021)*
[9] *BWCE Flex Presentation (for induction sessions) updated 15.6.21*

- holding Living with Renewables and Heat Pump webinars[10]
- preparing new guidance for using the Flex Community Portal[11]

5.2 Householder Recruitment and Participation

Our new on-line recruitment campaign did encourage householders to complete an Expression of Interest[12] accessed from the BWCE web site and to commence their Customer Journey (see below) on the Flex Community Portal. Overall, 75 households completed an Expression of Interest, see section 5.3 for a full breakdown of recruitment numbers. A smaller number of these registrants proceeded to full Flex Community membership and onto completing a more detailed Plan. Many reasons were identified for this, some being specific to householders and others being outside the control of all the Flex Community participants. These included:

- the quotes for new 'flex enabled' energy technologies were higher than expected by householders. This was exacerbated by householders being to able to get cheaper quotes for non-flex enabled heat pumps and also by information distributed alongside the Green Homes Grants scheme that suggested much lower prices for heat pumps.
- continuing Covid restrictions preventing installer access to households to undertake surveys, prepare quotes and undertake installations;
- Covid concerns and pressures making it more difficult to make time to turn interest into action;
- suppliers being unable to procure energy technologies largely manufactured/assembled in the EU due to Brexit related custom control delays;
- discovering that already installed older generation energy technologies offered by householders were not able to be connected directly to the Stemy platform via cloud-to-cloud communications;
- the requirement to install flex enabling Stemy smart devices to compensate for the lack of cloud-to-cloud connectivity, which were themselves subject to both manufacturing delays (due to sourcing components from China) and customs delays;
- unavailability of installers due to them being flooded with customer enquiries prompted by the short-lived Green Homes Grant;
- equipment failures and unreliability of the Hot Water Controller, the smart control device used for controlling immersion heaters, and the limited stock of the replacement.

From the initial interest in Flex Community, but prior to the removal of the failed Hot Water Controllers, there were 21 active Flex Community members. Following the removal of the Hot Water Controllers, only 5 of these were replaced, so during the remaining phase of the project, there were 9 active participants.

5.3 Summary of Recruitment Numbers

Table 5 provides an indication of the fallout rates at different stages of engagement.

Although in the face of many challenges, the project did not involve as many Flex Community members in flexibility trading as planned, we have gained insights into the recruitment process, including valuable feedback on the experiences of being a Flex Community 'pioneer'.

[10] *Heat Pump webinar poster*
[11] *Guidance on using the Flex Community Portal (August 2021)*
[12] *https://www.bwce.coop/flex-community/*

Table 5: Recruitment numbers by stage of engagement

Recruitment stage	Recruitment numbers	Comments
Households Reached	Over 2,000	Includes households that received information about the project
Householders directly engaged with	100	Includes households that BWCE had some direct contact with
Households completing an Expression of Interest	74	Providing basic information about their interest and situation.
Households fully onboarding on the Flex Community Portal	49	Fully completing a My Profile section on the Portal
Households completing a specific technology plan	31	Providing detailed information about their property and its suitability for specific technologies (12 for HPs, 9 for EVCPs and 10 for HW)
Households directly involved in flexibility trading	12	Actively engaged in providing flexibility. Includes unique households across both phases of trading.

5.4 Key insights on Participant Recruitment

The key insights we have gained during the project include the following.

1. The concept of 'flex' in practice is hard to explain. Many householders understand the need to reduce electricity consumption on cost saving grounds and because they have a sense that 'it is good to reduce their carbon footprint' but don't fully understand what this means in practice.

   The principle of shifting electricity demand to …

   a) determine what type of electricity is consumed i.e., low carbon intensive renewables compared with high carbon intensive fossil fuels;

   b) reduce pressure on a congested grid, to avoid expensive and environmentally damaging grid upgrades;

   c) facilitate more renewable generation to access the grid as the DNO becomes more confident that electricity consumption peaks and troughs are smoothed, thus opening access to more generation,

   … is difficult to convey, particularly in remote/on-line settings.

2. The early interested householders, or 'pioneers', had a better understanding of the concept of flex. Whilst they were therefore willing to offer their household to participate in the project, many already had a number of installed energy technologies which prevented them from being able to offer much, if any, flexibility because they had:

   a) already finely-balanced these energy technologies to meet their household needs so there was no excess electricity consumption to offer for flex during times of high fossil-fuelled peaks, nor excess pv generation to divert from export to the grid for household consumption;

   b) already maximised their consumption in real time of on-site roof-top pv;

c) an Immersun/iBoost and/or a battery to store excess on-site pv generation;

d) solar thermal for Summer-time water heating;

e) an overnight Time of Use Tariff (TOUT) for EV charging.

3. In these instances, the Stemy equipment either wasn't able to participate in the energy technology mix because it wasn't able to access and control certain items e.g., the battery; or, worked against, or in conflict with, others i.e. the Immersun/iBoost or the solar thermal. Indeed, householders offering control of their hot water via their immersion heater had to have their Immersun disabled in order to participate in the project.
4. The project tested if these more complex households could be supported, but it became apparent that the ability to offer flex was minimal or indeed disadvantaged the householder. An example of this is switching EVCP charging to when on-site pv is being generated with the result that the householder did not enjoy the benefits of a cheap overnight TOUT, coupled with the resultant shift of water heating to a potentially high tariff period. In these households the Stemy equipment was de-installed.
5. The presence of a TOUT is a very effective market mechanism for incentivising households to switch their electricity consumption and it particularly suitable for overnight EV charging.
6. The timing of grant support worked against the recruitment of HP households to the project. The launch of the GHG incentivised householders to explore the potential for installing a HP under the possible misunderstanding that the £5k capital grant equated to approximately 50% of the installation costs. The reality, once a full HP installer survey had been undertaken, was that average full HP installation costs ranged between £14k - £20k so many households did not proceed. In the meantime, because HP installers had been inundated with enquiries, they had little spare capacity to follow-up the potential HP customers the Flex Community project had offered them.

5.5 The Customer Journey

The aim of the Customer Journey is to identify all the steps the householder needs to take to become a participant in the Flex Community project. The Customer Journey developed at the project outset captured the key milestones e.g. receiving the promotional message, attending an information session, registering on the Flex Community Portal etc. However, the Customer Journey[13] has been a working document that has evolved as the project has progressed.

In brief, the Customer Journey has the following stages:

5.5.1 Stage 1: Engaging

This stage comes before an individual is invited to join the Flex Community via the portal. The aims of this stage is to:

- Build awareness of Flex Community and its objectives, including the fact that this is a trial.
- Establish contact with householders prior to accessing the portal so we can gain feedback and learning based on their experience of joining the flex community.

5.5.2 Stage 2: Uploading details on the Flex Community Portal

The Flex Community Portal developed by Stemy Energy in collaboration with BWCE is the website which enables householders to join and participate in Flex Community.

The Flex Community Portal enables them to:

[13] *Flex Community Customer Journey v9*

1. Upload information to build up a comprehensive smart energy profile.
2. Apply to install Stemy smart technology to enable any existing energy technology they have to provide flexibility to the electricity grid.
3. Apply to install new energy technology (e.g., heat pump, EV charge post) PLUS Stemy smart devices enabling them to provide flexibility to the electricity grid.
4. Arrange site surveys with potential installers and choose which one they wish to proceed to installation with.
5. Arrange an installation date.

Once they have arranged an installation date (5) they go outside the portal to complete their installation and make the necessary contractual arrangements with the installer.

5.5.3 Stage 3 Installation of Flex enabled Energy Equipment

Installation of heat pumps, EV charge points

Installation of Stemy smart devices to make existing or newly installed energy technology flex enabled

5.5.4 Stage 4: Providing Flexibility

This stage applies to those householders who have either:

- Completed and been accepted onto a Flexibility Plan for existing energy technology.
- Installed flex enabled energy technology via Flex Community.

During the project we refined the Customer Journey to reflect what occurred in practice. Tracking householders on their journey through the Portal also provided useful information, and we concluded that the Journey was slower than expected. This was due to:

- some of the parallel installer journey steps were slowing down the process. This included the requirement of installers to upload their availability to undertake pre-installation evaluation visits to the Portal calendar. Due to time delays in providing estimates some of these dates soon became obsolete, This issue was addressed by Stemy (see below);
- the time taken for installers to upload quotes to the Portal following evaluation visits (even with the removal of the estimate stage) due to the high demand for installer services, particularly HP installation, caused by the Green Homes Grant;
- the time taken for householders to consider the quote(s) prepared by installer(s) which suggests a hesitancy on making the investment in the energy technology, again particularly for HPs.

5.6 Recruitment of Installers

Through experience in the local renewable energy technology installer industry, BWCE was able to identify and approach good quality local RECC and MCS registered installers to join Flex Community. Installers with a good reputation for the installation of HPs and EVCPs were recruited following a robust due diligence exercise that included reviewing the documentation in Table 6 below.

Table 6: Due Diligence Requirements for Flex Community Installers

Priority Due Diligence Documentation	Secondary Priority Due Diligence Documentation
Confirmation of RHI / MCS accreditation for heat pumps	Sample RAMs for heat pump installations
Copy of RECC membership or equivalent	Details of a typical customer journey with residential clients
Copy of H&S policy	Confirmation of the company's installer status with the manufacturers of the products the company installs i.e., installer accreditation
Copy of safety certification (Safecontractor or equivalent)	Certificates of competency for key staff working on design and installs specific to BWCE's area (Bath and surrounding area) including heating and electrical and safety qualifications and specific heating installation qualifications
Copy of the company's latest published financial accounts	Details of sub-contractors (where used) records and length and type of relationship with the company
Copy of Employer Liability, Public Liability and Professional Indemnity insurance certificates	N/A
Copy of the company's workmanship terms and conditions	N/A
Copy of a typical quote for a residential client	N/A

To on-board the installers, BWCE undertook some on-line training to explain the Flex Community project and their Installer Journey (see below). Installers were invited, and all accepted, to also become Stemy smart device installers (which required electrical skills). The installers would therefore install the Stemy smart devices either as a stand-alone installation where the energy technology had already been installed in the household (a Flex Plan household, or as part of an energy technology (HP or EVCP) installation (a Third-Party Plan household), see section 4.2.3).

Stemy prepared Installation Manuals for their devices and phone assistance to the installers during the installation process. Part of the installation of the Stemy smart devices also involved supporting the householder to download the Stemy app and to test its connectivity to the Stemy smart device.

As the Flex Community project progressed, it became necessary to clarify that whilst the Flex Community facilitates the bringing together of householders who wish to participate in the flex trials and installers who wish to be notified of potential customers, the Flex Community Portal is not involved with the provision of any contractual arrangements between the householder and the installer.

Once a householder accepts a quote from an installer for the installation of an energy technology and/or Stemy smart device and the installation date is arranged, all liaison between the householder and the installer is outside the Portal and follows the normal procedure for making the necessary contractual arrangements.

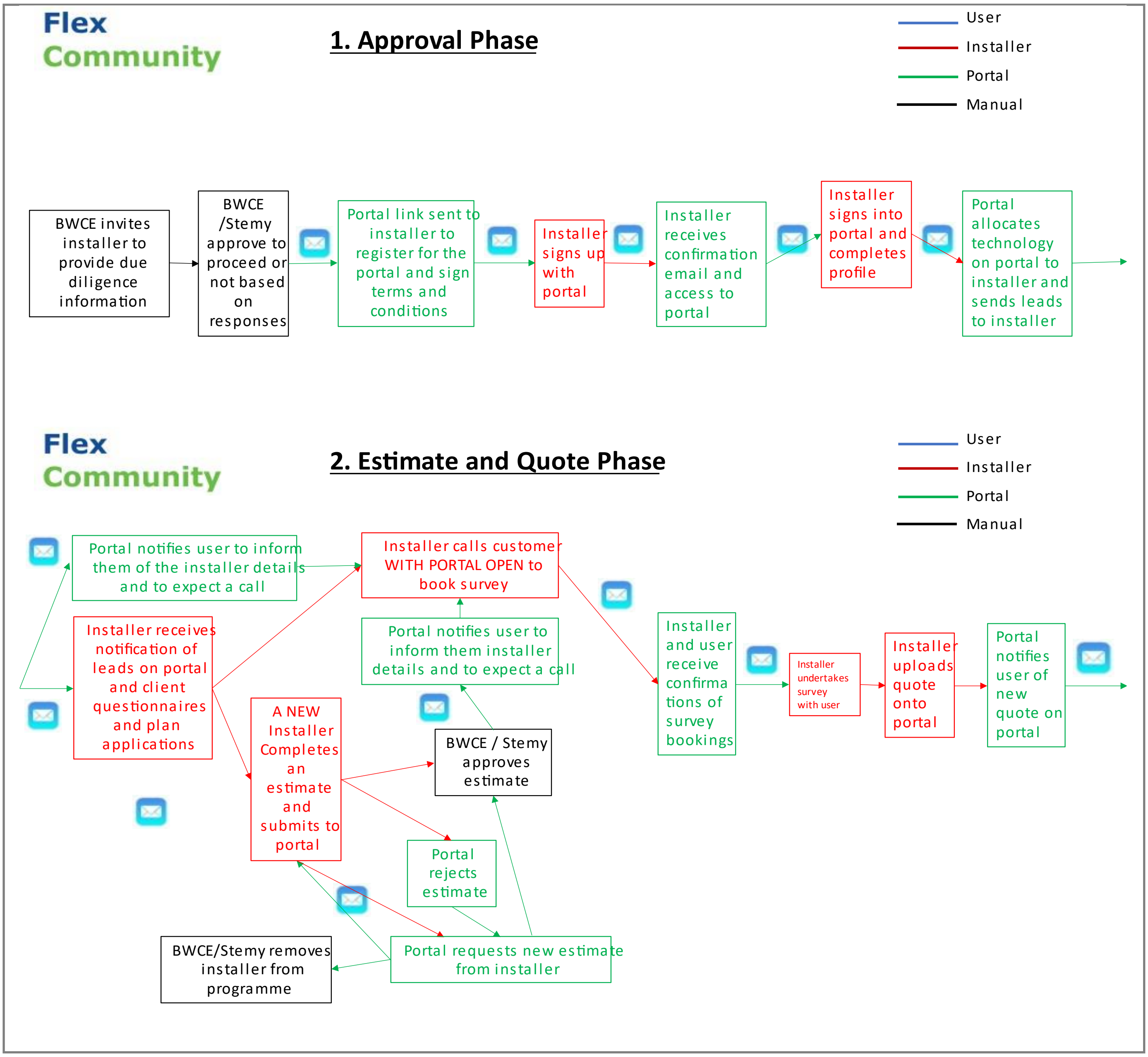
5.7 The Installer Journey

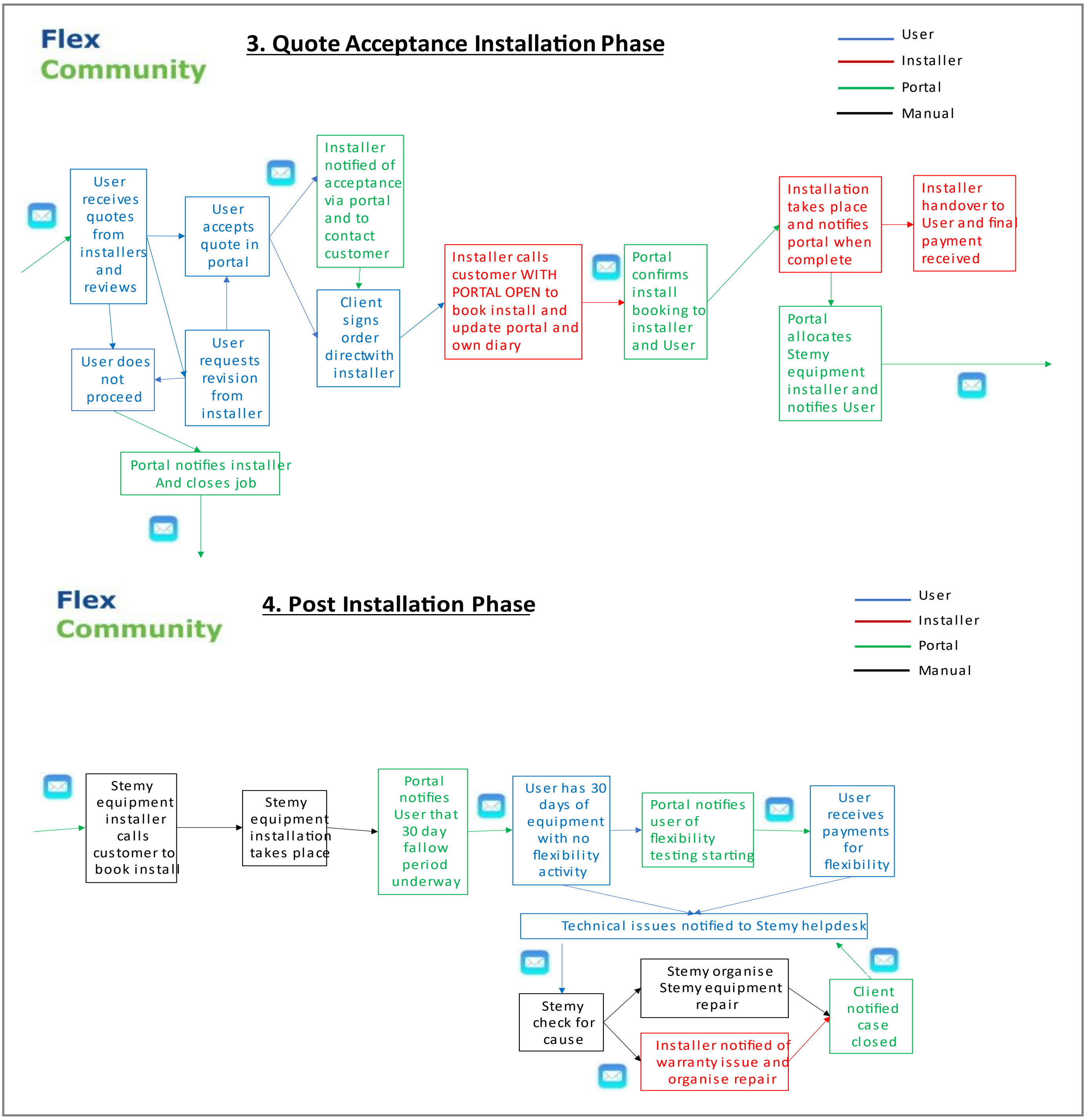
The Installer Journey is outlined in Figure 12 below and covers four main steps from approval through to post installation.

Within Figure 12:

- The far-right hand arrow in each diagram leads to the far left of the next step.
- The User or householder actions are show in blue and all Installer actions are shown in red.
- All actions undertaken via the Portal are shown in green.
- Some actions are outside the Portal and are shown in black.
- The mail symbol indicates where an automatic message is sent from the Portal to the installer to progress to the next step.

Figure 12: Installer Journey



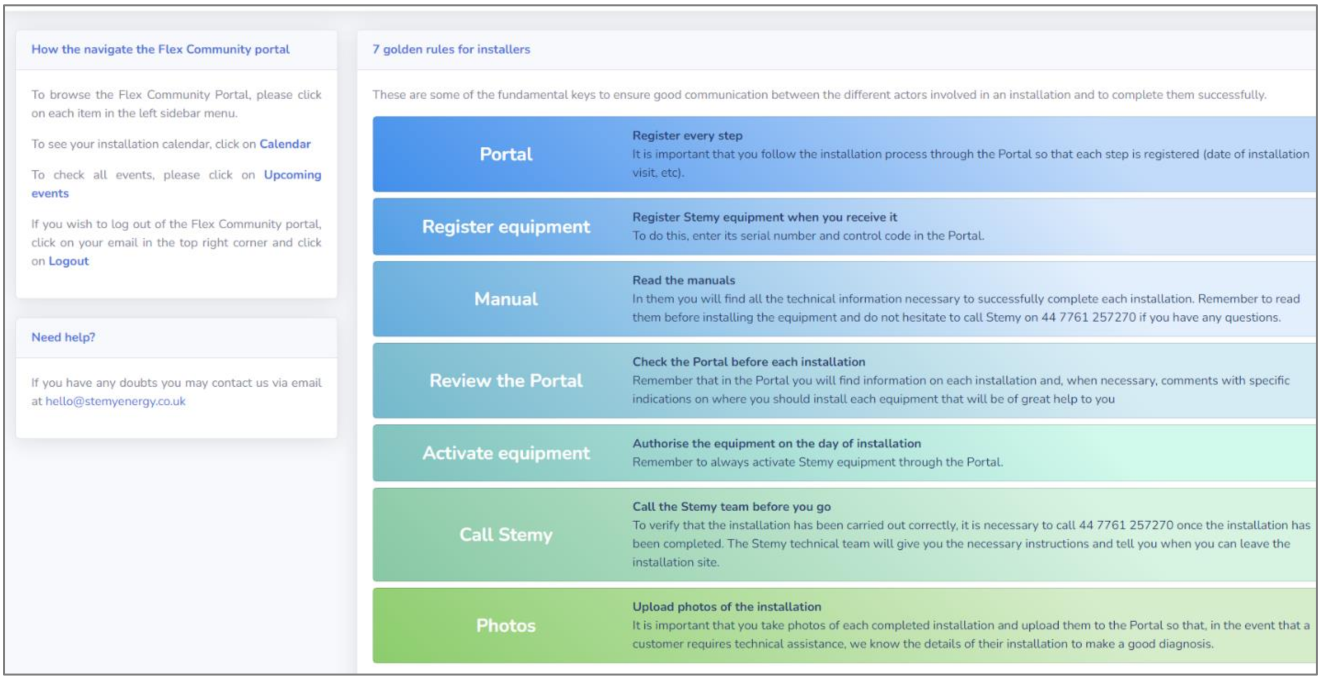


The Portal has specific installer pages, which include:

- a welcome page (see Figure 13 below) which provides:
    - an overview of the Portal architecture
    - details on how to navigate the Portal, and
    - the seven golden rules for installers
- a company details and team management page
- an approvals page for installing Stemy smart devices with associated downloadable Installer Manuals
- a management of Stemy devices stock page

- contact details of householders whose Plan to join Flex Community has been approved by Stemy and BWCE, and for whom they have been assigned as a potential installer
- calendar for uploading evaluation and/or installation visits once agreed off-Portal with the householder.

Figure 13: Portal Page - Welcome Page for Installers



5.8 Recruitment and Compatibility of Energy Technology Manufacturers

It was originally envisaged that the project would recruit householders who were interested in installing new energy technologies i.e. heat pumps (HPs) and electric vehicle charging posts (EVCPs). Because one of the aims of the project was to test the effective connectivity between Stemy's artificial intelligence platform, SPLODER, and the householder's energy technology, the energy technologies would need to be 'smart' i.e., are wi-fi enabled so can be controlled via the internet.

This limited the number of brands and products that could be installed as part of the project.

Research showed that most brand market leaders either already had a smart product version commercially available or were to launch one within the lifetime of the Flex Community project. BWCE therefore focussed on establishing links and testing regimes with these manufacturers.

Part of this process would also have required the preparation of agreements between the energy technology manufacturers and Stemy to cover the connectivity arrangements between their HP or EVCP with Stemy's platform, SPLODER. In addition, once connectivity had been proven, Stemy was keen to advertise or promote these brands on the Flex Community Portal for which agreement with the manufacturers would be required.

During regular detailed discussions with the UK market leading HP and EVCP manufacturers which spanned several months, Stemy explored whether their planned and preferred cloud-to-cloud connectivity was a feasible option, both technically and from an IP perspective.

Whilst both HP and EVCP manufacturers were rapidly developing and improving smart versions of their products, none were either at the stage of having developed, nor were willing to share, the level or granularity of data exchange required for successful cloud-to-cloud connectivity. The reasons for the unwillingness were:

- a desire to maintain product connection only with their own platforms
- this would permit software upgrades as and when required
- a plan to ultimately operate in the emerging flex market themselves

Therefore, direct connectivity between Stemy's platform SPLODER, and all HP and the majority of EVCP technologies, was unproven during the Flex Community project. Therefore, direct agreements between Stemy and the manufacturers were no longer needed.

For those EVCP manufacturers who were willing to consider direct connectivity, testing regimes were conducted, and for those products that were compliant with open-source OCPP v1.6 software, connectivity could be established using this software.

The EVHS, or Electric Vehicle Home charge Scheme, grant provided by the Office for Zero Emission Vehicles (OZEV), was an important incentive to UK EV drivers. Colloquially known as the 'OZEV grant' (previously 'OLEV grant') it offered up to £350 off the cost of purchasing and installing an EVCP at a domestic property.

To encourage householders interested in installing an EVCP and because of the incentive from the OZEV grant, only OZEV-approved OCPP1.6 compliant EVCPs would be eligible for participation in Flex Community. Following extensive connectivity trials, it was confirmed that three EVCP brands with a good UK market share could participate in Flex Community, resulting in one of each of the brands being installed in three Flex Community participants homes.

However, we did not continue promoting two of these brands. This is because one is an expensive premium product and another has data security issues, which to date, are unresolved. However, the other OCPP-compliant EVCP product has been successfully installed and given that it is more price-competitive and widely regarded as a 'good domestic product' is the only product currently being offered via the Flex Community.

In the absence of a direct connectivity option for existing installed non-OCPP1.6 compliant EVCPs, Stemy developed an intermediary wi-fi connected device as an alternative method for controlling the EVCP. This is like the Hot Water Controller device they had developed for controlling the immersion heaters in the previous Hot Water Pilot.

This device, the Anderson Box, is installed between the incoming electricity supply to the household and the EVCP. By remotely controlling the on/off switching of the EVCP, it makes it flex-enabled. The Anderson Box should be able to connect with any EVCP, although it has only been tested in three households each with a different EVCP brand.

Despite lengthy discussions with HP manufacturers to find a direct solution, none was forthcoming. Stemy therefore pursued an alternative approach to connecting via smart thermostats and a gateway, which would avoid the need to interrogate the software in the HP.

However, the preparation for this took quite some time and connectivity trials in an existing leading HP brand household only commenced at the end of April 2022. A second HP brand is scheduled for similar connectivity trials in late Summer2022. These fall outside the scope of this project but are being pursued as part of the EU-funded extension to this Flex Community project.

5.9 Stemy Smart Control Devices

5.9.1 Measuring Household Level Electricity Consumption

To participate in the project, Stemy did not require potential participants to already have a Smart meter (SMETS2) installed. This was because it was envisaged that there could be possible data protection issues, coupled with the requirement for the supplier's approval to gain access to this data, which could be time-consuming. There was also a concern that the level of granularity of smart meter data was insufficient to allow for flex offerings in all markets. Instead, Stemy has developed a smart device known as an Ampere which is wi-fi connected and analyses the consumption of electricity at the household level. It is usually housed in a small separate box and installed close to the householder's consumer unit.

Figure 14: Stemy's Smart Control Devices

5.9.2 Enabling Flex from Existing Installed EVCP

For households who already had an EVCP installed but with which there was no direct connectivity, Stemy developed the Anderson Box, which is wi-fi enabled, to measure the charging power of the EVCP. It is installed between the incoming main electricity supply and the EVCP, or, between the conventional socket and the charger of the EV.

5.9.3 Enabling Flex from Existing Installed HP

For householders who already had an HP installed but with which there was no direct connectivity, Stemy developed the Maxwell for air-to-water HPs. The Maxwell measures and controls the temperature of the home as well as the use of domestic hot water, and along with the Ampere (see above) the amount of electricity consumed by the heat pump. It is installed within 2 meters of the compressor of the heat pump.

5.9.4 Enabling Flex from Existing Immersion Heater

For householders who already have an immersion heater installed as their primary means of heating domestic hot water, Stemy developed the Waddy Box. The Waddy Box is wi-fi enabled and measures the power consumption of the immersion heater and estimates the hot water demand. It is installed close to the hot water cylinder.

6 Flex Community Learning

Domestic demand flexibility is a relatively new area of working and a lot was learnt during this Next Generation funded project. The Learning Strategy[14] set out learning outcomes and mechanisms with a particular focus on the following project areas:

1. to improve our marketing
2. to improve the customer journey
3. to improve the user experience
4. to improve the supplier and installer experience
5. on the collective impact of Flex Community.

Methods for acquiring learning included:

1. from householder participants via surveys and face-to-face meetings where possible
2. from supplier and installer participants via on-line Zoom meetings and webinars
3. from project partners via regular on-line project meetings.

6.1 Baseline Householder Energy Attitudes and Behaviour Survey

Prior to accessing the Flex Community Portal, the intention was to survey all potential Flex Community participants about their attitudes to, and behaviour around, energy use. However, because of the delays in recruitment we undertook this survey[15] in August 2020 after the project had been running for several months and after householders had already joined the Flex Community.

The key messages from this survey included:

- half of the respondents have changed their day-to-day actions to reduce the *amount of energy* they use in their home (in response to climate change awareness);
- but only one third of respondents knew that *shifting when they use electrical appliances* from 8pm in the evening to 2pm in the afternoon can cut carbon emissions by up to 50%;
- which was reinforced with the response that over a third of respondents either did not feel, or only sometimes felt, the need to change the time of day when they use energy in their home;
- however, in contrast, half of the respondents felt that they had a moderate amount of pre-Flex Community project knowledge of the energy transition, domestic low carbon energy technologies and smart appliances;
- over half also agreed that sacrificing individual convenience by allowing remote control of energy technology demand was part of meeting climate change goals;
- the desire to be part of a non-commercial community-owned solution to aggregating energy demand to help with the climate crisis was a very important motivator for two-thirds of the respondents.

The conclusions drawn from this reflect:

- that many of the early Flex Community participants were BWCE members so were already 'community energy-minded';

[14] *Flex Community Learning Strategy v8*
[15] *Flex Energy Awareness Attitudes Survey 07.07.21*

- the messaging around flexibility could be clearer, even with a well-informed audience;
- there is a willingness for self-sacrifice for the greater environmental good, though this may be less pronounced within other audience groups.

6.2 Post Installation Survey

The post-installation survey of the 16 HW Controller householders was undertaken in May 2021[16] (all but one participant completed it). Following the survey, we held two focus groups of people who had completed the survey to discuss responses in more detail.

The key messages from this survey are:

- three quarters of the respondents said that the Stemy app for the HW controller was easy to use and the information it provided was clear and useful;
- this left a quarter of respondents feeling that the information on the app was not useful;
- approx. half of the respondents had to consult the User Manual for the HW Controller (but not the app) and for some, this happened several times, but they felt that the information was helpful. The other half did not consult the User Manual at all;
- all bar one of the respondents said the general communication around Flex Community was good or very good;
- the vast majority of respondents have required assistance less than five times up to this point in the project (15 months) but on every occasion this support was sought via email to Stemy (and less so from BWCE) and the advice was very satisfactory or satisfactory;
- the impact on the availability of and quantity of hot water on the respondents' needs has been mixed: whilst 40% said it made no difference, one third experienced a slight negative impact and a quarter said it had a slight positive impact (and one replying it had a big positive impact) and pleasingly, none said it had a big negative impact;
- the impact on the respondents' electricity costs has been no difference for the majority, with three householders experiencing a big negative impact and two a big positive impact
- approx. half of the respondents said that their participation had made no difference for their household, although a third said there had been a positive valuable impact;
- approx. half said they would consider participating in Flex Community on an ongoing basis to help the electricity grid better balance supply and demand;
- and approx. half said they would recommend participation in Flex Community to other people, although half also said that they are not interested in applying for any other plans on the Flex Community Portal.

The conclusions drawn from this include:

- the Stemy HW controller app was intuitive to use, although having the User Manual and access to Stemy via email was helpful;
- further follow-up would provide the reasons for the poor user app experience e.g., lack of interest, unfamiliar data format;
- the slight negative impact on the availability of hot water probably may reflect the initial control signals sent by Stemy to test the HW Controller as the majority of participants' feedback on this was early on in the project and none latterly;

[16] *Hot Water Control feedback survey - responses*

- householders experiencing a big negative impact on their bill was due in part to them switching from cheaper bulk-purchased oil to more expensive electricity to heat their water; all householders were fully compensated for the increase in their electricity bills;
- however, the data analysis in section 8.1also suggests that the amount of hot water used during the trial itself increased markedly, and that this increase would have been significantly higher if the platform hadn't been optimising the electricity demand for hot water heating;
- whilst recognising the benefits of the trial and willing to recommend others to join, the respondents lack of interest in applying for other Flex Community Plans i.e. for the installation of an EVCP or HP, or for the inclusion of an existing EVCP or HP, does not reflect their lack of interest in Flex Community; rather, but that the cost of installing new energy technologies was prohibitive or any existing technology was, at that time, not suitable for joining the project.

6.3 Installer Feedback

In addition to seeking householders' views, we also sought the views of installers on their experience of being part of Flex Community and their use of the Portal. Again, because of Covid restrictions, this feedback was sought via on-line Zoom calls. In particular, the installers reported that:

- the concept of demand side response, or 'flexibility', is not that easy to explain to a householder because the installer isn't fully aware of how the flex markets work themselves; BWCE prepared an installer briefing to help with this;
- their perception was that householder motivation for participation in flex was financially driven but greater clarity on the financial upsides needs to be provided; BWCE will help with this going forward;
- their overall experience of using the Flex Community Portal was easy;
- the requirement of an estimate stage (based on the householders' responses to the Portal Plan questions) prior to the installer making contact with the householder to arrange a pre-installation evaluation visit was time-consuming so Stemy removed the estimate stage from the Portal;
- the Portal calendar function didn't align with the installers normal practice of managing their work timetable, so Stemy amended this to reflect the installers practice;
- Stemy smart device installations weren't always straightforward as there were often wi-fi connection issues; however, successive installations became easier as installers gained experience and were better prepared;
- the Installer Manuals were helpful, but they were aimed at the European market and were not therefore always in accordance with, or compliant to, UK Electrical Regulations; Stemy has addressed this;
- experience of supporting the householder to download the Stemy app was that it was relatively straightforward;
- the benefit to installers at this trial stage is the introduction of new customers via the Flex Community Portal and we would anticipate this to grow;
- they recognise the need for mechanisms to support the grid as demand for electricity grows so would recommend other installers to join the Flex Community.

6.4 Review Groups

It was our intention to establish a review group of participants that would act as a sounding board across the development of the project. However, because of the significant delays with the project and because of the restrictions due to Covid, we did not host review group meetings. However, when we re-focussed our project analysis on the assessment of the qualitative learning, and hence prepared the Flex Toolkit, we set-up a Sounding Board of participants to review the Flex Toolkit (see section 9).

7 Domestic Flex Market Review

To understand how the results of the simulated DSR events could be used for flex services, BWCE worked with Everoze to review ESO and DSO flexibility markets for domestic flexibility in GB. Everoze's market review was supported through BWCE's participation in the EU funded ReDREAM project, as referenced within the Executive Summary.

Everoze summarised their findings in a report to BWCE[17]. Some of their findings together with diagrams from their report are presented in this section.

In brief:

- The opportunity for revenue from domestic flexibility is at an early stage and not many revenue streams are readily accessible for domestic flexibility at this time.
- The long-term value or revenue generation appears to be in offering flex to the National Grid (ESO market) with the WPD (DSO market) likely to be a shorter-term opportunistic revenue stream.
- Currently however, the ESO market or services are not readily accessible to domestic assets and portfolios due to a combination of technical and regulatory barriers.
- However, upcoming regulatory reforms i.e., the P375 code modifications, can open the Balancing Mechanism (BM) for third party aggregation of domestic assets, but the ESO will need to be assured of the technical capability of domestic portfolios to enable wide-scale participation. Indeed, the results of the modelling from proxy trading in the BM during the Flex Community trial will be shared with National Grid ESO to help provide assurance of domestic portfolio capability.
- The monthly revenues depend on two key drivers:
    - flexibility capability of the portfolio; and,
    - the level of utilisation of the service by the DSO and ESO.
- The flexibility capability of a domestic portfolio can vary considerably and is influenced by:
    - the asset make-up of the portfolio i.e. which energy technologies are offering flex;
    - consumer behaviour i.e. their willingness to accept any 'inconvenience' or 'discomfort';
    - the level of asset dispatch and control used by the aggregator.
- Given the range of possibilities, there is no single approach to domestic flexibility provision. However, part of the Flex Community trial is to test a domestic portfolio capability to provide certain DSO and ESO flexibility services.
- For the level of utilisation of the flex service by the DSO or ESO, there is little data on how the DSO or ESO would treat domestic portfolios in operational decision making and how this will influence their dispatch decisions. This affects:
    - how often and for how long the portfolio will be utilised for system services,
    - which in turn, affects revenues as many of these services are remunerated on the kWh utilised.
- To overcome this lack of data as guidance, experience from utility scale storage has been used as a proxy to provide indicative assumptions.
- Currently, opportunity assessment and revenue estimates are subject to high uncertainties. Estimates of gross monthly revenues between £2.5 to £7.4 per kW of contracted flexible

[17] *Domestic Flex Market Review FINAL, Everoze, 2022: Funded as part of the ReDREAM research project via the EU's Horizon 2020 funding programme.*

capacity (not including any portfolio availability adjustments) are widely acknowledged in the industry as realistic.

- However, modelling of the data and findings from the Flex Community trial was used to verify the assumptions used in the revenue stack and payment estimates.

To participate in the local and national flex markets requires a thorough understanding of how dispatch is operated and how a domestic community aggregator can respond. In particular, potential community aggregators need to be mindful of the various adjustments to payments due to asset portfolio availability i.e. householder willingness to participate, and this is the biggest factor outside of the aggregator's control. The payment adjustments can also have a big impact on total revenue received, which in turn, could make some flex service offerings financially unviable.

It is also interesting to note that energy bill savings from time-of-use-tariff (TOUT) optimisation against supplier tariff is widely accepted across the energy industry to be the greatest source of value at present. Indeed, many EV owners have already moved to a TOUT for overnight EV charging. In addition, the upsides to a TOUT are that it does not require:

- the installation of smart devices to remotely control energy technologies (only the installation of a Smart meter);
- the householder to forego control of their use of their energy technologies, as they simply receive SMS or app messaging when the TOUT is about to significantly change;
- the potentially expensive administrative exercise of domestic aggregation and revenue calculation by the community aggregator;
- the provision of a software platform to act as an interface between the community aggregator and the DNO/ESO flex service.

The domestic DSR revenue streams are summarised in Figure 15 below.

Figure 15: Summary of WPD Flexibility Revenue Streams and Priority for BWCE

FLEXIBILITY SERVICE		PRIORITY FOR BWCE	EVEROZE COMMENT
DSO constraint management services (*in WPD distribution network*)	Secure, Dynamic and Restore	MEDIUM	These services are attractive for assets and homes capable of sophisticated real-time controls; however, not all homes & assets will have the ability nor desire to give up control. There is higher complexity to build portfolios and achieving volumes at scale due to CMZ-level grouping of assets.
	Sustain-H*	HIGH	This service attracts a wider pool of homes and assets, including those that do not have nor are willing to give up control of assets. However Sustain-H can be unattractive for homes & assets with dispatch capability due to higher opportunity costs where alternative services are available.
ESO frequency response services	Dynamic Containment (DC), Dynamic Moderation* (DM) and Dynamic Regulation* (DR)	LOW	Stringent metering requirements present a major barrier to entry for domestic assets. In any case, although the service is technology neutral in principle, batteries have a technology advantage (at least in the short term) so is not suitable for BWCE's portfolio with EV chargers, heat pumps and immersion heaters.
	Firm Frequency Response (FFR)	LOW	FFR is set to be phased out soon and replaced by the new DM and DR services. As such FFR is not covered in further detail here.
ESO reserve services	Fast and slow reserve*	MEDIUM	Initial details published by ESO indicate this service may be attractive for domestic assets with dispatch control capability, however further clarity is needed on metering requirements and baselining. Competitive pressure from current volumes providing STOR will likely suppress prices.
Other services	Balancing Mechanism (BM)	HIGH	BM is a deeper market and can be lucrative. Upcoming reforms can open the market for 3rd party aggregation of domestic assets. There is precedence for EV chargers participating in the BM; more data is needed to understand how domestic flexibility assets will be utilised for balancing actions in the BM.
	Capacity Market (CM)	LOW	Domestic flexibility's eligibility to participate in CM auctions is unclear, and given low historical prices, Everoze has not covered this in detail here. The high clearing prices in the recent CM auctions are not an indicator of future value, but merits a watching brief and further investigation in the future.

** these services are yet to be commercially launched*

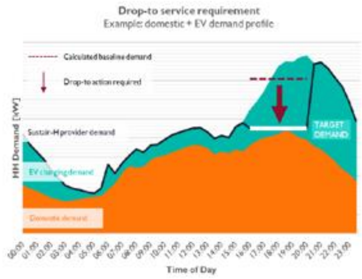
The main revenue streams that are referred to and/or utilised in this analysis are summarised in the figures below and include WPD's Sustain H (Figure 16) and Dynamic Service (Figure 17) and the Balancing mechanism (Figure 18).

Figure 16: WPD's Sustain H Service

Sustain-H is Western Power Distribution's (WPD) new scheduled demand reduction service for homes. The service is radically simplified from the incumbent DSO services where homes deliver a pre-agreed change in import or export (kW) over a defined period of time. Sustain-H is a new service and WPD aims to commercially launch the service by March 2023 across its four licensee zones. No other GB DSO has adopted this service at this time.

KEY CONSIDERATIONS FOR DOMESTIC FLEXIBILITY

Sustain-H attracts a broader customer base but offers lower value to the dispatch-driven services	Service providers reduce portfolio demand to a level at or below a pre-agreed target demand, maintaining this over the full duration of the 4-hour delivery period every weekday in the month. The simple scheduled service focuses on achieving demand change primarily through customer behaviour change rather than dispatchable control, and therefore attracts a wider pool of homes and assets than those currently available to service providers relying on dispatchable control. The service simplification comes at a cost however, as the tariffs offered are substantially less than WPD's dispatch-driven services.
Simplified data and metering requirements suitable for domestic assets to keep participation costs low	No sophisticated metering solutions are needed, and service providers can choose one of two metering options based on their capability: (i) asset-level metering taking data from meters of qualifying assets only, and (ii) household-level metering using smart meter data including the whole home demand; in both cases, portfolio-level metering at half hourly resolution. Also, baselining is simplified with pre-defined baselines for each qualifying technology. Portfolio baseline for remuneration is determined from the asset make-up of the portfolio and is fixed over the full contracted period.
Service providers will need to consider the value vs volume trade-off when selecting the tariff bands	WPD is developing systems to digitalise and automate procurement and settlement processes in time for commercial roll-out. This is with the aim of reducing admin and participation costs which is crucial given the low tariffs. The CMZs are grouped into one of three tariff bands offered by WPD, ranging from high to low value. Tentative tariffs are £8 /kW, £2.5 /kW and £1 /kW for the high, medium and low value bands respectively. Depending on the assets' geographic distribution, service providers can select one or more of the three tariff bands for their portfolio. The homes in a tariff band will be grouped as a single portfolio across the corresponding CMZs in the chosen tariff band.



PROCUREMENT & ROUTE TO MARKET

Aggregation is permitted, and is done across one of three tariff bands (which are groups of CMZs). No minimum volume threshold for participation.

The service will be procured every 6 months via Flexible Power. Service providers will be able to add/remove homes on a monthly basis.

Service providers will need to qualify their portfolio and assets prior to contract award. One-off API system testing is needed for new service providers. There is no portfolio service testing prior to service commencement.

CMZ: Constraint Management Zone

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Figure 17: WPD's Dynamic Service

Western Power Distribution (WPD) currently procures three services – Secure, Dynamic & Restore – for constraint management across its network. These services are demand turn-down or generation turn-up services based on the ENA's standardised products for DSO services. WPD is currently consulting on the future procurement arrangements for its current product suite, so changes are expected in the near future.

KEY CONSIDERATIONS FOR DOMESTIC FLEXIBILITY

Need for remote dispatch capability reduces available pool of homes & assets for this service in the medium term	WPD schedules delivery week-ahead for the Secure service, whereas for Dynamic and Restore, service utilisation is triggered by dispatch notices from WPD. These services require dispatch controls – not all domestic assets will have this centralised control capability, nor will all consumers have the desire to give up control of their assets. At present, Everoze is only aware of a small number of home batteries providing these services to WPD in the domestic sector. This presents a challenge to build portfolios of diverse domestic asset types and achieve volumes at scale, at least in the medium term.
Until the BEIS standards are fully adopted, it is likely some costs will need to be borne to install additional metering equipment	WPD requires minute-by-minute metering, and not all domestic assets have this capability at this time which may necessitate installing additional metering and communication equipment. Although BEIS's new PAS-1878 standard for energy smart appliances prescribes 1 sec metering, there is uncertainty at present on how quickly & widely this standard will be adopted by OEMs. So until then, it is likely some additional costs will need to be borne by aggregators to install additional metering equipment.
Uncertainty in service utilisation and longer term availability of the service for a CMZ presents a barrier to achieve volumes in scale through aggregation	Service utilisation levels vary considerably from CMZ to CMZ depending on local network need resulting in high uncertainty for revenues that can be achieved. Also, there is uncertainty on the year on year volumes procured by WPD as this is linked to local reinforcement decisions. WPD has also indicated they will move towards competitive procurement in the near future. These revenues should therefore be considered on an opportunistic basis and not for any base case revenues. As procurement is on a per-CMZ basis and service requirements vary locationally, each CMZ will need to be treated as a separate portfolio. This presents a barrier to achieve volumes in scale through aggregation which is important to keep costs low.

	SECURE	DYNAMIC	RESTORE
Min/max service duration	0.5 hours minimum; no specified maximum		3 hours minimum; no specified maximum
Dispatch notice / response time	Week-ahead scheduling on acceptance	Week-ahead availability confirmation, with 15 minute response from receipt of dispatch notice	
Tariff	£125 /MW/hr availability fee and £175 /MWh utilisation fee	£5 /MW/hr availability fee and £300 /MWh utilisation fee	No availability fee and £600 /MWh utilisation fee

PROCUREMENT & ROUTE TO MARKET

Aggregation is permitted and is done on a per-CMZ basis. WPD has not specified a minimum volume for participation.

The services are procured per CMZ every 6 months via Piclo Flex or Flexible Power. Service providers declare their portfolio's *Availability Window* on a week-ahead basis.

Service providers will need to qualify their portfolio and assets prior to contract award. One-off API system testing is needed for new service providers. There is no portfolio service testing prior to service commencement.

CMZ: Constraint Management Zone; ENA: Energy Networks Association

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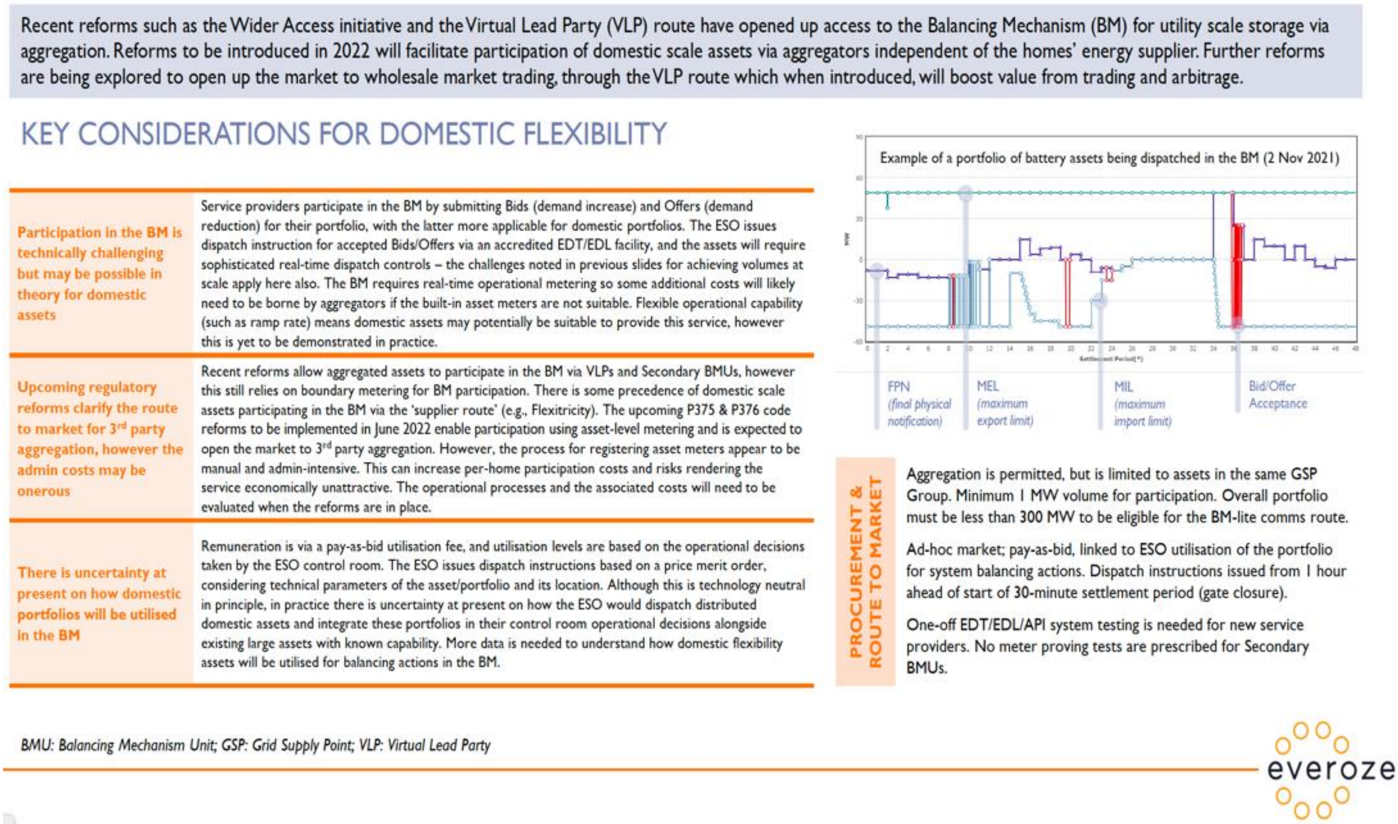
Figure 18: The Balancing Mechanism



These revenue streams do not have to be utilised individually but can be combined or stacked together. Though some revenue streams cannot be combined with others.

The potential for stacking revenue is outlined in Figure 19 below.

Figure 19: Stacking Revenue Streams

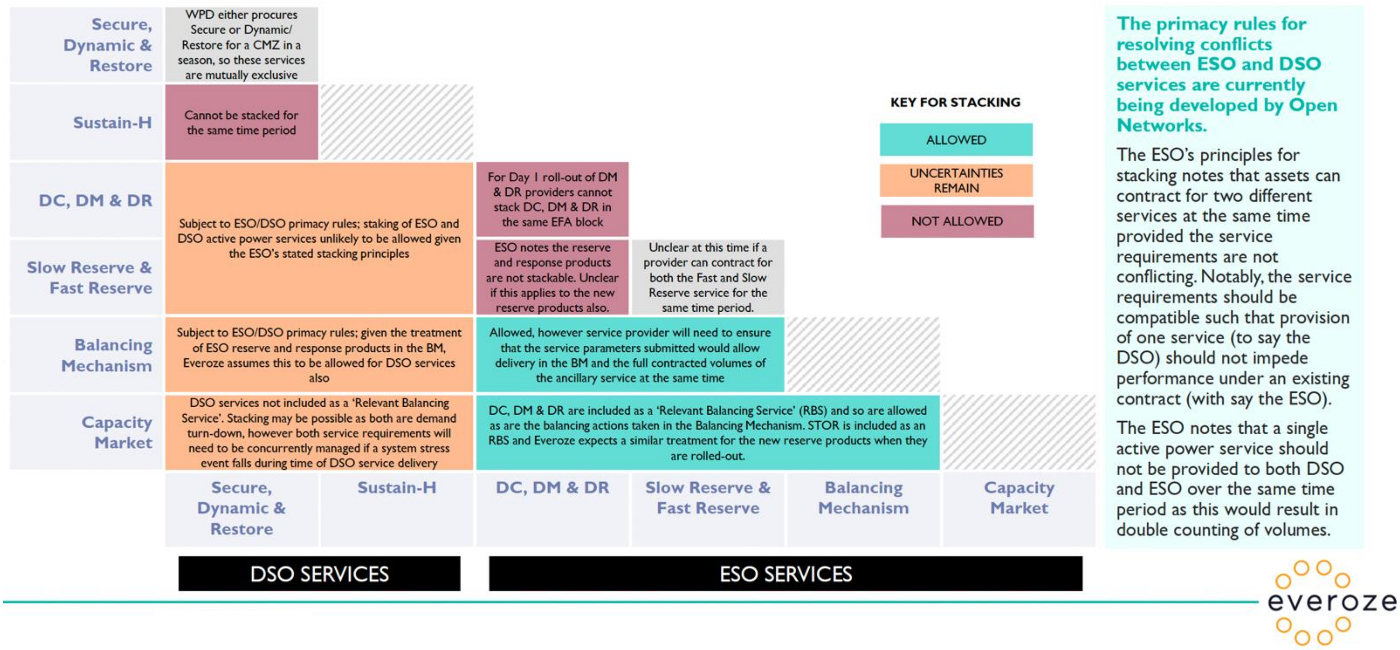


Figure 20 below summarises three scenarios for combining these revenue streams at different levels of risk and reward.

Figure 20: Estimate of Gross Revenues

** Energy bill savings from time-of-use-tariff optimisation against supplier tariff are not included in these estimates; Everoze expects this is likely to be the greatest source of value.*

The assumptions behind the values per kW per month outlined in Figure 20 are summarised in the Appendix.

It may be that community energy groups are not well placed to take the high-risk strategy, though phase 2 of the data modelling did in fact assume this strategy. However, to be cautious, the business plan hypothesis outlined in section 3 utilises the £3.80/kW/month figure as part of a medium risk/medium value strategy. These figures are then tested against the data collected as part of this trial, as outlined in section 8.2 below.

8 Results of Simulated Flexibility Trading

WPD establish local flexibility markets through a series of Constraint Management Zones across their network area. Each zone responds to the grid constraints specific to its area and calls for flexibility through a series of services, as outlined in section 7 above.

The Flex Community project operated outside of WPD's Constraint Management Zones and at a scale that wasn't large enough to be able to engage with the national Balancing Mechanism. As a result, it was not possible to trade flexibility directly with either the local or national flexibility markets.

Instead, the project simulated flexibility trading. The Stemy Energy platform utilised a profile of DSR requests from WPD's nearest Constraint Management Zone to send DSR requests to participating households' Hot Water heating or EV charge points and monitored the resulting utilisation rates.

Unfortunately, it is not possible to secure similar profiles for the national Balancing Mechanism. As a result, Stemy utilised a profile of the equivalent to the national Balancing Mechanism in Spain that operates on a similar basis, to send out DSR requests to participating households. The analysis outlined in the following sections of course utilised the pricing associated with the UK Balancing Mechanism.

Simulated flexibility trading took place over 2 phases. In the first, the platform simulated trading through just WPD's Dynamic Service. Within phase 2, the platform simulated trading with both WPD's Dynamic Service and the equivalent of the national Balancing Mechanism.

8.1 Quantitative Data Modelling

8.1.1 Phase 1 Trading

The SPLODER platform operated in three modes during the first phase of trading.

1. **Manual**: The platform takes no control of the householder's immersion heater but does collect data around energy consumption for hot water heating; when the householder uses the App to schedule when the immersion heater switches on and off, the platform learns typical household behaviours i.e. the 'intelligence' is on but is known as the monitoring period.

2. **Automatic with no flex**: The platform controls the householder's immersion heater in order to optimise the use of energy by minimising losses, aligning use with solar PV generation or ToUT if present, whilst minimising impact on consumer's required temperature levels and ensuring Legionella protection; therefore, the 'intelligence' is on.

3. **Automatic with flex**: The platform controls the householder's immersion heater in order to maximise the potential income from simulating trading flexibility via WPD's system, whilst also minimising impact on customer's required temperature levels. The platform provides flexibility only when it is profitable for the consumer and the 'intelligence' is on.

The platform will use its intelligence, developed by monitoring householder energy behaviour, to minimise the impact on the householder's level of service. However, the householder can control when flex is offered by overriding the flex request; indeed, the data indicated that this had occurred on some occasions (see below). Stemy plans to introduce a feature in the app that allows the householder to vary the level of flexibility offered (on a slider between 0% - 100%) and so provide the option of trading some comfort for increased flexibility and consumer savings.

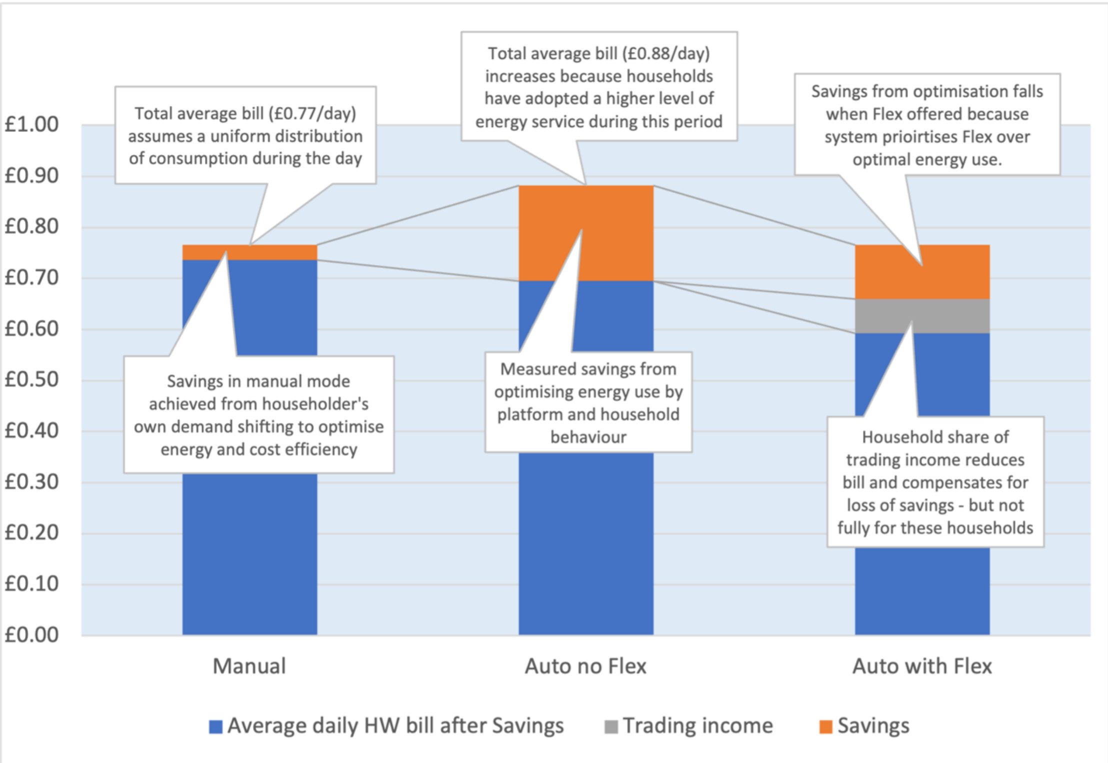
Data was collected from nine of the ten households in each of the three modes for 5 months, 2 months and 2 months respectively and was analysed as follows:

- The analysis split out the impact of the platform from the impact of variations in the set temperature of the hot water and the volume of water used.

- The savings were calculated from a baseline that assumes each day's energy bill is split out during the day with a uniform distribution e.g., if the average bill for the day's use of hot water is 72p then it is assumed that in each of the 24 hours the bill is 3p.
- In manual mode, savings represent the degree to which householders are optimising their use of their immersion heater away from this uniform distribution, without support from the platform e.g., shifting their own use of hot water to match generation from their solar PV or minimising the standing losses in the tank by ensuring their use of hot water is close to when the immersion heater is on.
- In automatic mode without flex, savings compared to the baseline represent the degree to which the platform optimises use of the hot water immersion heaters, as outlined above.
- In automatic mode with flex, savings represent the impact of changing immersion heater use in line with the simulated flexibility requests from WPD. In many cases, this reduces the ability of the platform to optimise use because it is prioritising requests for grid flexibility.
- In both automatic modes, the estimated net savings achieved by the operation of the platform, is the difference between savings in manual mode and savings in the automatic modes. These net savings will be lower in households that are already demand shifting and increasing their own energy and cost efficiency, consciously or not. In this way, we sought to assess the added value of the platform in terms of optimisation.

The relationship between average savings and energy bill for these households is shown in Figure 21 below.

Figure 21: Relationship between savings and actual average bill (£/day)



The results of this modelling are summarised in Table 7 below.

Table 7: Household Data

	Column	1	2	3	4	5	6	7	8
ient	Platform Operational Mode	Average HW bill per day (£)	Average platform savings/day (£)	Avg. flex revenue per day - 100% (£)	Change in HW bill, Manual to Auto no Flex	Platform savings in Auto no Flex/day (£)	Platform savings in Auto with Flex/day (£)	Household benefit including flex revenue 100% (£)	Household benefit including flex revenue 33% (£)
hold 1	Auto Flex	0.8599	0.1896	0.1734	35%	0.4284	0.1454	0.3188	0.2032
	Auto No Flex	0.8196	0.4726	-					
	Manual	1.2688	0.0442	-					
hold 2	Auto Flex	0.7324	0.0267	0.1733	-58%	0.0185	0.0064	0.1797	0.0642
	Auto No Flex	0.8888	0.0388	-					
	Manual	0.5621	0.0203	-					
hold 3	Auto Flex	0.6314	0.3229	0.2254	-37%	0.3779	0.3041	0.5295	0.3792
	Auto No Flex	0.6294	0.3967	-					
	Manual	0.461	0.0188	-					
hold 4	Auto Flex	0.3925	0.0873	0.1458	16%	0.1017	0.0687	0.2145	0.1173
	Auto No Flex	0.4041	0.1203	-					
	Manual	0.4799	0.0186	-					
hold 5	Auto Flex	0.7848	0.1167	0.1755	48%	0.1460	0.0607	0.2362	0.1192
	Auto No Flex	0.5087	0.202	-					
	Manual	0.9724	0.056	-					
hold 6	Auto Flex	0.2635	0.0388	0.3086	-8%	0.0268	0.0159	0.3245	0.1188
	Auto No Flex	0.4469	0.0497	-					
	Manual	0.4156	0.0229	-					
hold 7	Auto Flex	0.5533	0.1191	0.2454	4%	0.2990	0.0902	0.3356	0.1720
	Auto No Flex	0.805	0.3279	-					
	Manual	0.8352	0.0289	-					
hold 8	Auto Flex	1.4124	0.0479	0.2313	-16%	0.0192	0.0126	0.2439	0.0897
	Auto No Flex	1.2896	0.0545	-					
	Manual	1.1115	0.0353	-					
hold 9	Auto Flex	0.3044	0.0086	0.1406	10%	-0.0045	-0.0170	0.1236	0.0299
	Auto No Flex	0.4615	0.0211	-					
	Manual	0.5148	0.0256	-					
			Av. reduction all households			23%	12%	42%	22%
			Households with savings only			24%	13%	-	-
			Av. annual benefit per household			£57	£28	£102	£52
			Av. annual income to each BWCE & Stemy Energy			-	-	£0	£25

The data suggests that:

- Four of the nine households have energy bills that go up during the period when the platform is in automatic mode with no flex when compared with the period when the platform was in manual mode, due to much higher use of hot water. These changes in hot water use may be caused by seasonal variations or holidays affecting the average daily use of hot water.
- Eight of the nine households generate savings from the operation of the platform in automatic mode without flex offered, through optimisation of hot water use; these savings do not include the impact of changing demand for hot water, described above.
- All households generate lower savings from the operation of the platform when flex is being offered, because the provision of flex reduces the ability of the platform to optimise for the highest savings.
- When the flex revenue is also included, all households enjoy an overall reduction in their electricity bill from their HW Controller being in automatic mode with flex.
- However, three households (household 1, 6 and 7), see a lower benefit from savings and flex revenue, when offering flex than when the system is just optimising for maximum bill savings.
- Overall, households saw:
    - An average 23% reduction in their electricity bill for hot water heating due to the optimisation created by the operation of the platform in automatic mode, with no flexibility offered.

  - An average 12% reduction in their electricity bill for hot water heating when the platform was seeking flexibility (flexibility prioritised over optimisation)
  - Between 22% and 42% reduction in their electricity bill for hot water heating when the platform was seeking flexibility and the flex revenue is added. The range depends on the proportion of the revenue allocated to the householder, as opposed to Stemy Energy (the platform operator), and BWCE
  - Savings range from an average of £57/year from platform optimisation to a total of between £52-£102/year when offering flex, depending on the proportion of flex income allocated to the householder.
  - Approximately 0.5 immersion heater boosts per month per householder, suggesting that the platform provided reasonable levels of service overall. Though this will be confirmed through fuller consumer feedback.
- If flexibility income is split equally between the three parties (householder, Stemy Energy and BWCE) each party might receive around £25/year per householder.
- During flexibility events, the activation rate (the percentage of available capacity that was simulated as a request by WPD) was between 85%-100% and the overall average householder success rate in providing flex was 77%
- Income has been calculated assuming £5/MW availability and £300/MWh for utilisation, based on WPD's Dynamic Service see section 7 and Figure 17 above.

During this test, the platform had effectively optimised hot water use across 8 out of 9 households and generated overall benefits for all households if flex revenue is included.

Though when flex is being offered three of the households were worse off when compared to when the system was just optimising for maximum savings.

Due to variations in levels of energy service utilised within the household, energy bills actually rise for four out of nine households, indicating the importance of transparency and clarity around savings in order to keep householders engaged with the project.

The platform appeared to deliver benefits without creating a significant impact on levels of energy service for most households, although feedback from some of the households indicated that they did use the boost function as they experienced insufficient hot water on occasion.

The implications of this data analysis on BWCE's business model are shown below in section 8.2.

8.1.2 Phase 2 Trading

During this second phase of trading, seven households participated, five with electric hot water heating, three with EV charge points (one with both). All technologies were already installed. Five of the householders participated in the phase 1 process.

Due to delays in recruitment caused in the first instance by Covid, there was not enough time to draw-in households that wanted to install new technologies into the project.

Everoze modelled data provided by Stemy over a 10 week period as follows:

- **10th January -10th February 2022: Optimisation:** In this period, there was no flex operation as the Stemy platform focussed on optimising hot water heating and/or electric vehicle charging to reduce demand and/or the householder's energy bill.
- **10th February-31st March 2022: Flexibility:** In this period, the Stemy platform offered flexibility from households, by controlling demand by drawing on simulated DSR requests from WPD (DSO) and the Spanish national market as an ESO proxy.

Revenue from flexibility services: This is calculated at the aggregated portfolio level across all households using the 15-minute portfolio meter data provided by Stemy Energy. Two services were simulated during the trial: the Balancing Mechanism (BM) and WPD constraint management services.

BM: Stemy Energy simulated dispatch of the portfolio using signals from the Spanish balancing market (a FFR service). The simulations included delivery requests for demand reduction and demand increase in line with Offers and Bids in the BM in GB. Payment is proportional to the energy delivered in the correct direction and Everoze has assumed payments are capped at 100% delivery, i.e., there is no revenue for over-delivery above the requested volume. Everoze has assumed an Offer and Bid tariff of £200/MWh and £40/MWh, respectively

WPD constraint management: Stemy Energy simulated dispatch of the portfolio using simulated signals from WPD. As this is a constraint management service, delivery requests are only possible for demand reduction. WPD offers an availability and utilisation payment for their Dynamic Service (see section 7 and Figure 17) valued at £5/MW and £300/MWh,

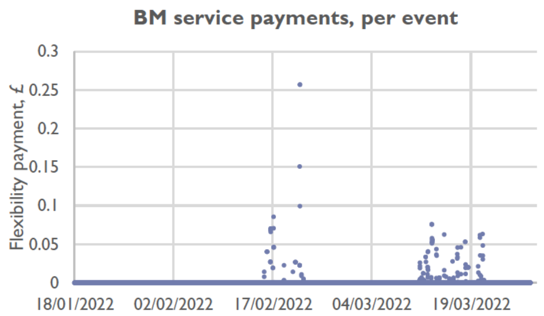
The outcomes from the modelling are outlined in the Figure 22 below

Figure 22: Revenue from the Balancing Mechanism (a) and WPD's Dynamic Service (b)

(a) Balancing Mechanism

TOTAL REVENUE: **£4.26** *£0.28 per day*

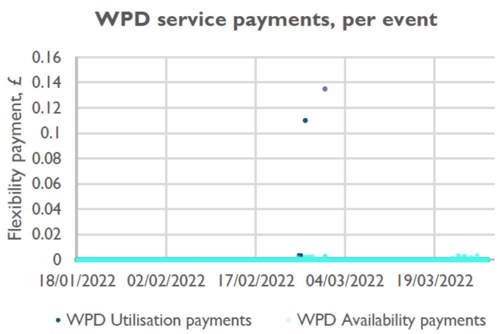
Days active:	15.1
Number of discrete events:	45
Total time service is committed (hours):	95
Total committed energy[1] (kWh):	321.2
Total energy requested[2] (kWh):	155.4
Service utilisation rate:	62%
Total energy delivered[3] (kWh):	191.16



(b) WPD's Dynamic Service

TOTAL REVENUE: **£1.05** *£0.08 per day*

Days active:	12.5
Number of discrete events:	3
Total time service is committed (hours):	29
Total committed energy[1] (kWh):	29.4
Total energy requested[2] (kWh):	5.4
Service utilisation rate:	34%
Total energy delivered[3] (kWh):	71



These figures equate to an average of committed capacity of 3.4kW to the Balancing Mechanism and 1kW to WPD's Dynamic Service. Though the number of events linked to the Dynamic service is very small.

But this capacity generated an average of £2.5/kW/month from the Balancing Mechanism and £2.4/kW/month from WPD's Dynamic Service. The total of £4.9/kW/month is lower than the estimated revenue associated with the high risk/reward strategy which stacks these two revenue streams. But these figures are reduced significantly by lower service utilisation rates. The utilisation rate has gone down from around 75% during the first phase of modelling to 63% within the Balancing Mechanism and to 34% within the Dynamic Service.

There were also some data inconsistencies that reduced the measured committed capacity within the Balancing mechanism from 4.1kW to 3.4kW. The additional revenue that may have been generated if utilisation rates were more like the first phase of modelling and there were no data inconsistencies could have been more like £6.8/kW/month.

Further work is needed to check the data and see whether the lower utilisation is for example due to householders overriding the system more regularly.

Revenue from bill savings: Data inconsistencies, particularly within the baselining data meant that bill savings data was not reliable.

8.2 Testing the Business Model

Table 8 summarises and compares the key cost assumptions utilised in the business model hypothesis outlined in section 3 with the data collected in this trial, as outlined in section 8

Table 8: Comparing the Business Model Hypothesis with Actual Data

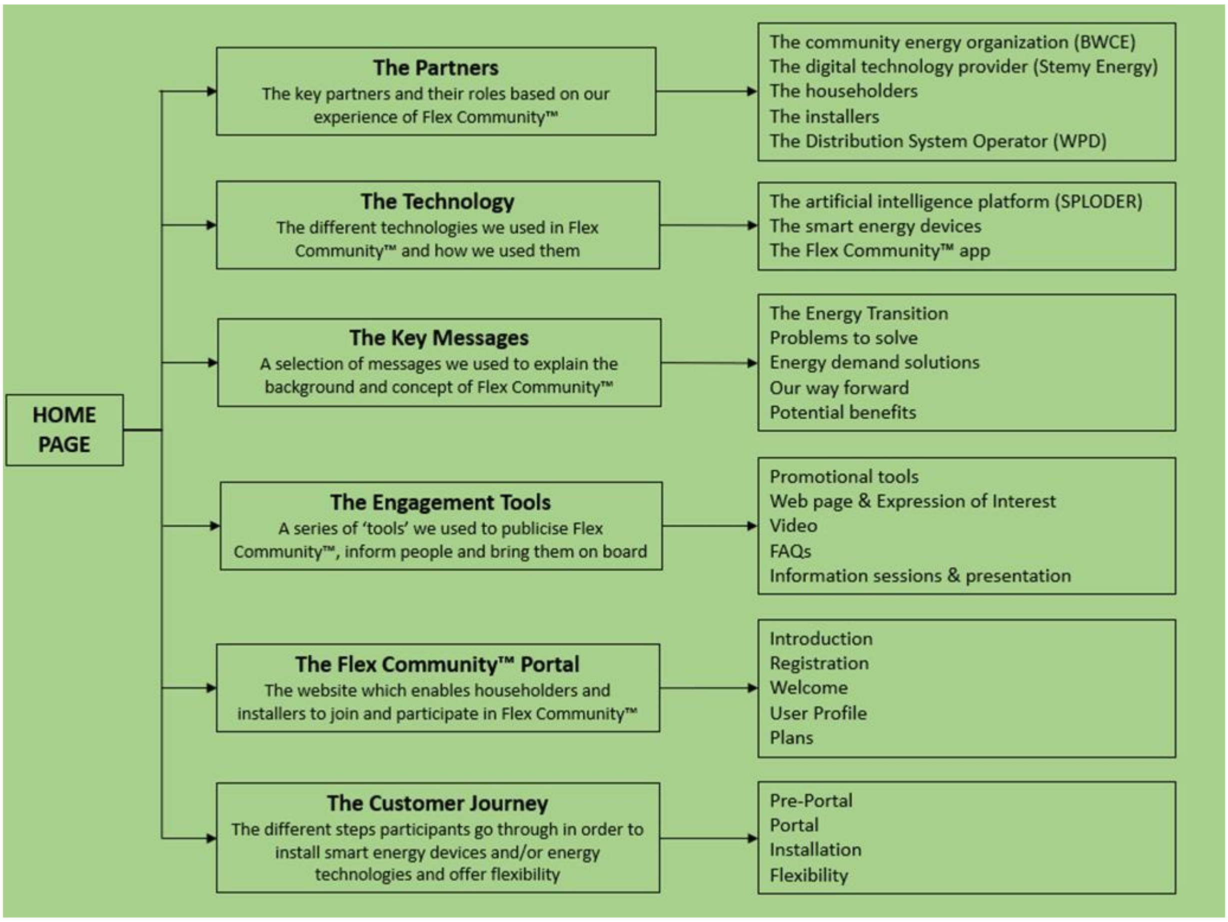
	Business model assumptions	Evidence from Flex Community Trial	Implications for business model analysis	Further work required
Flex Trading Income	Based on £3.80/kW/month generating an average of £205/hsld for all technologies (see appendix for assumptions) of which BWCE retains 33%. The phase 2 modelling adopted the high risk/reward strategy and should be compared to the higher £7.8/kW/ month figure.	Phase 1 - Average flex revenue per household of £74/year or £7.7/kW/month Phase 2 – Average flex revenue of £4.9/kW/month, though a more comparable figure with the first phase analysis might be more like £6.8/kW/month	Whilst data is limited, the trial findings do not contradict the business model assumptions. Phase 2 analysis suggests that EV charging via Time of Use Tariffs could be encouraging pre-testing demand shifting, so reducing the impact of flexibility. Though the lower utilisation rates and data issues could also explain the lower results.	Data inconsistencies in the phase 2 modelling will be resolved and the modelling updated. More widely, further analysis is required with: • Larger sample sizes • a more complete set of technologies employed, • increased support for householders to install new technology • financing for new technologies through grant and/or community finance This will be continued within the EU funded extension of this project.
Energy bill savings, supporting householder subscription	Based on average savings of £187/hsld drawn from Stemy's own experience of which BWCE retains 25%.	Phase 1 - Average savings per household of £28/year when Flex being offered as well, or £57/year without Flex	Whilst data is limited, the trial findings do not contradict the business model assumptions. Savings are only for hot water rather than all three technologies. Though clearly the interaction between	

		Phase 2 – Data Inconsistencies undermine baseline analysis and as a result the reliability of savings data	providing flex and the ability to optimise technologies and generate bill savings needs further investigation.	
Installer referral fees/ subscription	Nothing assumed.	Insufficient workflow at this stage to open conversation with installers on the potential for referral fees/subscription fees for access to market via the portal.	Whilst referral fees could be incorporated, this could undermine the independence of the service. Subscription fees could work as they would be the same for all installers that utilised the portal.	Increased workflow is required before we can initiate dialogue with installers around value and the potential for referral fees and/or subscription fees.
Smart control device costs	Based on Stemy estimate of an average of £430/hsld to support all technologies, including installation costs	Actual equipment costs for a home that installed all three technologies would have been £570 per household, plus installation of over £500.	Installation costs would come down significantly with familiarity with the equipment. However, the equipment costs are even higher than assumed within the business model analysis, emphasising the barrier this represents to the financially viability of trying to do anything other delivering control through cloud-to-cloud communication.	Longer term there needs to be increased interoperability and harmonisation of communications standards in order to be able to rely on cloud-to-cloud communications for appliance control. In the short term there needs to be a fuller review of commercially available alternatives for the additional control equipment to enable smart operation and/or significant price reductions.
Staffing levels	Based on between 1.5 to 2 FTE to run activity depending on scenario	Around 25 days spent during the pilot on recruiting and liaising with on average around 10 households	In order to deliver between 500-1000 participants at the same staffing levels as in this project, would require a 75-80% drop in staff capacity to achieve the staffing levels assumed within the business model. This doesn't seem unreasonable given the potential improvement in system efficiencies gained from learning and operating at scale	The relationship between staffing capacity and longer-term financial sustainability of any service will be crucial to keep under review as participant numbers grow. An ongoing process of drawing out the learning from this review and embedding change within operational systems will be critical in ensuring longer term success.

9 Flex Toolkit

We have developed an online toolkit, which is designed to share learnings from this project with other community energy organisations who might want to become involved with supporting a local flexibility service. Other organisations may choose to go about it differently, as flexibility markets are rapidly changing and developing. Therefore, the Toolkit is not meant to prescribe how organisations should proceed, rather it's hoped that it might provide tools and advice based on experience that might help others develop a flexibility service without having to 'reinvent the wheel'.

Figure 23: Flex Toolkit Structure



The toolkit format enables users to drill down into detail on what they are most interested in, with links to the various sections. The structure of the Flex Toolkit is shown in Figure 23.

By following the links, they will be taken to information on the different elements of Flex Community and will see what we learned from our experience of developing and implementing it. Links to third party web pages will open in a new separate tab. There is a link for returning to the Home Page at the bottom of every page. The toolkit itself can be seen on BWCE's website at https://www.bwce.coop/flex-community-toolkit/.

10 Conclusions and Recommendations

10.1 Challenges Faced

There were a number of challenges faced while delivering Flex Community. Whilst the project adapted well and maintained delivery in many areas, the project was unable to secure the number of participants originally targeted. This had implications for project outcomes, including the business modelling exercise. The factors that contributed to the lower participation levels were as follows.

1. The Covid pandemic resulted in a number of householders who had previously expressed an interest in joining the Flex Community project to withdraw. It also prevented us from pursuing our successful face-to-face recruitment sessions.
2. The refocussing of our recruitment to on-line meant that the 'message about flex' was even harder to convey.
3. The Flex Community Portal (ecosystem) took much longer to programme and develop, including the preparation of supporting documentation e.g. the Terms and Conditions for householders and installers to participate in Flex Community. As a result, some of the householders had to wait a lot longer than planned to progress within the project.
4. Direct connectivity between Stemy's platform SPLODER, and HP and EVCP technologies was unproven, largely due to manufacturers reluctance to permit Stemy access to their product software. This meant that we couldn't pursue new technology installations.
5. To recruit existing installed energy technologies required the development of innovative intermediary smart devices. However, these smart devices were not always readily available and despite pre-dispatch testing, the majority required installer follow-up visits for repairs or replacement.
6. Wifi connectivity was not always strong enough where installation of smart devices was required, complicating and in some cases preventing installation.
7. The remote operation of the Stemy engineers also posed difficulties in resolving site specific issues with respect to the installation of smart devices.
8. Some household's electrical works were not compliant with current UK Electricity Regulations, so upgrades were required before further electrical works could be undertaken.
9. Engaging with customers via the Flex Community Portal was initially not a traditional way for installers to operate so there was less enthusiasm to follow-up these leads.

10.2 Key FIndings

10.2.1 The Community Role

Summary:
The project confirmed the value of the intermediary role that community energy can play, generating interest and building on local trust and credibility to address participant concerns and retain enthusiasm and confidence in a long project that didn't always go to plan and faced a number of challenges during delivery

In detail:

- The interface between the flexibility trading platform based in Spain and householders was eased significantly by BWCE's community intermediary role
- Whilst this interface was useful in addressing the language issues specific to this project, it was also helpful in bridging the gap between engineers and non-specialist household participants

- BWCE's role became particularly important when the project encountered delays and changes in approach.
- BWCE's existing networks generated interest and engagement with the project, even if householder progression within the project was reduced due to the challenges encountered.
- BWCE's local presence, track record and local credibility provided an accessible point of contact that emphasised a clear non-profit approach to the energy transition that was reassuring and motivating
- Ensuring clear boundaries between issues dealt with by BWCE and those escalated to Stemy was important to avoid confusion and provide a good client experience

10.2.2 Recruiting Participants

Summary:
The concept of flexibility is complex so clear messaging and a more nuanced approach to targeting is required to draw in participants that are not already effectively flexing their demand or whose needs are not suited to the type of flexibility service being offered.

In detail:

- Clear messaging about what flex means in practice is essential for the effective recruitment and retention of households. Long term engagement in offering flex is likely to require changes in behaviour around energy that may at times be inconvenient whilst householders become accustomed to new patterns of energy use.
- Many 'pioneer' households were already using low levels of electricity or were (either knowingly or not) effectively and efficiently flexing demand with a TOUT, or by having a pv to hot water diverter for example, so their ability to offer additional flex was limited.
- Not everyone that wants to be involved may be appropriate for a trial project. Temporary disruption i.e. the need for smart devices to be installed in the home, or periods of short duration inconvenience or discomfort i.e. insufficient hot water as a result of testing the smart devices are likely to be an unreasonable demand for more vulnerable households.
- Similarly, understanding situations where providing flex may on occasion force the use of energy at times of day that reduces potential bill savings is also important to understand better in order to protect vulnerable households.
- Low carbon energy technologies are not cheap, and those that are already 'flex ready' can be even more expensive. So, their installation is limited to those with the finance to do so
- The high cost of heat pump installation put off a lot of the potential participants that expressed interest
- Using additional smart control equipment requires sufficient space and a suitable location
- Using an App to control the smart equipment to control energy technologies requires participants to be 'tech savvy' and have suitable up-to-date smart phones.

10.2.3 Delays in Project Delivery were Unavoidable

Summary:
Project delays during Covid, an inability to rely on cloud-to-cloud data transfer and the resulting need for additional smart devices that required significant development time to deal with unreliability issues, and the difficulty in achieving compatibility with heat pump and EV charge point technology, significantly reduced the number of participants and level of data that could be collected during the project.

In detail:

- The project encountered significant delays because of Covid that affected engagement with participants and potential participants, both due to practical restrictions but also, as importantly, because people were focussed on other priorities
- Covid delays also significantly reduced the time available to support households to install heat pumps or EV charge points as part of the project.
- The switch to focussing on households with existing technology already installed therefore meant working with older generation heat pumps that were not flex enabled and EV ChargePoint's that weren't compatible with standard communications (OCPP) protocols.
- As a result, the project also had to switch away from relying on cloud-to-cloud communications between the platform and the householders' appliances as a means of appliance control.
- The project had to install new smart control equipment that was specifically designed and manufactured on behalf of Stemy, that has not always been reliable during its development. This created further delays and complications for participating households.
- The reduced number of participating households was insufficient to generate robust data to fully test the viability of the business model.

10.2.4 The Business Model

Summary:
Analysis of the business model hypothesis, and validation with data that the project was able to collect, emphasised the importance of cloud-to-cloud communications, the need for scale, multiple revenue streams (rather than just from trading flexibility), and/or increased market value, to creating a financially sustainable community business strategy.

In detail:

- The shift away from a reliance on cloud-to-cloud communications required the installation of expensive smart control devices that significantly raised the bar to achieving a viable business model.
- Even assuming a significant reduction in the cost of this additional smart control equipment the project would need to secure in the order of 500-1000 participants to break even, which in turn would require significant investment at risk to achieve.
- Revenue strategies bring risk, particularly strategies that rely on more uncertain or new flex income streams
- The integration of additional income streams beyond flexibility, for example through the sale of renewable electricity direct to consumers as a means of maximising self-consumption, could be crucial to a more balanced and secure business model, as well as to creating more householder awareness and motivation to shift demand.
- The basic market value of flexibility is set in line with the avoided cost of grid reinforcement and so does not value the carbon reduction that can be achieved from shifting demand away from the most carbon intensive times of peak demand.
- An increase in value awarded to those offering flex could increase the motivation to shift demand as well as underpin a more viable business model for intermediary organisations like community energy groups, that are perhaps better placed than the energy industry to engage and draw householders into new markets

10.2.5 Supply Chain

Summary:
Good quality installers of both energy technologies and smart devices are limited, are exceptionally busy and have limited capacity to focus on new approaches, so good working

relationships establishing clear expectations on both sides around workflow and non-standard installations where necessary is essential

In detail:

- Good quality installers of both low carbon energy technologies and smart control devices tend to be exceptionally busy and do not need more work
- This means that it is not easy to introduce new ways of working that require time to learn and adopt.
- Within Flex Community, adapting expectations to fit around existing working practices around acquisition of work significantly improved engagement
- Installation of nonstandard smart control devices, whilst technically straightforward, needed significant support and clarification of expectations on both sides to generate satisfactory results
- Overall, the longer-term upsides for electrician and installer participation did not materialise during the project
- However, the project did generate a lot of good will amongst supply chain partners who could see the longer-term value, through regular communications and dialogue. This goodwill is still being relied on to take relationships to the point where tangible financial benefits for partners can be seen
- Close liaison between installers and community energy groups is needed to ensure a deep understanding of the requirements of the installation of smart devices, if required.
- Community energy groups need to explore the potential for installation cost savings following a pre-agreed installation trial period i.e. after 10 x installations.
- To keep installation costs to a minimum, pre-installation evaluation visits for smart devices are probably not needed. However, to help prepare for the installation, it is important to obtain plenty of relevant location photos beforehand.
- Clarity on the upsides for installers of their participation in a flexibility project is required, particularly if this involves them working in a different way to their normal business practise i.e. how flex customers are introduced to them.

10.2.6 Learning

Summary:
Given the rapidly developing flexibility market and the significant hurdles that exist in recruiting household participants, learning from the analysis of qualitative data is as important as the analysis of quantitative data.

In detail:

- The flexibility market is rapidly changing; new regulations, market rules and income streams are being developed that will fundamentally shift the basis on which impacts, and benefits can be assessed.
- Whilst it will of course always be important to effectively quantify outcomes, the changing context for flexibility means that qualitative learning about what influences householder interest and engagement with new markets will be critical to take up.
- Just relying on economic drivers is unlikely to be sufficient without also understanding barriers to involvement and the attitudes, habits and behaviours that both support and hinder engagement with flexibility markets
- A deeper understanding of the most effective messages and the best messengers to convey them, will speed the adoption of new and complex local energy markets that are nevertheless central to the transition to net zero

10.3 Further Work Required

Work to be taken forward as part of the EU funded ReDREAM research project that will provide an extension of Flex Community, and potentially the wider community energy sector through their own activities:

- Expand the number of participants engaged in Flex Community across all technologies, analyse results and refine and build out the business model for a community role in flexibility
- Carry out more analysis on the relationship between flexibility and the potential reduction in bill savings from the less than optimum use of energy technologies that might be caused.
- Carry out action research on the potential positive interaction between peer-to-peer trading and the adoption of demand flexibility that can be motivated by a desire to maximise the self-consumption of local renewable generation
- Carry out more detailed analysis of the community role across all stages of engagement
- Increase understanding of the impact of trust issues between householder and flexibility service provider and how these issues need to be reflected within engagement and the analysis of project outcomes
- Ensure that the selection of target householder participants during marketing is more nuanced and more broadly based than just 'pioneers' who might typically be considered the ideal target audience
- Ensure that the participant recruitment process is clear on the possible teething problems of trialling either innovative smart devices or the remote direct control of energy technologies
- Ensure that the participant recruitment process is clear on how shifting energy consumption patterns may impact on lifestyles.
- Alongside an assessment of technical suitability, undertake a non-technical assessment to sensitively check for participant vulnerability issues and understanding of potential implications for energy use and how to reduce impacts
- Ensure close liaison between installers and community energy groups to ensure a deep understanding of the requirements of the installation of smart devices, if required.
- Explore the potential for installation cost savings following a pre-agreed installation trial period i.e. after 10 x installations.
- Enable production of location and property photos by householder to remove need for surveys prior to installation of smart control devices in order to keep installation costs down.
- Provide clarity on the upsides for installers of participating in a flex community project, particularly when this involves them working in a different way to their normal business practise e.g. around customer interactions
- Seek more comprehensive pre and post-manufacture testing on innovative devices, prior to installation in households, including those for trial purposes
- Ensure good quality data feeds to enable more comprehensive analysis of project impacts

10.4 Recommendations for the Wider Sector

- Ensure all new heat pumps are flex enabled and adopt compatible standards for cloud-to-cloud communications, as has happened with EV charge points and the adoption of Open Charge Point Protocols
- Rapidly reduce the costs for smart control devices if and when required in order to improve the financial viability of the business model
- Explore the sourcing of capital, if required, through community finance

- Increase the compatibility of flexibility services offered by both ESO and DSO to maximise the potential to stack revenue streams
- Speed the adoption across all DSOs of standardised systems, expectations and services with regards flexibility
- Provide training and market development opportunities for community energy groups and the supply chain partners on flexibility and the implications for doing business in this area
- Increase the potential for knowledge transfer between the energy and community sectors through maximising partnerships in innovation projects, secondments and university led programmes
- Improve smart meters such that data can be recorded at a level of resolution that will facilitate flexibility at a domestic level, or adapt domestic flexibility services to rely on lower resolution data (e.g. WPD's Sustain-H)
- Adapt electricity supply regulations such that the sale of electricity to local consumers can be recognised within the market and value can be attributed to the reduction in distribution and transmission costs

11 Appendix – Revenue Assumptions Drawn from the Everoze Modelling

Figure 24: Summary of Everoze's Revenue Estimate Assumptions

SUSTAIN-H

Baseline demand	= 1.35 kW	*A home with an EV charger is assumed for the purpose of estimating Sustain-H revenues. The average of the summer and winter baseline is used here. A target demand of 0.35 kW is assumed to get 1 kW contracted flexible capacity.*
Target demand	= 0.35 kW	
Contracted capacity	= 1 kW	
Sustain-H tariff	= £2.5 per kW	*The medium tariff band is assumed*
Monthly payments	= 1 kW x £2.5 per kW	
	= **£2.50 per month**	

BALANCING MECHANISM (BM)

Contracted flexible capacity	= 1 kW	*Assumed unit flex capacity per home*
Days service is offered	= 30 days	
Number of dispatch events	= 15 events per month	*Subject to high uncertainty as it is unclear how the ESO would dispatch domestic assets in the BM.*
Avg. duration of dispatch event	= 30 minutes	
Hours service is utilised in month	= 15 events x 30 minutes	
	= 7.5 hours	***Revenue critical assumptions subject to high uncertainty***
Utilisation estimate	= 7.5 hrs x 1 kW	
	= 7.5 kWh	
BM Offer price	= £175 /MWh	*Price assumption based on example prices offered by utility scale storage in the BM*
Monthly payments	= 7.5 kWh x £175 /MWh	
	= **£1.31 per month**	

DYNAMIC SERVICE

Contracted flexible capacity	= 1 kW	*Assumed unit flex capacity per home*
Days service is offered	= 30 days	*Bridgewater CMZ requires volumes all days of the week. Revenue stack assumes 3 hours offered from 4-7pm*
Availability window duration	= 3 hours	
Probability of securing weekly tender	= 75%	*Indicative assumption based on anecdotal view from WPD from the MADE innovation project*
Hours service is offered in month	= 67.5 hours	***Revenue critical assumption subject to high uncertainty***
Probability of utilisation	= 20%	*Indicative assumption based on anecdotal view from WPD from the MADE innovation project*
Utilisation estimate	= 30 days x 20% x 3 hrs x 1 kW	
	= 18 kWh	***Revenue critical assumption subject to high uncertainty***
Availability payments	= 1 kW x £5 /MW/hr x 67.5 hrs	*£5 /MW/hr availability tariff and £300 /MWh utilisation tariff per WPD's current published tariffs for the Dynamic services*
	= £0.34 per month	
Utilisation payments	= £300 /MWh x 18 kWh	
	= £5.40 per month	
Monthly payments	= £0.34 + £5.40	*These payments will not be available every month but only for the months the DSO has a need for the service in that CMZ*
	= **£5.74 per month**	