



Project Symphony

Our energy future

Work Package 3.3

Social Research Report

26 September 2023

In partnership with:



Purpose

This report has been prepared by the University of Tasmania (UTAS), in collaboration with Synergy, to capture and understand responses, attitudes and preferences of customers to the technology and solutions being trialled; underlying value propositions; critical issues for maintaining engagement; and critical issues for transferability and scalability as well as impact on policy.

The report covers three key areas:

1. Assessment of what policy support needs to be considered to support the scaling of the Project from a pilot to mass market adoption.
2. Customer sentiment towards a variety of DER asset types and offerings.
3. The social equity implications of mass market adoption.

ARENA Disclaimer

This project received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program. The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

Project Participant Disclaimer

Neither this report, or the inputs to it, should be taken to represent the views of Synergy, Australian Energy Market Operator (AEMO) and Electricity Networks Corporation trading as Western Power or the Government of Western Australia.

The Project Symphony Project Participants support this report however, the information herein should not be considered as a basis for investment and interested parties should undertake independent modelling to inform such decisions.

Acknowledgement

The Project participants acknowledge the support, co-operation and contribution of Project Symphony's customers and thank them for their participation in this pilot.

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WP3.3 Social Research Report Preface

The WA community is installing rooftop solar at unprecedented rates. With one in three households in the SWIS already having a rooftop solar PV system, and over 3,000 households adding a new system each month, customers with DER are already enjoying the benefits of lower electricity bills while contributing to de-carbonising the power system.

However, the high penetration of DER, particularly rooftop solar, can pose a significant risk to power system stability, for example at times of low system demand in an isolated network such as the South West Interconnected System (SWIS). In response, the WA Government released the DER Roadmap¹ of which Project Symphony is a key DER Roadmap action. One of the Project's working hypotheses is that DER can provide cheaper, lower carbon outcomes by providing energy markets with services and then sharing most of the value back to customers.

The Project Symphony Social (customer) Research Report was conducted by The University of Tasmania (UTAS) with Synergy as the customer facing electricity retailer of the pilot, and with contributions from the Australian National University. The report was conducted on behalf of Project Symphony's project partners, Western Power, Synergy, the Australian Energy Market Operator (AEMO) and Energy Policy WA (EPWA).

The Social Research Report has provided project partners with an understanding of customer responses to the constructs of the Project Symphony pilot. Pleasingly, the way the research was conducted enabled some findings to be incorporated during the pilot itself.

The final report provides learnings and recommendations across the key themes of value, customer communication and asset orchestration. It is important to note that as a truly innovative pilot some of the outcomes of the research could only be incorporated when the objectives of the pilot were known. For example, some of the report's outcomes around customer value could not be incorporated into the pilot because the actual quantified value of the service was not yet known, with a nominal incentive provided to customers instead, and this context is important when digesting the findings of the report.

As a pilot Project Symphony aimed to assess the costs and benefits of having customers participate (using DER assets in homes), in new energy markets and services. Meaning, customers were provided with a nominal value through asset subsidies and incentive payments to enable participation, and orchestration payments to compensate participants for any negative bill impacts that may occur from the orchestration. Project Symphony did not attempt to provide customers with a product that directly compensated them the actual commensurate value for the services their assets were participating in. The values of these services were unknown when customers were recruited and are a planned outcome of the pilot through the completion of the Cost Benefit Analysis (CBA).

It is anticipated that following the completion of the CBA, for future scaling Synergy will develop customer products with values that are more aligned to the markets and services that customer's assets are participating in.

It is also worth noting that Project Symphony also experienced technology challenges that impacted on the intended test schedule. The energy industry is experiencing a rapid evolution due to the increasing integration of renewable energy into our electricity mix. The software and hardware-based solutions necessary for managing this renewable energy, such as integration, aggregation, and settlement of DER services, are still in a relatively immature state of development.

¹ <https://www.wa.gov.au/government/distributed-energy-resources-roadmap>
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During the program execution, the program partners faced the challenge of not finding complete end to end software solutions that met their specific needs. As a result, they had to rely on emerging, immature solutions that had to be innovated on and co-developed in parallel to the program's implementation. So, whilst Project Symphony sought to achieve technical, energy market and customer objectives, obtaining technical feasibility became a primary challenge. This resulted in delayed, more frequent, and responsive testing.

The Social Research Report clearly shows that customers had a lower sentiment towards Project Symphony during the initial intensive period of testing and Project Symphony acknowledges that largely their expectations for participation, particularly around transparency and communication, in the pilot were not met. However, once platform stability was achieved and a planned testing schedule was in place and executed, and communicated, customer sentiment improved.

Project Symphony's ambition was to support the Distributed Energy Roadmap's vision of progressing toward a future where the integration and participation of DER in markets supports a safe, reliable, lower carbon and more efficient electricity system. As technology matures customers will remain central to that outcome.

Project Symphony would like to thank our customers for participating in this innovative pilot and providing the insight needed to ensure that customers continue to embrace DER and customers continue to experience the full economic and environmental benefits from their assets.

Project Symphony Steering Committee

26 September 2023

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Project Symphony social research report

Final report on social research conducted for Project Symphony 2021-2023

30 August 2023

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The social science research team

The University of Tasmania (UTAS) conducted this social research with Synergy as the customer facing electricity retailer of the pilot, and with contributions from the Australian National University. Synergy's key social research collaborator is Jade Soh, a Synergy customer researcher specialist (Dion Parera was also in this role early in the project). Other Project Symphony staff at Synergy provided important contributions and feedback to the report as needed. The UTAS research team is Dr Phillipa Watson (lead investigator), Dr Maureen Boyle (main social researcher) and Professor Heather Lovell. Mr Cameron Atkinson (research assistant) from UTAS also provided research support on the project. Dr Louise Grimmer and Professor Martin Grimmer were involved in the project from 2020 (beginning with preparation activities) to 2022. Dr Benn Parr also assisted with research in the first quarter of 2022. Laura Jones from ANU provided input to the report from May-July 2023.

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Acknowledgements

Project Symphony is a collaboration between Synergy, Western Power, the Australian Energy Market Operator (AEMO) with support from Energy Policy WA. Project Symphony is a key deliverable of the State Government's Distributed Energy Resources (DER) Roadmap and Energy Transformation Strategy.

In addition to WA State funding, Project Symphony has also received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

The views expressed herein are not necessarily the views of the Australian Government, and the Australian Government does not accept responsibility for any information or advice contained herein.

Our social research team would like to heartily thank:

The funders for allowing the space for social research to occur on this project.

The helpful and respectful people at Synergy who kept sharing information needed, answering questions and providing a space for Maureen to work in their office.

The participants of this research for taking time to talk with us and share your very important experiences and insights during the pilot.

Other Project Symphony pilot partners for review, comments and reflections during the final report drafting.

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Abbreviations

ABS – Australian Bureau of Statistics

AEMO – Australian Energy Market Operator

AMI – Advanced Metering Infrastructure

ANU – Australian National University

App - Application

ARENA – Australian Renewable Energy Agency

BTM – Behind the meter (at a customer's residence)

CER – Customer Energy Resources (an alternate description used for DER)

DEBS – Distributed Energy Buyback Scheme

DER – Distributed Energy Resources

DMO – Distribution Market Operator

DOE - Dynamic Operating Envelopes

DSO – Distribution System Operator

EOI – Expression of interest

EPWA – Energy Policy WA

ESM – Emergency Solar Management

EV – Electric vehicle

kW – Kilowatt

kWh – Kilowatt hour

NEM – National Electricity Market

NSS – Network Support Services

PI – Project Interviewee

PV – Photovoltaics

REBS – Renewable Energy Buyback Scheme

RQ – Research question

SA – South Australia

SWIS – South West Interconnected System

UTAS – University of Tasmania

VPP – Virtual Power Plant

WA – Western Australia

WEM – Wholesale Electricity Market

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Executive summary

This report describes the social (customer) research findings from the Project Symphony pilot, run in several suburbs of Perth, primarily in Harrisdale and Piara Waters. This is the final social research report and is intended to support the project partners in their understanding of the customer responses to the pilot. This report will also provide key learnings for industry and will contribute to the sharing of knowledge about Project Symphony participant responses with future distributed energy projects. The report will have national and international significance and is likely to be of interest to the broader energy industry – for retailers, aggregators, the Australian Energy Market Operator (AEMO) and Distribution System Operators (DSOs). This report will also be provided, along with other Project Symphony learnings to the Australian Renewable Energy Agency (ARENA) for broader public dissemination.

Overall problem to be addressed

Project Symphony is a Virtual Power Plant (VPP) that was formulated as a key project under the Distributed Energy Resources (DER) Roadmap in recognition of a changing energy landscape, with increasing distributed and intermittent renewable energy generation, such as household solar photovoltaics (PV) (Energy Policy WA, 2019). This changing energy landscape has created system security risks, such as low daytime demand across the South West Interconnected System (SWIS), an extensive and isolated electricity grid in Western Australia AEMO (2022a). The DER Roadmap identifies the system security risks, and the opportunities to obtain value for customers and the broader community in Western Australia. The integration and coordination of DER into the electricity network is needed to ensure ongoing reliability and security of the electricity system, while also offering opportunities to obtain value for services on the Wholesale Electricity Market (WEM) (Energy Policy WA, 2019). Obtaining this value for the industry and participating customers is theorised to lower overall costs for the broader Western Australian community. Project Symphony is a key pilot that WA is testing to achieve technical, energy market and customer objectives.

Project Symphony as response

The Project Symphony pilot has an overall vision to "progress toward a future where the integration and participation of DER in markets supports a safe, reliable, lower carbon and more efficient electricity system" (Alexander & Blaver, 2021). The pilot seeks to achieve technical, energy market and customer objectives. The customer objectives, of which this report is fundamental seeks to understand the "willingness to engage, level of engagement, value drivers and the customer value proposition" (Alexander & Blaver, 2021, p. 21). Within Project Symphony, participating customers (participants), have their household DER, such as solar PV, battery energy storage, air conditioning and hot water systems "orchestrated" as a VPP. The objective of orchestrating household DER in this way is to test the value of these orchestrated assets on the Wholesale Electricity Market (WEM), and assist at times, with maintaining network stability. Through the pilot, a nominal value was provided to participants through asset subsidies and incentive payments – to enable participation, and orchestration payments – to compensate participants for any negative bill impacts that may occur from the orchestration (figures 3 and 4). The actual value of participation, for Synergy as the aggregator, for participants, and for Western Power as the DSO, is then determined through the testing of participants assets on the WEM (table 1).

Social research approach

This social research is an applied, multi-method, longitudinal study that investigates social phenomenon with participants involved in this pilot, which ran from October 2021 to July 2023. Our focus was on household participants that have agreed to be part of the pilot, and then also agreed to be part of the social research (via an invitation). Social research methods were guided by the four research questions that are listed in table 2. The research used data collected over repeat contact with participants (longitudinal data), from interviews, surveys and focus groups. It uses a 'before and after' activity assessment approach. Data captured from participants before substantive involvement with the pilot assists us to assess customer responses after involvement with critical activities of the pilot. The key activity in this case is orchestration of participants' assets. 'Before and after' research approaches are particularly useful in cases where control groups are unavailable.

The interviews and focus group recordings were transcribed and coded into initial themes using NVivo (Appendices 1, 2 & 3), with the data further interrogated to determine recurring patterns and themes. This initial analysis formed the basis of the discussions outlined in Part C – key thematic findings. Survey responses were analysed using the Q research software (quantitative responses, descriptive statistics, cross-tabulations and significance testing were used where appropriate), with some qualitative exploration from free text responses. The data collected and analysed from surveys was then integrated, combined with contextual information about the pilot sourced from Synergy staff and other project partners. Relevant literature is also used throughout the report to further contextualise the findings. All data collection and interaction with participants was reviewed and approved by the Human Research Ethics Committee at the University of Tasmania (UTAS). Participants of the social research were offered incentives to take part in the interviews and focus groups and these are described in Appendix 4.

Results of the social research

A summary of the results from the social research are related here using the research purposes that are derived from the research questions. The research questions had a distinct purpose and guided us as social researchers in seeking answers and can be found in table 2. Results of significance are described under the purpose of each research question as follows:

RQ1 purpose – To understand customer research findings from other VPP pilots

We examined the VPP literature, both academic and industry reports for social (customer) focused research. We identified through this literature review that the broad thematic findings of this social research align with findings of other studies and in particular, industry reports and accounts. We found limited social research in the academic review using search terms of VPPs. The academic literature review identified that trust, transparency, privacy, and legal factors were under reported in the literature. The academic literature also discussed the perspective of value reported in the literature, which focuses on the value of the network operator managing uncertainty, increasing flexibility and maximising profit for operators of VPPs. The literature review also found a limited consideration of placing people at the centre of VPPs, and the language used depicted a disembodied "DER" as participating in energy markets, as opposed to householders, with little to no mention of the connection of DER to people and their homes. As discussed throughout this report, particularly in section 8, the use of language is critically important for considering people in the equation of VPPs. The findings from the industry literature review revealed that customer learnings are often buried in technical reports and the dissemination and sharing of the results of VPP and DER integration trials needs a more active approach to embed these learnings.

RQ2a purpose – To understand customer sentiment (including perceptions and values) and customer responses to Project Symphony

The research conducted and discussed in this report provides a detailed understanding of customer sentiment, including their perceptions, values and responses to the technology installed, the orchestration, the incentives offered, and other non-financial measures of value as discussed in this report. Sections 11 and 13 discuss in detail the value for participants, both financial and non-financial.

The social research takes a broader view of measures of value in section 11, by outlining participants broader motives to join the pilot project, which included the battery and other asset subsidies, environmental reasons, being part of something greater and community benefits. Participants expected to see cost savings, and this was a key reason for participating from the onboarding survey and the interviews (figure 8). The main reasons for participating from the onboarding survey included maximising the use of solar, reduction of electricity costs, future proofing against electricity price rises and receiving the subsidised assets (mainly battery). Survey respondents were also motivated by broader community benefits and being part of something of broader benefit to the community.

For participants with a battery, there was an expectation that they would benefit by having energy stored in their battery to utilise at night, thus leading to reductions in their bill (energy arbitrage). Participants also had an expectation that they would have battery back up in the event of an outage, despite the grid being reliable and participants being aware of this reliability. Battery back-up was not configured on the batteries purchased by participants interviewed for this research. Therefore, participants expectations of battery back-up were not met in this research. Section 11.2.1 relates the expectations of battery back-up for participants in more detail.

Section 13 provides a perspective of value that is more encompassing and considers the effort participants expended to be involved, which broadly included time, money and physical and mental effort. This section also highlights the interchange of effort and value being expressed as care throughout the pilot from the project team at Synergy through to the pilot participants. Care from the project team and pilot participants was expressed in several ways and was critical for the success of the pilot. However, these types of relationships are more difficult to sustain outside of a pilot environment, and there was considerable leeway and patience from project participants, based on their experiences of orchestration. These broader considerations of value are often not considered in project design, and deeper consideration of things that participants value and care about, as well as the effort expended to participate needs to be considered in future pilots.

The social research also sought to understand responses to the technology in place (the technology in the home) and its monitoring in section 10. This section highlights that there are complex technology mixes needed for the pilot that included home battery systems, gateway devices and high-speed data recorders, as examples. This technology had to be retrofitted in, taking up space and needed to be engaged with through adjusted practices in households. Participants were generally comfortable with the installation processes. Data from various sources showed that installations became smoother with less issues over time as organisational processes were iteratively improved and installers familiarised and refined their approach. Households mostly took up offers of quality assurance checks where they were offered by Synergy. Quality assurance checks were received well, with householders asking for important information about their systems at quality assurance checks.

Most participants with a battery wanted to understand the technology installed and wanted to be able to monitor this. However, it was difficult for participants to monitor as there was not a single interface with which to see data and participants moved across information sources, such as the inverter and battery apps, as well as Synergy's My Account, which frustrated participants. Having a

battery in the garage and monitoring of pilot equipment in homes led to more active attention. Participants were stressed when battery use by the pilot seemed inconsistent, and they wanted information about tests, timing and the reasons behind these. That there were a range of monitoring behaviours is important to recognise in any future program. Participants showed that they used a range of information to check on and understand systems, and this was useful for participants. Battery ownership is also an expression of several householder values, such as battery back-up and energy arbitrage that can clash with use of the battery for the pilot. This clash will be important to consider moving forward at scale.

RQ2b purpose – To investigate the element of pricing from RQ2a in further detail to understand the implications of pricing and incentives used in Project Symphony.

Incentives, such as asset subsidies were used in Project Symphony to recruit participants and the orchestration payments applied to participants' bills were intended to mitigate any negative bill impacts from orchestration. Through the research, we found that the asset subsidies (particularly for the battery) were a significant factor for participants to be involved in the pilot. Results from the onboarding survey indicated that 76% of participants rated the asset subsidy as being influential for their reason to participate (figure 8) and this was also the most significant motivation to participate for interview participants (figure 31), particularly for the home battery system. From the onboarding survey, the incentive payments were still a lower motivation to participate, (rated second lowest).

Incentive payments for existing assets were rarely mentioned by participants as being influential for participation and the perceived value of these payments as the pilot progressed was limited as discussed in sections 9, 11 and 13. Sections 11 and 13 interrogate the incentive payments further and discuss how participants weighed up the value of these payments when asked in the second interviews and the perceived limited value of these on balance, when considering their concerns about orchestration, issues that may have arisen at the installation stage and their time and effort to participate.

As there were no price signals for participants in Project Symphony, we could not report on how participants had, or would respond to price signals with orchestration. Participants had no control or visibility with orchestration and were therefore unable to respond. The responses from participants that we did hear about through the research was in relation to changes in electricity usage with orchestration as discussed in section 9.3. Participants informed us that they were familiar with maximising their use of their solar PV generation during the day for self-consumption. The first phase of orchestration impacted on participants ability to self-consume during the day, when solar was being constrained at the gross level (zero output). There was significant angst when this occurred for participants as they could see with the use of their solar inverter apps that they were importing grid electricity during sunny days for household usage. This did not match expectations for the project, with some participants reporting confusion about the purpose of the project as being about green energy or saving energy. Participants also reported having their batteries charged from the grid at odd times, mentioning around 2am, which also did not make sense for people who were aware they were also being charged to purchase this electricity, and for what end or purpose was very unclear for participants.

The majority of participants remained on the flat A1 tariff throughout the pilot. This tariff is approximately 30c kWh. However, section 11.4 discusses tariffs from the experience of three participants on the electric vehicle (EV) time of use tariff and the midday saver tariff. The experience from these participants who had awareness of different tariffs showed that it was not feasible to try and work out how to maximise their benefits through the use of these existing tariffs. One participant on the midday saver, did use inventive methods of directing his battery to be charged at the off-peak time through the inverter, however it is unclear to the social researchers if this participant was able

to prevent the charging of his battery at odd times in the middle of the night and early morning as other participants reported.

RQ3 purpose – To understand the social equity implications of Project Symphony activity, particularly relating to mass market deployment and adoption.

Research question 3 set out to understand the social equity dimensions of Project Symphony in relation to further scaling. This research question is primarily addressed in section 12, which steps through participants ability to pay for energy and assets, their views on fairness, power dynamics between Synergy and the participants, and considerations of gender equity for future projects. The demographics of Project Symphony participants (section 7.1) are such that this research is not fully representative of a cross section of the broader community, and the pilot did not intend to be representative. All participants were homeowners with the majority having household solar PV. Over half of the participants (figure 9) had an annual household income of \$150,000 and above. A smaller percentage of participants, 6% earned under \$50,000 per year. The majority of primary participants (68%) also identify as male, with females making up a smaller percentage of the participants. Section 12.4 discusses gender equity more broadly and implores that gender is considered in future pilots to avoid designing only for resource man (Strengers, 2014), a fictional male character who understands all aspects of energy use and rationally responds to price signals.

Other aspects of social equity to consider and discussed in section 12 is the power imbalance that the social researchers observed between Synergy and participants. This was by no means intentional but occurred as a result of various factors discussed in section 12.3. Those factors include:

- Participants were non-contestable customers;
- The pilot intended to determine the value for customers, but through the testing period there was a lack of optimisation of participants assets for their benefit (most relevant for battery participants);
- The financial value for participants was intangible and difficult to determine;
- Limited information about what to expect with the pilot in the first orchestration phase;
- The use of industry insider terms and language that did not convey meaning for participants and contracts that were complex, with vague terms;
- Inability to opt out of orchestration events, have visibility of orchestration or be notified about what was occurring, and
- Return visits for installations that some participants reported as being time consuming and somewhat disruptive.

Project Symphony is operating on the premise of broader benefits, both for participants and for the broader community as discussed in section 12.3 and this is reflected in various documents that refer to Project Symphony such as the founding Project Symphony Vision and Impact Pathway (Alexander & Blaver, 2021).

Section 13 highlights the effort and time invested in Project Symphony from project partners and from participants. It appeared that the effort from participants was not fully known or considered at the outset by organisations involved. There was an expectation that participants would be involved in the pilot based on the information that was given, the contract participants signed (section 8.1) and the subsidies and incentives offered (figures 3 and 4). The project partners perceived this exchange as fair value. However, there is little evidence from our research that anyone fully appreciated the level of engagement that would be required of participants as discussed in this report, from reading through complex information, time and effort for the installations and follow up visits, combined with an experience of orchestration that was confusing for participants. It is only through this social research that we can understand all these aspects of participants experience of

the pilot, to fully appreciate what was asked and expected of participants. The perceived value given from organisations versus the perceived value gained from participants, conflicted in the first phase of orchestration. Section 13 relays in further detail, participants perception of value after considering the effort they expended physically, financially and with time.

RQ4 purpose – To understand government policy implications that emerge during the social research to inform energy policy settings, market design and regulatory reform that will enable optimal deployment and use of VPPs.

Section 14 of the report contextualises the social research in view of current and relevant policy work occurring in WA. Project Symphony, as a pilot program has the potential to influence ongoing policy and regulatory decisions in WA for the benefit of future participants. The results of this research provides some useful learnings to inform energy policy in WA, some of which is already in place such as the DER Orchestration Roles and Responsibilities Information Paper, which sets out "key requirements and implementation pathways for the DSO and DMO functions in SWIS" (Energy Policy WA, 2022a, p. 3). This report sets out a key theme of protection of consumers, that includes ensuring visibility of how customer assets are managed "to ensure trust and social license is maintained" (Energy Policy WA, 2022a, p. 7).

The findings of our research detail some key areas where the protection of participants in the pilot could have improved. Section 8 presents some of the issues that occurred in the pilot as a result of limited information (particularly around orchestration), the use of terms that did not carry meaning, and the lack of visibility (sections 9, 10.5 and 11.4). A lack of visibility was communicated by participants in the first phase of orchestration and participants reported feeling confused about what was happening with their assets. Participants had limited awareness about what orchestration was - whether orchestration was a technical issue, or an intended event.

Section 10 highlighted technology, both as physical infrastructure and the monitoring of technology as important to consider in policy decisions moving forward and these issues are not, to our knowledge, currently covered by WA policy. Physical and technology considerations include:

- Often there was a lot of technology installed, which was generally retrofitted into already well utilised garages.
- Bollards, most often seen in public spaces for safety purposes, were installed in certain garages where batteries were installed (also for safety).
- Accumulation of technology and the use of garage space could become a challenge in the future.
- Installations were in part successful also because they were being installed in comparatively new housing; and,
- Installations of technology in smaller housing types are more challenging.

Section 14 relays more broadly how negative lessons from policy and programs are at risk of being ignored, as they are less mobile across policy contexts and institutions than success stories. Although some areas of this social research have reinforced areas that need to be addressed with VPPs, such as tariffs – there is still a risk of the learnings from this social research not being mobile across the institutions involved. The risk of not considering the lessons of this research and social research in general also carries for other VPP projects. This risk increases due to the limited number of social researchers who have been deeply involved, in comparison to the technical and market focus of the project. This risk is further compounded by the storylines (Hajer, 1997) that are used across the project partners of techno-optimism that is common across the industry, with an example of these storylines detailed in section 11.4 in relation to the VPP responding to market and network signals.

Summary of key thematic findings

We provide a summary of the key thematic findings (Part C) and situational insights (Part D) of this report below. Substantive recommendations from the findings of this research are provided in the conclusion.

Section 8 – Communication

1. The majority of participants were unaware of exactly what they were signing up for and returned to their contracts and others in the pilot to find answers as the pilot progressed. Our findings suggest that specific information and clear parameters should be provided in contracts, and in any marketing for future pilots or programs. This will enable clarity, set expectations and assist in decision making about involvement at the outset.
2. Our research showed that participants sought clear, graphical information about what was happening with their assets with orchestration, and a broader contextual understanding of what this meant for them and the broader community. These findings are similar to industry research as discussed in the grey literature review. Therefore, we suggest that participants and future customers are kept informed through regular updates and apps with easy to understand statistics.
3. Our research showed terms like orchestration had very little meaning for participants. The use of technical terms that lack explicit meaning, which customers can relate to is common within the energy industry as evidenced by ECAs campaign to change the use of DER to Consumer Energy Resources (CER). These findings suggest a much broader issue within the energy industry about the use of insider terms, that then make it out unfiltered to the customer.
4. A clearer value statement at the outset of the project detailing what participants were part of would have assisted in setting expectations for participants. Our research showed that participants questioned the value of participating, as they were not given clear information about what to expect or what the pilot was actually trying to achieve. It was clarified to the social researchers later in the pilot that Project Symphony was providing a nominal value (in the form of the various incentives offered) to determine the actual value of operating participants assets on the WEM. Had this been communicated effectively, participants are likely to have been better informed and aware of what would occur with the testing scenarios (table 1).

Section 9 – Orchestration

5. Our findings showed that orchestration was an unknown for participants, and as discussed in section 8, the word itself carried little meaning. Therefore, there was no understanding of the effects of orchestration on participants assets, or for their household energy use. These findings, along with those discussed in section 8.3, suggest that the social licence to orchestrate participants assets was tenuous, despite participants signing a contract saying that Synergy will use their assets for the purpose of Project Symphony (figure 14).
6. The research found that many participants expressed concern about the constrain to zero scenarios, particularly when this was operating at the zero output (gross) level, which required participants to import electricity from the grid. Participants were less concerned when constrain to zero (net) was operating as it enabled household demand to be met from solar generation.

7. Participants discussed having notifications when orchestration events would occur. We understand that there were challenges in providing notifications for Project Symphony, due to the range of testing that was triggered at short-notice or that required flexibility from the aggregator (to respond to wholesale prices for example). Given the level of flexibility that would be required to operate customer assets in this way, such opportunities need to consider customer acceptance and how to engage customers in such products.
8. The value of the project for battery participants was hindered by orchestration when there was an expectation at the outset of bill reductions. Other measures of value such as battery back-up were based on a conventional understanding of the individual benefits of having a battery to store excess solar generation for use in the evening (energy arbitrage). The issue of value is discussed in more detail in sections 11 and 13 but suffice to say in this section that "value" from the customer perspective needs to be substantially considered.

Section 10 – Technology and systems

9. Installations overall were positive and improved over time, but there were issues. Quality assurance visits by the retailer are a very positive part of the installation process. They also serve as an intervention, ensuring high quality installations and to check householder understanding of the safety aspects of systems. Positive installation practices captured are listed in the report.
10. Retrofitting of gateway devices, high speed data recorders and home battery systems, and the physical house space limitations for participants are important to understand. Certain housing is going to be more suitable for retrofitting of larger assets, like batteries. Understanding the features that support or challenge DER installations will be useful for planning future programs and for understanding how housing features may hinder people being involved.
11. Installations became more complicated with each asset connected and there is a lot of technology being installed, taking up significant space in already often highly utilised garages and service spaces. End of program and in the future, end of life of assets stages need consideration in any future program. Installations were successful in part because they were being installed in comparatively new housing. Households need more up-front explanations of what is being installed in their homes at time of installations. Garages are active places and therefore may need to be checked from time to time to ensure that batteries and other technology is situated without obstructions.
12. There were safety features, such as bollards and heat sensors added into participants garages due to the retrofit of batteries. These safety features are new to domestic spaces and needs further consideration in future programs. For example, how can building codes respond to support safety of DER technology in homes?
13. Battery expectations can be proactively managed and further communication around how batteries are used in programs in the future would help to ease concern around battery use by the system or the network. Battery charge and recharge is an example of an issue that could be engaged with through further communication. Participants value the battery for the personal control it provides over energy use and energy arbitrage. These values and the way a battery is useful for these participants clashes with the use of a battery for a pilot such as Project Symphony. This is reasonably well understood, but needs further exploration moving forward, as household storage is often a key component of ensuring DER on networks is successful.

14. Monitoring and feedback from the perspective of the participant and at the house site was useful to understand. Participants monitor their technology if they think it is, or have been told it is, a useful practice. Programs likely need householders to monitor and maintain their systems over time, thus the risk of unmonitored systems may also grow over time. We know from other battery integration trials that battery companies monitor batteries too (Watson et al., 2019). This observation and control may or may not work with a future VPP.
15. Participants with access to new apps, particularly those who had also installed a battery, increased their monitoring via apps and Synergy's My Account. Increased checks and learning about energy can be assumed when programs like this occur. That there were a range of monitoring behaviours is important to recognise in any future program as householders showed that they used a range of information to check on and understand systems and technology installed in their home.
16. Participants were keen to have data between apps align and this could be a sticking point for householders in future programs. Managing the confusion of this could become time consuming for a program and is therefore a risk worth exploring. This issue is understood, and solutions are currently being explored for this by project partners.

Section 11 – Value for participants

17. A broader definition of value is suggested that includes consideration of expectations (such as battery back-up, bill reductions), motivations for participation (such as environmental, costs savings, community benefits) and effort required of participants (section 13).
18. For future VPP projects, there is a responsibility for the aggregator and the DSO to ensure that customer assets are optimised for their benefit, or an appropriate tariff is provided. Given that the orchestration payments were only applied to participants with existing assets and not to battery participants, this requires further interrogation around the value of participating for future battery participants. As discussed in section 11, the frequency and duration of orchestrating assets intensely in the first phase of orchestration, may have led to a perceived or (actual) loss of value for battery participants. The generous battery subsidies were an attempt to mitigate this loss, but as our research shows, this was not necessarily communicated or well understood by participants.
19. There is a need for increased visibility and understanding of what participants are signing up for at the outset. If participants had the type of visibility and understanding of how their assets would be orchestrated as shown in figure 34, some participants may have chosen not to participate. A social licence to conduct orchestration, which considers the private costs and risks for participants is needed. Visibility of orchestration (and the meaning of orchestration) is required to assist in creating value for participants.
20. Concerns about the first phase of orchestration, issues that may have arisen with installation and the general time and effort required to participate as discussed in section 13.3 led to unclear value propositions for participants. This was particularly the case for battery participants who make up the majority of this social research.

Conclusion

The research findings are further situated in relation to several broader themes in Part D of this report. The broader themes include, social equity (section 12), acceptance, values, effort and care (section 13) and policy implications (section 14). Section 12 and 14 findings are noted in the RQ3

and RQ4 sections of this executive summary above. In relation to Section 13, we add that the research found a great deal of care and effort was expended by project participants. There were examples through the research and discussed in this report where this participant effort was not fully visible to the project partners and was only uncovered as a result of this social research. Similarly, Project Symphony has been a very large and complex technical, market and customer integration pilot, with the pilot teams working consistently to meet the aims and objectives set out for the project. As discussed in section 13, a great deal of care and effort was also given by all the project partners. This effort and care (including personal concern) was very visible for the social researchers when working closely with the Synergy team. Indeed, Project Symphony was also framed around caring for an electricity system that society relies on for essential energy services (Alexander & Blaver, 2021). The key challenge for project partners going forward then is defining a VPP or DER integration business model that considers factors that participants value and care about to improve the value proposition for customers in future projects.

Recommendations for important next steps are provided in the conclusion section of this document.

Part A. Background and context

1 Introduction

This report describes the social (customer) research findings from the Project Symphony pilot, run in several suburbs of Perth that are captured in the Southern River substation, primarily Harrisdale and Piara Waters¹. Project Symphony (the pilot) seeks to achieve technical, energy market and customer objectives and was identified as a key project of the DER Roadmap. The pilot aims to assess the costs and benefits of having customers participate (using DER assets in homes), in new energy markets and services. The vision is one of the future where "DER is integral to a safe, reliable and efficient electricity system, and where the full capabilities of DER can provide benefits and value to all customers" (Energy Policy WA, 2019, pp. 9-11). The pilot was also identified as a key project in WA's Energy Transformation Strategy (Government of Western Australia, 2021).

The pilot also engages with issues that have occurred with increasing DER (mainly solar PV) and their changing two-way energy flows on electricity networks across Australia. Measures are in place in Western Australia to deal with system security risks that have occurred with increasing solar PV, through the Emergency Solar Management (ESM) requirements, which directs that all new solar PV and battery installations with an inverter capacity 5kW or less need to have the capability to be turned down or switched off in emergency situations (Government of Western Australia, 2023a). The pilot assists with emergency system security risks, but ultimately aims to assess the cost and benefits of having customer owned assets participating in new markets and services through testing these assets on the market in what is termed "orchestration".

The pilot also aims to understand the willingness of customers to engage in DER integration, their levels of engagement, and the values that drive customers. (Alexander & Blaver, 2021, p. 21). Within Project Symphony, participating customers (participants), have their household DER, such as solar PV, battery energy storage, air conditioning and hot water systems orchestrated as a VPP. Operating participating household DER in this way has the potential to enable customers to be part of a future energy market that is stated to have the potential to "unlock greater economic and environmental benefits for customers and the wider community" (Project Symphony, no date - milestone 2, p. 4).

Project Symphony involves a consortium of industry, government and research organisations that includes, Western Power as the DSO, Synergy as the participating customers' retailer and aggregator and the Australian Energy Market Operator as the Distributed Market Operator (DMO). Government support and policy guidance is provided by Energy Policy WA. These organisations and the WA government are collectively referred to throughout this report as 'project partners'. Other collaborating organisations include, the University of WA (UWA), the University of Tasmania (UTAS), the Australian National University (ANU) and the University of Technology Sydney (UTS), with funding support from The Australian Renewable Energy Agency (ARENA). The social research contained in this report was conducted by UTAS and Synergy as the industry collaborator, with additional analysis provided by an ANU social researcher.

¹ The pilot area is defined by suburbs served by the Southern River substation. This area includes not only Harrisdale and Piara Waters (the two main suburbs serviced by the substation) but also neighbouring suburbs, such as Southern River and Canning Vale.

Project Symphony is officially running until September 2023. The social research occurred from late October 2021 to July 2023 and was devised to help meet the overall pilot aim noted above. A longitudinal research approach was applied to this social inquiry, meaning researchers engaged with customers multiple times, over an engagement period from early 2022 through to mid-2023, using multiple research methods (qualitative and quantitative). This multi-pronged, long-term, and repeat-contact approach ensured as many insights were captured as possible about the different stages the pilot progressed through. Data was collected through in-depth interviews, focus groups and surveys with customers, and this data was contextualised with observations of asset installations and the broader pilot context. The longitudinal approach also supported the approach to learning and development that was used in the overall pilot.

The project partners, and particularly, Synergy as the aggregator, engaged in an iterative process for the pilot, with a focus on testing and learning. Improvements and lessons learnt from testing were continuous throughout the period of this social research. Longitudinal research allowed the social researchers to observe and respond to evolutions in the pilot and to understand challenges for participants. Synergy as the social researchers' main collaborator, responded to those challenges as they occurred.

This is the final report for the social research, which presents the social research findings. This report, while covering all social research stages, does not cover the entire testing phase. Therefore, some of the testing of the pilot (May-September) falls outside the reporting periods of this report. This report is a public document and is expected to be of interest to the broader energy industry (retailers, aggregators, DSOs) and stakeholders involved in energy transitions, including government, peak bodies, consumer organisations and the Project Symphony participants (whose contributions form the basis of the social research and this report).

This report steps through four sections, that contain further sub sections:

- Part A relates background and context, with a focus on the pilot background (section 2) and the social research (section 3),
- Part B relates broad findings and insights, focusing on the pilot journey for participants (section 6) and introducing the demographics and early motivations for participants (section 7),
- Part C thematically reports on participant responses, with in-depth analysis of participant communication and engagement (section 8), responses to orchestration (section 9), technology and systems findings (section 10), and value that participants identified (section 11)
- Part D situates these findings within broader themes, including in relation to social equity (section 12), acceptance, trust and exchanges of value (section 13), and relates implications and considerations for policy (section 14).
- Finally, the report provides a conclusion that includes recommendations.

2 Pilot background

The Project Symphony pilot has an overall vision to "progress toward a future where the integration and participation of DER in markets supports a safe, reliable, lower carbon and more efficient electricity system" (Alexander & Blaver, 2021). The pilot seeks to achieve technical, energy market and customer objectives. Within Project Symphony, participating customers (participants), have their household DER, such as solar PV, battery energy storage, air conditioning and hot water systems "orchestrated" as a VPP. The objective of orchestrating household DER in this way is to test the value of these orchestrated assets on the Wholesale Electricity Market (WEM), and assist at times, with maintaining network reliability. Through the pilot, a nominal value was provided to

participants through asset subsidies and incentive payments – to enable participation, and orchestration payments – to compensate customers for any negative bill impacts that may occur from the orchestration (figures 3 and 4). The actual value of participation, for Synergy as the aggregator, for participants, and for Western Power as the DSO, is then determined through the testing of participants assets.

This pilot was also motivated in WA primarily by the rapid growth in DER in the state and the impact caused by low daytime demand, or minimum operational demand on electricity networks. Low operational demand is a problem around Australia as it causes electricity system security risks, including voltage and frequency issues. Project Symphony seeks to address the issue of low demand on the South West Interconnected System (SWIS), an extensive and isolated grid in WA serving the majority of the state's population (AEMO, 2022a; Government of Western Australia, 2022b, p. 9). The minimum demand threshold for the SWIS was recently defined to be between 550MW to 650MW (Government of Western Australia, 2022b), meaning there is a system security risk if demand is lowered below this threshold. Demand is projected to continue to decrease, due to the continued uptake of household solar PV.

As of June 2023, there are over 38 percent of dwellings with solar PV installed in WA, which continues to increase (Australian Energy Council, 2023; Australian PV Institute, 2023). The use of home batteries is also growing, albeit at a slower pace than solar, due to the longer payback period of home battery systems (Kaka & Pendlebury, no date). As of 30 April 2023, there were 6,941 home battery systems installed in WA. This compares to 15,955 systems in SA and 71,844 installed nationally (Clean Energy Regulator, 2023). SA has the highest number of battery installations per capita, largely due to the home battery scheme in the state, which ceased in June 2022 (McClaren, 2022; Mercer, 2023). However, SA is now lagging in installations and other states on the National Electricity Market (NEM) are installing home battery systems at record rates due to high electricity prices (Mercer, 2023).

The most recent assessment of future electricity needs on the SWIS indicates that significant investment in renewable energy generation assets, storage and transmission infrastructure will be required under what has been coined the 'Future Ready' load growth scenario (Government of Western Australia, 2023b, pp. 4-6). Preparing a future ready SWIS is a challenge compounded in WA by the isolated nature of the electricity networks. Project Symphony is a key project to integrate DER into the electricity system and is testing four scenarios, described below in Table 1. The scenarios are related here in a simplified version for clarity and meaning for a broad audience. More detailed descriptions can be found in technical pilot reports referenced in the footnote. The orchestration scenarios being tested not only test ways to resolve voltage, frequency and peak demand challenges, they also allow exploration of ways that virtual power plants and market interaction can occur moving forward in a world with increasing levels of DER and two-way energy flows.

Table 1: Scenarios tested as part of Project Symphony

Testing Scenario	Technical description ²	Revised simple description ³
Energy Services (balancing market)	"The balancing market is a mandatory 'gross pool' market for dispatch and 'net pool' for settlement that determines the most economically efficient dispatch of generation to meet system electricity demand at a given time." It requires that "all registered facilities, including DER aggregated assets are available to participate and must comply with dispatch instructions from AEMO." Wholesale market customers can buy energy from the wholesale balancing market, but in Symphony the aggregator is a new party that can interact by buying and selling energy in the WEM, while adhering to dynamic operating envelopes (DOE).	DER assets are utilised in response to wholesale market prices, which vary through the day, for example, to buy electricity when the wholesale price is low and sell when the price is high. Managing DER in this way also assists in improving system security as the prices correlate to what is needed at any given time.
Network Support Services	"Network Support Services are a contracted service provided by a generator, retailer, or DER aggregator to the DSO (Western Power) to help manage or solve localised network constraints. A network support service could alleviate distribution level peak electricity demand or reverse power flow and/or local voltage issues identified by the DSO at a cost that is less than traditional augmentation such as larger transformers, more 'poles and wires' or otherwise expanding capacity."	Network support services can manage DER assets on the network at times when there is peak demand. For example, on a hot summer night when there is no solar output and high demand for air conditioning. Using DER assets in this way, assists in managing peak demand and can resolve local voltage issues on the network. This has the potential to avoid the costs of upgrading the poles and wires of the electricity network or increasing generation capacity simply to meet peak demand periods.
Constrain to Zero	"To demonstrate the ability of the AEMO Platform to instruct the aggregator platform to constrain energy output from DER to zero export (net) or zero output (gross). The intention is that this be offered as a market service."	Constrain to zero refers to the restriction of export from household solar PV and occurs when the market operator (AEMO) instructs the aggregator (Synergy) to restrict energy output from solar on the network. Zero export (net) allows self-

² Text for the official scenarios is sourced from Project Symphony. (no date). *Project Symphony Lessons Learnt Report 1* (Milestone 01). <https://arena.gov.au/knowledge-bank/project-symphony-lessons-learnt-report-1/>

³ Simplified description of testing scenarios is adapted from Synergy's FAQs sent to project participants. Synergy. (2023d). *Project Symphony FAQ*. Retrieved 11 January 2023 from <https://www.synergy.net.au/Global/Projects/symphonyinfo>

Testing Scenario	Technical description ²	Revised simple description ³
		consumption of solar generation, and zero output (gross), prevents any generation from household solar, and does not allow for self-consumption. Both net and gross are used in this testing scenario. There may be potential for participants to be remunerated to offer this service to the market in the future.
Essential System Services (contingency raise)	Essential System Services is a "market provided response to a locally detected frequency deviation to help restore frequency to an acceptable level in the case of a 'contingency event' such as the sudden loss of a large generator or load. An example of [contingency] raise is the discharge of rapid generation such as starting a fast response generator on the network to bring frequency back to an acceptable level."	This testing scenario utilises participants batteries to determine if this can be used to maintain the balance (frequency control) on the electricity network in the case of unplanned outages, for example in response to the loss of a larger generator.

Project Symphony is one of several large, technically focused pilots active in Australia seeking to understand how to solve grid problems at scale and in real time on the power system. It is testing solutions in a way that is particular to the WA context, and it is considered a large and complex project in Australia. Householders with DER are a fundamental part of the Symphony pilot solution. Their involvement, via their assets supports system security and their input is crucial to consider in the wider implementation of VPPs. The participants who were part of this pilot (and discussed in this report) consented via a contract with Synergy as their retailer (and the aggregator) to participate in the pilot (by connecting specific assets in their homes).

The Project Symphony pilot had a target of connecting 900 assets across the pilot, which was reached at the time of writing this report. The term 'assets' is used interchangeably with household DER in this report, and refers to household solar PV, home battery systems, air conditioning units and heat pump hot water systems. Some participants have several assets connected, for example solar PV, battery and air conditioner, whereas other participants may only have one or two assets connected. The pilot also includes two commercial network battery energy storage system (BESS) installed at the City of Armadale Fitness and Aquatic Centre, and in Harrisdale. Although the 900 assets connected includes those managed by other aggregators, this report only examines household participants who are Synergy customers, and not customers who are participating with other aggregators. Participants with other aggregators were recruited after this social research was well underway which made it difficult to integrate their customers into the social research permissions-wise and methodologically.

3 The social research, its aims and guiding questions

This social research is a component of the overall Project Symphony pilot and engaged with participants to understand their responses to various aspects of pilot orchestration solutions. This customer stream of investigation was originally to "explore the residential and commercial customer preferences regarding DER, including willingness to engage, level of engagement, value drivers and the customer value proposition" (Alexander & Blaver, 2021, p. 21). These intentions remain, with the exception that the social research conducted and discussed in this report includes only residential customers and not commercial customers. The focus on residential customers emerged as the pilot progressed through iterative stages (evolutions) in the technical design of the pilot, and sampling plans for the tests to be conducted.

The social research participants referred to in this research are energy consumers who are also customers of Synergy. Synergy customers participating in the pilot chose to take part in the pilot after considering invitations and contract details. In this report we refer to these pilot customers as participants. Further information about the research participants is described in Part B of the report, with section 7 outlining demographics.

The overall aim of the social research that was co-developed with Synergy, was to identify in-depth insights of participants (customer) responses to, and experiences of Project Symphony's technical solutions, systems, agreements and communications, their motivations and expectations and the implications of these findings. The research questions (RQs) were established in co-design meetings between UTAS and Synergy that were conducted before the pilot began, in 2021. Originally two further topics of research were considered for inclusion in the social research activity. These topics were to understand aggregators in the West Australian context, and to observe organisational learning and memory (i.e., processes and their shifts, decision making, embedding of knowledge and insights) as the pilot progressed. These topics were removed due to planning decisions, movement of Synergy staff, and a reduction of scope and budget of the social research. These topics are noted here as they are considered in recommendations at the conclusion of this report.

The social research was guided by the four research questions listed in table 2 below.

Table 2 Project Symphony research questions

RQ	Purpose of the question	Research Question (RQ) to be answered
1	To understand customer research findings from other VPP pilots	Regarding Australian VPP pilots, what are the key insights Synergy, Australian industry, government and academia have identified about customer responses to relevant new energy technologies? What knowledge gaps remain?
2a	To understand customer sentiment (including perceptions and values) and customer responses to Project Symphony.	How do small use residential customers, in different socio-economic situations and locations, view, value and respond to the Project Symphony pilot technologies, systems, product offerings and pricing?
2b	Investigating further detail of an element of 2a, 2b is to understand implications of	How did incentive types and incentive-related factors, particularly pricing and pricing communications, affect customer acceptance, use and engagement of Project

	pricing and incentives used in Project Symphony, to inform design of pricing and incentives for optimal deployment and use of VPPs in the South West Interconnected System (SWIS).	Symphony DER technologies and systems? Did customers perceive prices / incentives as fair? What factors affected these perceptions? What does this understanding tell us about wider deployment of the VPP technologies, systems and processes tested in Project Symphony?
3	To better understand the social equity implications of Project Symphony activity, particularly relating to mass market deployment and adoption.	What are the social equity implications for residential and small use commercial customers of Project Symphony VPP technologies, systems and pricing? How can understanding of these social equity implications inform larger scale roll-out of VPP's and DER aggregation?
4	To understand government policy implications that emerge during the social / customer research to inform energy policy settings, market design and regulatory reform that will enable optimal deployment and use of VPPs.	What aspects of policy do the findings from the above three RQs indicate need to be considered? What new or amended policies, market rules or regulations may be required, at what level and in which organisations, to address the findings and support successful and wider implementation of the VPP technologies, systems and processes tested in Project Symphony?

Responses to the research questions were generated through a variety of data collection and analysis methods, and they are in turn answered across a number of different sections in this report. Methods used to gather and analyse data to answer these questions are described in section 4 of this report, with further detail in Appendix 5. We found it logical to report findings in certain sections, which meant that answers to the research questions are spread throughout the report, however a summary of the responses to the research questions are provided in the executive summary. Responses to RQ1 are covered in the literature review (section 5). RQ2a and b are mainly answered in Parts B and C of the report (as experiences, responses and values), and through findings in other sections. RQ3 and RQ4 are answered in Part D of the report with the most direct answers in section 12 – implications for social equity, and section 14 – implications for policy.

Why explore customer experiences and responses in this pilot?

Of all the possible social research that could be captured, consumer reactions and experiences (including their motives) were identified as key data to capture. This is acknowledged in RQ2 a and b (Table 2 above). Participating customer findings are captured because they are known to be important during energy transitions as consumers play a critical role, especially when considering public good (and government related) energy systems, such as the SWIS. Therefore, consumer acceptance of technical innovation, such as is being tested in this pilot, is critical if the innovation is to be realised and scaled (Lovell, 2019; Patterson-Hann & Watson, 2021).

Consumer reactions to technological interventions may be affected by a range of potentially contradictory factors which can influence uptake. With regards to energy use, consumers may, for example, be motivated by possible cost savings due to energy use curtailment, but at the same be held back by perceptions of the high upfront cost of energy efficient technology (Cattaneo, 2019). Many factors can affect consumer responses in such complex situations as this and so quick or brief checks are not that useful and more in-depth understanding is required. Drivers and barriers to

consumer decision making may be internal (personal) or external (from the context or society) (Cattaneo, 2019; Grimmer et al., 2016). Internal factors could include attitudes, preferences, and orientations (Carrington et al., 2010). External factors could include the consumption environment, information availability, the weather, as well as the social environment (Belk, 1975; Cattaneo, 2019). Gillingham and Palmer (2014), found that when consumers lacked information on a technology's energy efficiency and potential savings, they invested less in that technology. The issue of risk is a further factor, which can be considered as both internal (the consumer's perception of risk) and external (the actual risk of the technology not working) (Schleich et al., 2016). These factors highlight the importance of the consumer perspective in studying the impact and success of technological interventions, and of ensuring multiple methods and capturing of data over time.

In-depth, longitudinal consumer focused social research on large technical energy system transition projects has been rare in the past but is now a growing field of research. There is gradual integration of social research into technical pilots underway in Australia (see the literature review in section 5). This social research therefore offered a relatively rare opportunity to conduct in-depth explorations during a large-scale, applied technical pilot, and to consider possible scaled responses of consumers. The pilot's social research allowed capture of participant perspectives over time, through repeated interaction/consultation with participants from pilot sign up, through installation, to orchestration. This longitudinal research approach facilitated the capture of more complete customer responses and insights, development of understanding of how participants might react to the scenarios tested in this pilot (or in similar VPP-style solutions) at scale, and identification of related social equity and policy issues and implications. In this context of emerging social understanding of VPPs, and future network management, Project Symphony social research provides the opportunity to generate nationally relevant, public good information about customer responses to important changes occurring to power systems across Australia and provides important comparative understanding for Western Australia to use in their own energy transition.

Alongside the inherent value of understanding consumer perspectives and reactions in the pilot, Project Symphony intended to build and test a system that would benefit electricity customers and to see how "renewables can benefit communities" (Synergy, 2021). That is, there is a greater good consideration here about a public good resource (the electrical system) and concerns about how it may affect customers and the community. Additionally, this focus on the benefit to consumers links to Synergy and Western Power being government owned entities, that are regulated by the Economic Regulation Authority. Being state owned and regulated ensures that benefits accrue to the state and for the people of WA more generally. As a result of government ownership, the relationship with consumers can be different to some other states in Australia where retailers and networks are for profit, commercial entities. Similarly, AEMO as a public company limited by guarantee, have their roles and functions prescribed under national and state frameworks and legislation, such as the National Electricity Law, the National Electricity Rules and the Wholesale Electricity Market Rules in WA (AEMO, 2022b).

4 Approach (methods)

This social research was an applied, multi-method, longitudinal study that investigated social phenomenon with the participants involved in the pilot. Our focus was on household participants that agreed to be part of the pilot, and then also agreed to be part of the social research (via an invitation). Social research methods were guided by the four research questions that are listed in table 2. The research used data collected over repeat contact with participants (longitudinal data), from interviews, surveys and focus groups as main sources of data, and it was also guided by contextual information about the pilot, and information from relevant literature.

We used a 'before and after' activity assessment approach. Data captured from participants before substantive involvement with the pilot assisted the social researchers to assess customer responses after involvement with critical activities of the pilot. The key activity in this case was orchestration of participants' assets. 'Before and after' research approaches are particularly useful in cases where control groups are unavailable, as was the case in this research. All data collection and interaction with participants was reviewed and approved by the Human Research Ethics Committee at UTAS. Participants of the social research were offered incentives to take part, and these are also described in Appendix 4.

This research was a collaborative endeavour between university-based researchers and Synergy. A customer researcher based at Synergy provided the majority of Synergy input into the research. Further support and information, referenced in this report as Synergy (personal communication) was provided by other Project Symphony staff at Synergy. Context and extra information were provided throughout the research as needed, and when asked for further clarification. Some project partner interviews were also conducted as part of the research and used where referenced in this report. Having a team of university (socio-technical) researchers collaborating with Synergy ensured that the appropriate specialist research skills, critical thinking, external perspectives, inside customer and technical context could all be factored into this applied research. During the report writing, additional reviews were led by the project management office (Western Power) and reviewed by Synergy and other project partners noted in the introduction. Collaborative processes influenced each step of the research, including the development of the research questions, data collection and analysis processes.

The main methods are described here in brief, with further description and detail in Appendix 5.

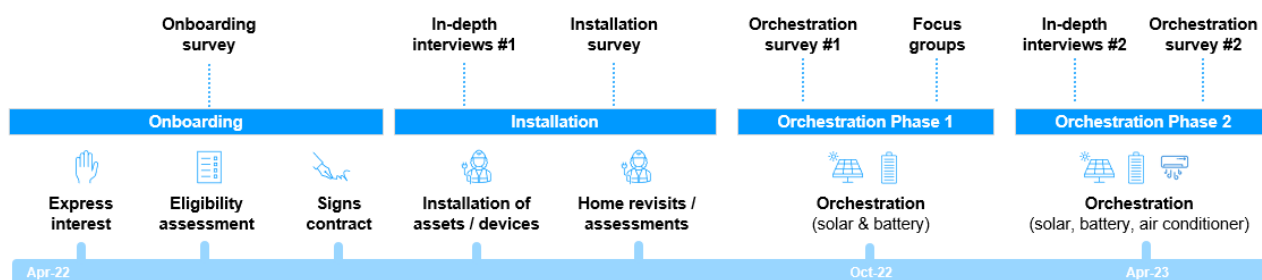
1. A **literature (document) review** was undertaken that included industry government and academic documents (section 5).
2. **Surveys:** multiple surveys were sent at different stages of the pilot (Refer to survey questions in Appendix 7). The first survey (onboarding survey) was sent to all pilot participants as they signed up to the pilot, before installation of technology, as they onboarded. Participants were sent this survey at different times as they became involved between March 2022 to March 2023. This survey had a response rate of 36% (125 responses). A second survey was sent after the installation of pilot technology at houses (installation survey). The installation survey had a response rate of 9% (31 responses). A phase one orchestration survey was sent in December 2022, and phase 2 orchestration survey was sent in May 2023. These had high response rates of 43% (110 responses) and 37% (128 responses) respectively. The surveys were structured, but with opportunities for free text inputs (qualitative answers). The surveys captured broad information about what was occurring for participants, allowed questions to be asked at appropriate times over the course of the pilot, and allowed researchers to cross-check the prevalence and occurrence of key issues raised in interviews. Survey responses were analysed using the Q research software. In analysing quantitative responses, descriptive statistics, cross-tabulations and significance testing were used where appropriate. Some qualitative exploration from free text responses was also used in the research.
3. **Interviews:** these were conducted when householders were recruited for the pilot and then again after the first phase of orchestration (just as the second phase of orchestration began). They were semi-structured, which means there were set questions, but participants were encouraged to spend time on points they wished to elaborate on. Householders were invited by UTAS to take part in initial interviews – called first interviews in this report - if they indicated an openness to being interviewed in the initial onboarding survey. The first interviews were undertaken via online virtual meetings with 33 Project Symphony participants. These occurred from April to November 2022 and captured experiences of

householders during the early stages of the pilot, with the majority of interviews timed so that participants were able to speak about the installation of pilot technology during the interviews. Interview participants from the first interviews were then invited to the second round of interviews - called second interviews in this report. All participants gave us permission to send out the second interview invitation and 27 follow up interviews were eventually held, after the first orchestration phase. These were undertaken in late March and early April 2023. The majority of these were face-to-face in participants' homes, with the remainder occurring online. All interview questions are listed in Appendix 8. The interviews with participants were recorded, transcribed and coded using NVivo, with all participants deidentified. The interview and focus group transcripts were coded using NVivo into a list of themes (codes) that occurred from the data (Appendices 1, 2 & 3). Further analysis was also undertaken on themes and content outside of NVivo using Excel and Word. Recurring themes and patterns then emerged from this analysis to form the basis of Part C – key thematic findings.

4. **Focus groups** were used to explore the issue of orchestration in depth. Due to the negative sentiment from the first orchestration survey, this indicated that a focus group would be useful. An expression of interest to attend focus groups was therefore sent out to all participants of the pilot. Due to high levels of interest, a group of participants was selected from those who expressed interest using random selection methods in Excel (Appendix 5). Four semi-structured, in-person focus groups were held in February 2023 in a hired room in a community centre in Southern River, a short distance from where participants lived. The focus groups were audio recorded, transcribed and coded (Appendix 3). The discussion guide for the focus groups is found in Appendix 9.
5. **Technology observations:** participants were asked to take photos of their installed assets and share them with us during the first round of interviews. Householders sent photos through where they felt comfortable, and could find the time, to do so. The majority of participants that we interviewed provided photos and were used as a prompt for discussion in our first interviews. Examples of photos are in the report (section 10). Photos of the pilot technology were also taken by participants of the social research during the second interviews. The social researchers attended participants homes, where householders were happy for photos to be taken of the technology in situ.

The interviews had a high participation rate against the quota, with 94% participation in the first interviews and 82% participation in the second interviews. Focus group participation against the quota was 83%. Surveys also had a reasonable participation rate with the highest participation of 43% at the orchestration phase 1 survey. Further information about participation rates for all surveys, interviews and focus groups can be found in Appendix 6. Further information about the timeline and sequence of the social research and data collection activities are described in figure 1 below.

Figure 1: Timeline and sequence of research activities



The timing of social research data collection was undertaken according to broader pilot report and contract submission deadlines. Due to this, the interviews were unable to capture much of the second phase of orchestration activities, but surveys were able to capture part of the second phase of testing with orchestration.⁴

5 Literature review - Social research in virtual power plants

This section reports on our findings in relation to RQ1, which asks: Regarding Australian VPP pilots, what are the key insights Synergy, Australian industry, government and academia have identified about customer responses to relevant new energy technologies? What knowledge gaps remain? These questions were devised to guide some background research and checks to ensure that the Project Symphony VPP social research was situated within, and aware of, a wider relevant body of research.

There were two parts to this literature review: one on international academic research, and one on Australian policy and industry research (so-called 'grey literature'). This section will first discuss the academic literature and secondly, the policy and industry research findings.

5.1 Academic literature review

We searched the international academic literature for research about VPPs with a consumer and social research focus. We focused on VPPs as that is the term used in Project Symphony, and the term within our RQ1 (see above). We found only ten peer reviewed journal papers that fitted our search criteria (Refer to Appendix 10 for the search method). The low volume of papers indicates either how little academic research there is about VPPs and consumers, or that academic researchers are using a different term to VPP when writing up their research. From our experience,

⁴ This report structures the discussion of our findings according to the themes that emerged, and not according to the type of data that was collected. Survey, interview and focus groups are all reported where useful in the findings, sometimes together and sometimes separately. The source of data is noted and referenced in the case of interview data.

we know that there are academics working in this field but that much specific work they are doing is in industry (grey literature) reports.

We note that significantly more literature was identified in our Australian grey literature (59 industry and policy research reports) compared with the academic literature review. This was not surprising to us as industry reports are published quickly compared with academic publications, and hence are in circulation well before academic research, which can experience significant lags not just in publication of research but also in applying for funding and building research teams.

The ten academic papers we reviewed are quite mixed in terms of the topics they focus on, and the area of expertise of the authors. The majority are quite technical papers and use modelling and simulations, rather than being based on real-world social research data. The following summary points are noted:

- only half of the studies (5) included some form of social research data (Arslan & Karasan, 2013; Büscher & Sumpf, 2015; Gui & MacGill, 2018; Kahlen et al., 2018; Nicholls et al., 2019), and it was not the main focus of any of the studies
- all the studies were on VPPs (as per search criteria), but no homogeneity was found for either research techniques employed, or foci of analysis – there was a lot of variety and each study considered different approaches to both. The most common empirical focus was the role of electric vehicles (EV) in VPPs (covered in 2 of the papers) (Arslan & Karasan, 2013; Kahlen et al., 2018).
- The most popular country that the research was conducted in was Australia – the focus of three of the ten papers (Gui & MacGill, 2018; Nicholls et al., 2019; Wang et al., 2020), followed by California, USA (Arslan & Karasan, 2013; Gong et al., 2021), northern Europe (Kahlen et al., 2018; Ma et al., 2017), and Germany (Büscher & Sumpf, 2015).
- Although the majority (60%) of papers were about households as VPP participants (Arslan & Karasan, 2013; Büscher & Sumpf, 2015; Gong et al., 2021; Gui & MacGill, 2018; Nicholls et al., 2019; Schlund & German, 2019), only half of these papers reported details about the number of participants (Arslan & Karasan, 2013; Gong et al., 2021; Nicholls et al., 2019). This correlates with a more general lack of information regarding the age of participants, along with other details.
- Values and motives were discussed in seven of the ten studies (Büscher & Sumpf, 2015; Gui & MacGill, 2018; Kahlen et al., 2018; Ma et al., 2017; Morstyn et al., 2018; Nicholls et al., 2019; Wang et al., 2023). However, not all of these studies considered values beyond monetary or financial ones. See Büscher and Sumpf (2015); (Gui & MacGill, 2018; Ma et al., 2017; Morstyn et al., 2018) for examples of wider values being acknowledged.
- Trust, transparency, privacy, and legal factors were under reported – only half of the papers mentioned these important consumer issues, with (Büscher & Sumpf, 2015) focusing specifically on trust issues.
- Social equity was under reported; however, social fairness or equity was mentioned or discussed in half of the studies (Büscher & Sumpf, 2015; Gui & MacGill, 2018; Kahlen et al., 2018; Morstyn et al., 2018; Nicholls et al., 2019).

Discussion of the literature

VPP is a term orientated towards, and devised by, utilities: it is about services that help utilities manage the electricity network in the context of increasing decentralisation of assets. It is after all a term derived from conventional (physical) power plants, which have been operated by the electricity industry since its inception. However, some definitions of VPPs are more socially-orientated, for example, VPP as:

“...a coordinated aggregation of DER that can participate in energy markets and provide grid services as conventional power plants. A VPP aims to simultaneously integrate, both technically and commercially, small-scale DER, *bring great value to customers*, and provide flexibility to the system” (Wang et al., 2023, p. 2 emphasis added).

“The VPP (virtual power plant), a newly introduced aggregation unit, is responsible for load management and resource scheduling. It obtains energy from the DERs, and *contracts with the consumers* in order to supply energy to their PHEVs and residential loads. To this end, it creates economies of scale in a whole new way” (Arslan & Karasan, 2013, p. 26 emphasis added).

Although the above definitions could be considered more socially-orientated due to their acknowledgement of customers, none of the definitions consider how customers interact with VPPs, but instead refer abstractly to DER as “participating in energy markets” (Wang et al., 2020, p. 2) and that “it” referring to the VPP, “obtains energy from the DERs” (Arslan & Karasan, 2013, p. 116). The definition from Wang et al. (2020, p. 2) also broadly states that VPPs aim to “bring great value to customers”. However, the scenarios modelled in the research indicate that unless VPPs link together multiple markets, to achieve multiple revenue streams, then cost savings for customers are inadequate, particularly when considering the payback period of installing DER (Wang et al., 2020, p. 15).

The literature review provides reference to several papers which have looked at value from the perspective of the network operator managing uncertainty, increasing flexibility, maximising profit for operators of VPPs, and as a hedging strategy for retailers to manage wholesale pricing volatility on the National Electricity Market (NEM) (Wang et al., 2020, p. 3). The notion of value relates to the system operator gaining value from customers changing the times they use energy. For example, the paper by Wang et al. (2020) discusses value in the context of customers participating in demand response programs and responding to price signals to manage peaks in demand for the system operator (Wang et al., 2020, p. 3). However, there is some evidence to suggest that customers don't always respond to price signals and that pricing incentives, such as time of use tariffs, may in fact be regressive, particularly for low-income consumers (Burns & Mountain, 2021).

As discussed by Say and John (2021, p. 6), financial value for customers with solar PV and battery systems is likely to include the value of self-supply and the value of excess generation to the grid. This value varies according to the feed in tariff price, or the distributed energy buyback scheme (DEBS). Lower feed in tariffs incentivise self-supply (Say & John, 2021, p. 6), which is the case for all solar PV participants involved with Project Symphony who are currently on the DEBS in Perth with a significantly lower export price for solar generation in off peak periods (i.e., during the day when most solar PV is generated) (Synergy, 2022).

Another definition of VPPs centred on communities and not networks, is the concept of a community VPP (cVPP) van Summeren et al. (2020). This paper was sourced outside the search parameters of this literature review but is included here in discussion because of its close ties to our research. Unlike previous definitions, the idea of a cVPP includes a “network of people” (van Summeren et al., 2020, p. 6) performing roles in relation to the energy system, thus placing people centrally within the VPP, not as an abstraction to meet system operator goals. The authors define a VPP as:

“A portfolio of DER aggregated and coordinated by an ICT-based control system, adopted by a (place- and/or interest- based) network of people who collectively perform a certain role in the energy system. What makes it community based is not only the involvement of a community, but also the community-logic under which it operates” (van Summeren et al., 2020, p. 6).

The values and motivations of people involved in community energy projects is discussed by van Summeren et al. (2020), based on a review of the literature on community energy. It is concluded that values and motivations are diverse and fall under five categories: financial, institutional, environmental, technical, and social. Examples of motivations include reducing energy costs,

supporting renewable energy, reducing emissions, energy independence and community building (van Summeren et al., 2020, p. 4). Another motivation noted was linking the scale of energy projects to the community's own energy demand, which enables control over siting of commercial renewable energy projects in the local environment (van Summeren et al., 2020, p. 4).

5.2 Industry and policy (grey) literature review

This section will briefly discuss some key industry reports of relevance to Project Symphony. This industry literature review assisted answering RQ1, which sought to understand customer responses from other VPP pilots in the literature. Many of the industry reports contained some customer research, which was what we were looking for, but these findings were limited and mostly used secondary sources of data from other reports, and statistics or surveys at best.

As Project Symphony is significantly larger than many other trials and pilots, and is uniquely complex, we are not seeking to make direct comparisons with other projects. Synergy indicated that they did consider other trials and pilots; however, we note that some negative customer responses in Project Symphony were similar to lessons learnt from other projects, particularly the VPP in South Australia.⁵ While useful indicators could not directly be applied, we report findings here as customer responses found in industry reports, do align with responses from participants of this pilot and therefore are likely to be helpful during post pilot activity as scaling is considered and designed.

Structured steps were devised for the grey literature review, but this soon became problematic because the literature was difficult to find. From the search strategy, 110 grey literature reports and papers were uploaded into Covidence, a software program for systematic reviews. These reports were screened, with 51 reports excluded for various reasons including limited relevance to household VPPs, and because they had no social research (see Appendix 11). The remaining 59 reports were analysed for their social research learnings and a full list of these reports can be found in Appendix 12. Further relevant reports were added to the literature review, as the search strategy initially produced reports between 2018 to 2021 (when the grey literature was first searched) and other trials with relevant learnings were published up to 2023. A point to take away from our difficulty sourcing this literature is that it also would be very hard for industry to find available customer insights in grey literature.

Findings from the industry reports spoke to the experimental nature of trials and pilots, and that there were unknowns and gaps that were identified as the trials and pilots progressed. This was certainly the context for staff working on Project Symphony as well. We have chosen key lessons from the industry reports that aligned with the findings we were seeing from the social research for Project Symphony.

AGL produced several milestone reports on the VPP in SA and this provided useful context. AGLs first milestone report highlighted that customers lacked understanding of how cost savings were to be realised through participation in the AGL VPP. Conversations with customers of the VPP in the initial stages, showed that they wanted to have back up power in the event of an outage and AGL advised that battery back-up was not provided by default. However, the report notes that customers were willing to pay the extra \$899 to have this functionality (AGL, 2017, p. 14). Findings from

⁵ The social researchers understand that Synergy communicated with other retailers such as AGL on the VPP in SA. The 5MW VPP in SA, although less complex, had several key learnings and customer responses that are of relevance for Project Symphony.

interviews with participants of this research about their expectations for battery back-up are discussed in section 11.2.1.

In the final milestone report for the SA VPP, AGL (2020, p. 55) discuss bill impacts of orchestration and how they are inherently complex, and that there is a need for visibility for the customers affected by these bill impacts. The report also states that the value of orchestration should be shared with customers (AGL, 2020, p. 67). AGL conclude that to enable trust in VPPs the energy needs of customers should be met first, rather than that of the network or aggregator. This was a key learning in the SA VPP trial and is also discussed in this social research report with the first phase of orchestration that occurred in sections 11.3 and 11.4.

Another report that was found through the search strategy was the Demand Response Short Notice Reliability and Emergency Reserve Trader (RERT) Trial Year 2 Report (Australian Renewable Energy Agency, 2019). This report contained learnings on the use of air conditioner for direct load control. The report notes that, “during installations it was found that many AS4755 – compatible models required additional hardware, which significantly increased the cost and complexity of the installations” (Australian Renewable Energy Agency, 2019, p. 15). The result of the complexity and additional hardware for AS4755 air conditioners, meant that AGL found only 45 homes had compatible air conditioners, out of 123 households that expressed interest (Australian Renewable Energy Agency, 2019, p. 15). That there are problems nationally provides context for the difficulties Project Symphony had with both the AS4755 demand response and the infrared control for air conditioners.

The RERT trial report also stated that due to AS4755 compatible air conditioners not providing override or opt out functionality for customers, AGL provided a day ahead notification and email address for participants to opt out of orchestration events. AGL concluded that the use of air conditioning in the trial was “complex, time consuming and costly” and that the “existing system did not provide any feedback on the completion or success of transmitting an operating command” (Australian Renewable Energy Agency, 2019, p. 15). This finding is relevant context in light of lessons learnt reports from Project Symphony partners.

The Australian Energy Market Operator’s (AEMO) fourth knowledge sharing report on VPP demonstrations on the NEM discussed how customer experiences with VPPs can be improved through the following:

- Considering customers’ existing knowledge about DER and the grid
- Keeping customers informed through regular updates (apps and easy to understand information and statistics), and
- Translating how being part of a VPP has contributed to reducing customers electricity costs (AEMO, 2021, pp. 51-52).

AEMO (2021, p. 55) also state that it was not a requirement for VPP providers to provide an app for customers. However, for those customers that had access to an app, which enabled visibility of energy flow between the battery, the panels and the grid, reported higher satisfaction and retention. The report concludes that key processes should be standardised across VPPs, so customers know what to expect, with the main points being: transparency, consistency of language, a dedicated contact channel and complaints process and providing information to customers about how they are financially better off by joining a VPP (AEMO, 2021, p. 55). These findings align with results from Project Symphony and are discussed in sections 8, 9 and 11.

Project EDGE, although a later project that was happening concurrently with Project Symphony also found that strategies to give customers reassurance around the control of their devices was important to build trust. This included information on when and how much energy is exported as well as notifications for when their devices are being used. Project EDGE also discussed how a clear

value proposition needs to be communicated to customers, otherwise they are unlikely to perceive a benefit from participating in a VPP (AEMO, 2022c, p. 4).

In conclusion, there is:

- Trackable information on customers responses in publicly available reports from other trials
- Customer responses reported but they are often buried within technical reports,
- Key issues raised by participants in Project Symphony were similar to issues in previous and concurrent projects.

That the issues discussed here align across different projects, which are all relatively unique, means that there is significance at a national level to incorporate these learnings for future projects. The findings from this industry literature review of research being buried in technical reports appears to be an issue with the dissemination and sharing of the results of VPP pilots. The Distributed Energy Integration Program (DEIP) was set up by ARENA in 2018 and is a collaborative program with the intention to share insights across government agencies, market authorities, the industry, and consumer organisations (ARENA, 2023). The DEIP includes working groups with broader membership, and DEIP dive workshops that are open to a range of stakeholders, with publications from the DEIP available on the ARENA website. Disseminating reports and presentations through the ARENA website may not be sufficient to effectively disseminate customer learnings. Therefore, there may be scope for more stand-alone social research reports, or the collation of existing social and customer research to effectively disseminate this knowledge to the broader industry and public.

In relation to how social research was covered in the grey literature, we found that many of the pilots and trials conducted were limited in terms of primary data and interview data collection, but several trials included surveys. Surveys, although helpful to understand largely quantitative data, have some limitations as they are not useful as a single method to understand the full customer experience. Following in this report multiple primary data sources, including interviews, surveys and focus groups, are used to provide a more comprehensive picture of customer responses.

Refer to Appendix 10 for further details on literature review search methods.

Part B. Pilot journey for participants, early responses, and demographics

Sections six and seven below introduce the participants and provide key points about the key phases of the pilot for participants. The journey for participants, and some key early information provided by Synergy is noted in section 6 to contextualise the early experience for participants. Some findings from the onboarding and sentiment surveys are also presented here, as participants moved through the key phases of the pilot (figure 2). The participants who were involved in the research are introduced in section 7 by providing demographic information from the onboarding survey, with a broader comparison across the WA population. Participants importance rankings and motivations for reducing energy use in their home is also presented here from the onboarding survey in section 7.2, with further information on changes to electricity use with orchestration provided in section 9.3.

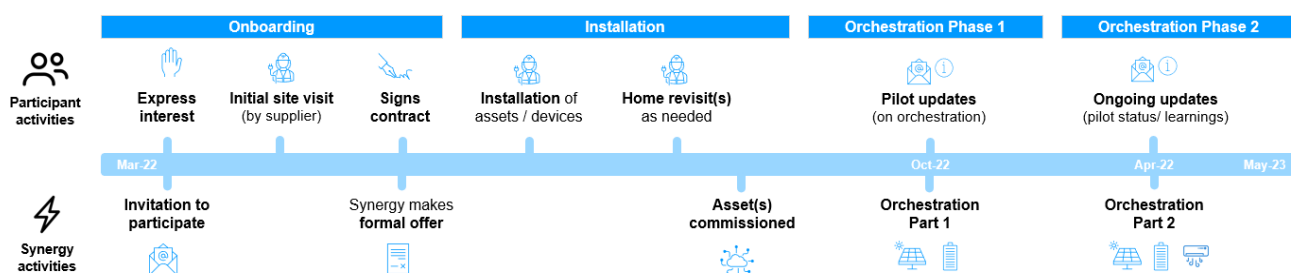
To support the reporting of findings for our research, we first detail information about the journey participants experienced and map some broad findings about their responses to this journey.

6 Participant journey

6.1 Overview of participant journey

There were four key phases within the participant journey – onboarding, installation, orchestration phase 1 and orchestration phase 2. These are depicted in figure 2 below with some further detail of activities of each phase also listed.

Figure 2: Key phases of participants' journey



The recruitment process for Project Symphony occurred concurrently with the iterative design of the platform, which meant that participants started their journey at different times, as they were recruited and as contracts were signed. Household participants therefore did not have the same length of experience. For example, one household's onboarding experience may have occurred at the same time as another household's installation. Indeed, installations were occurring for some of the later recruited participants as the first phase of orchestration was occurring.

Each participant's journey also differed according to the types of assets they had, what they were having newly installed for the pilot, and whether any technical challenges occurred. There was generally greater participant involvement in terms of time and effort when there were new assets installed (such as home battery, air conditioner and hot water systems). Timings between the

phases also varied depending on the installers' capacity to meet the targeted installs at the time and hardware availability.

- **Onboarding phase:** During this phase participants were invited to express their interest, followed by an initial assessment of their home to determine suitability for the pilot. If the houses met relevant requirements Synergy, as the aggregator, made an offer tailored to the household. If householders were satisfied with the offer and were happy to proceed, Synergy provided a legal contract for signing. Participants were offered financial incentives (figure 3) for signing up existing assets (solar PV or air conditioner). Pool pumps were initially considered with the pilot but were not pursued due to technical difficulties connecting these assets. Some participants were offered subsidised assets that included home battery and heat pump hot water systems. Subsidies for new air conditioners were offered at a later date and were mostly offered to participants who had already signed up other assets to the pilot.
- **Installation phase:** During this phase, orchestration devices and other relevant assets (such as home batteries) were installed. Additional installation and wiring work was often needed for participants with more assets. Once installed, Synergy connected each physical device to the orchestration software to ensure it could be remotely controlled. This step also determined when participants received their incentive payments for signing up their existing solar PV or air conditioner (figure 3). These incentive payments were applied as credits on participants' electricity bill, with the annual amount (\$150) spread across each bill.

Orchestration Part 1: The first round of orchestration started in late October 2022 and was a time of testing, to prepare for the second phase of orchestration. Only solar PV and batteries were orchestrated in this phase and VPP optimisation capability was nascent. Assets were described by Synergy as being "heavily orchestrated" in this period in terms of frequency and intensity. On average, assets were orchestrated for 9.7 hours per day, which is around seven times more than the second phase of orchestration (Synergy 2023).⁶

- **Orchestration Part 2:** The second round of orchestration started in April 2023, and household solar, battery and air conditioners were all orchestrated at this time, and VPP optimisation capability was further developed. Orchestration activities were less frequent and intense compared to the previous phase, with assets orchestrated for 1.4 hours per day on average (Synergy 2023).⁷

The majority of participants who were interviewed through the social research, and who attended the focus groups had a battery asset as shown in table 3 below. There were 81% of participants with a battery from the first interviews, and 75% of participants with a battery in the focus groups. The first orchestration survey also included a high proportion of participants with battery assets (72%), which likely indicates their concern with orchestration at this time. The second orchestration survey included 52% of participants with a battery.

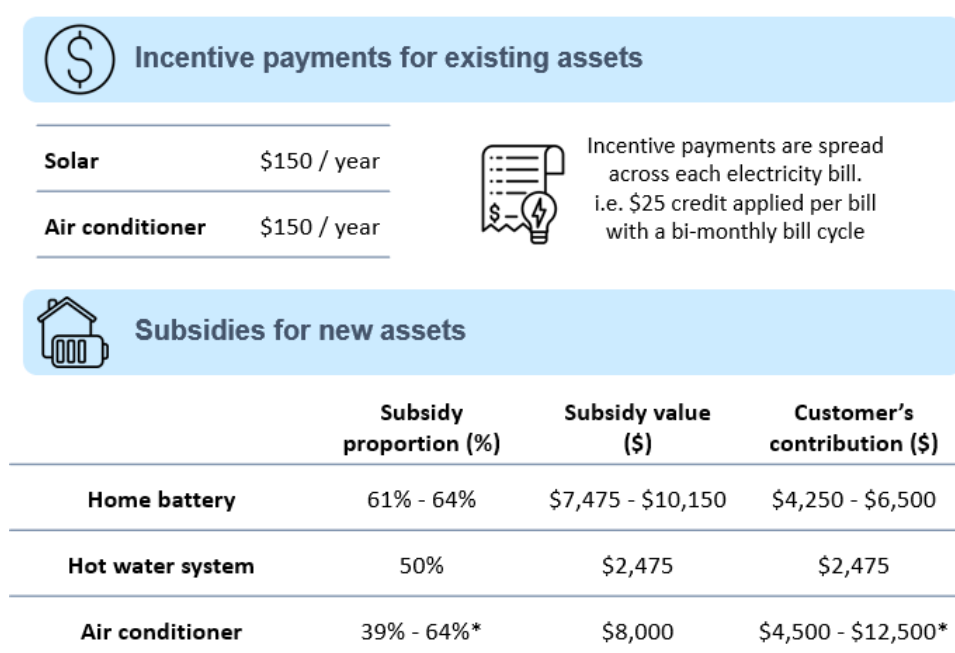
⁶ A compensation payment was provided to participants with solar and those without a battery subsidy. This payment is referred to throughout this report as orchestration payments and was an ongoing payment throughout orchestration phases 1 and 2 (figure 4).

⁷ The time period used to calculate average orchestration duration for Phase 2 is 1 April 2023 to 30 May 2023. An earlier end date is used due to timing for this report.

Table 3 Overview of research participation by asset type

Research activity	Proportion of participants with battery	Proportion of participants without battery	Total number of research participants
In-depth interviews (first interviews)	81% (n=27)	19% (n=6)	33
Focus groups	75% (n=25)	25% (n=8)	33
Onboarding Survey	44% (n=53)	56% (n=67)	120
Orchestration Part 1 Survey	72% (n=79)	28% (n=31)	110
Orchestration Part 2 Survey	52% (n=67)	48% (n=61)	128


Figures 3 and 4 below provide a description of the financial incentives, subsidies and payments offered as part of the pilot, which differed for each participant depending on what assets were connected. The orchestration payments (figure 4) were provided to offset any potential bill impacts that may occur due to orchestration. It is noted here that the financial incentives (mainly asset subsidy amounts) were quite large and were intended to maximise the participation rate in lieu of uncertainty about the financial impacts of the pilot. There were also time constraints with the pilot and a need to recruit participants from a relatively small metropolitan area of Perth. The subsidy value offered as part of Project Symphony, is unlikely to reflect what would be offered in any future VPP projects that are operating on the market (Synergy, June, 2023 personal communication).

Figure 3: Financial incentives offered as part of pilot

Notes about financial incentives:

- (i) All dollar figures above are inclusive of GST and do not include any extra non-standard costs which may have been incurred by participants.
- (ii) For home batteries, the subsidy amount and customer contribution differed depending on the individual battery size (comprising small, medium and large).
- (iii) Incentive payments were applied as pro-rata credits on participants bills across the period of the pilot.
- (iv) *Estimates only as participants can choose their air conditioner system size.
Additional subsidies were offered on an ad hoc basis to select participants. These included solar PV inverter (\$2,250 subsidy value + \$500 customer contribution) and a hybrid inverter, plus battery (\$9,450 subsidy value + \$5,500 customer contribution).

Figure 4: Orchestration payments

<div>  Orchestration payment* (Solar participants without battery subsidy) </div>			
Solar system size	Daily payment (\$)	Monthly amount (\$)	Annual amount (\$)
2 kw	\$0.85	\$26	\$310
3 kw	\$1.27	\$39	\$464
4 kw	\$1.68	\$51	\$613
5 kw	\$2.12	\$64	\$774

Notes about orchestration payment:

- (I) Based on estimate of 4.4 hours of orchestration per day
- (II) Orchestration payments began two months after the first phase of orchestration and were implemented to mitigate potential bill impacts from orchestration.
- (III) The monthly payment may differ depending on the number of days per month.
- (IV) Payments are in the form of credits applied to participants' electricity bill.

6.2 Responses from participants based on the participant journey

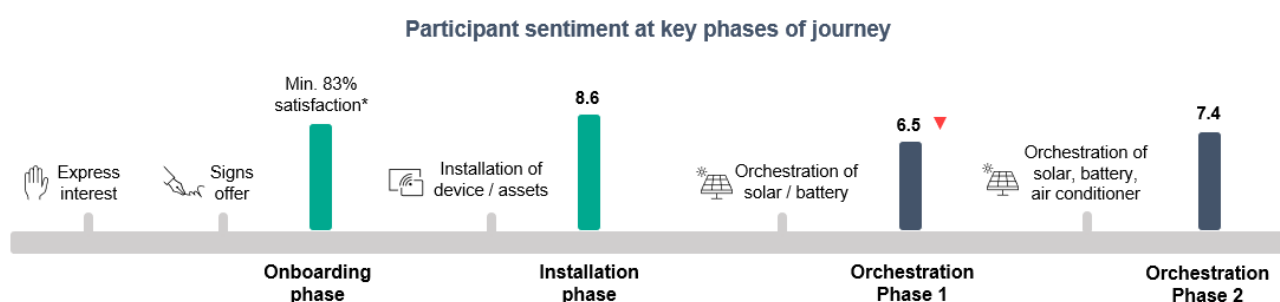
Overall trends in participant responses are described here according to the participant journey described above. Sentiment was checked throughout the pilot from surveys. There were high levels of positive sentiment during the initial phases of the pilot (onboarding and installation). This satisfaction appears to mainly have been driven by the ease of the process, the quality of the installation and the professionalism of installers. Negative sentiment was evident in the first phase of orchestration, due to various factors such as confusion about what orchestration was, lack of communication or notifications about orchestration, and concerns about the potential impact to participants' electricity bill.

Synergy have indicated that there were technical difficulties with providing notifications at this time, due to the scenarios that were tested, particularly, the energy services (balancing market) scenario (table 1), which in the first phase of testing sought to understand the potential for WEM participation

as a scheduled generator as discussed in section 9.1. So, while Synergy was aware that notifications in certain forms could be useful, there were barriers to them being able to communicate with more particular notifications.

Concerns eased in the second phase of orchestration, largely due to the reduced frequency of orchestration, which as noted above reduced to 1.4 hours per day on average, in comparison to 9.7 hours per day in the first phase of orchestration. Participants also became more familiar with orchestration events as they received further contextual information about orchestration from Synergy. There was also a level of acceptance that orchestration is part of the pilot and they agreed to participate, with some participants reflecting and re-reading their contracts they signed. Figure 5 below depicts the variation of sentiment across the pilot experience.

Figure 5: Participant sentiment at key phases



6.2.1 Participant enthusiasm and a smooth onboarding experience

As noted above, sentiment was largely positive during the onboarding phase. Responses from surveys indicate that:

- The initial marketing and branding of the pilot (figure 6) appear to have worked well in attracting participants.
- Participants were mostly content with the expression of interest and sign-up process. Over 80% (101/122 total) were satisfied with the ease of process, communication throughout and information provided (figure 7).
- The length of process rated slightly lower (73%) than other aspects due to a combination of factors that included, delays in participants receiving a response to their expression of interest (EOI), because of manual processes at the initial phase of recruitment. There were also longer than expected timeframes from sign up to installation of assets due to supplier staff shortage (from the COVID-19 outbreak and only two vendors were contracted to perform installation for the pilot).
- The professionalism of electricians and technicians in performing the initial assessment at participants' homes was a key stand out. At least 81% (79/98 total) of participants were satisfied with key aspects of this experience that included, staff attitude, timing of visit, punctuality, provision of information and cleanliness of the area after the visit.

Figure 6: Extract of expression of interest email

A little of your energy could mean big things for WA

Now more than ever, Western Australians are taking a step forward to generate and store their own energy, by installing Distributed Energy Resources (DER) like rooftop solar and batteries. Your neighbourhood has embraced renewable energy in a big way, with over 50% of residents having rooftop solar on their homes and enjoying savings on their electricity costs and the greener benefits of solar.

Why should I participate?



Get financially rewarded^

You may receive financial incentives for connecting your existing DER assets, like your rooftop solar PV system, to the Project Symphony VPP.



New subsidised assets~

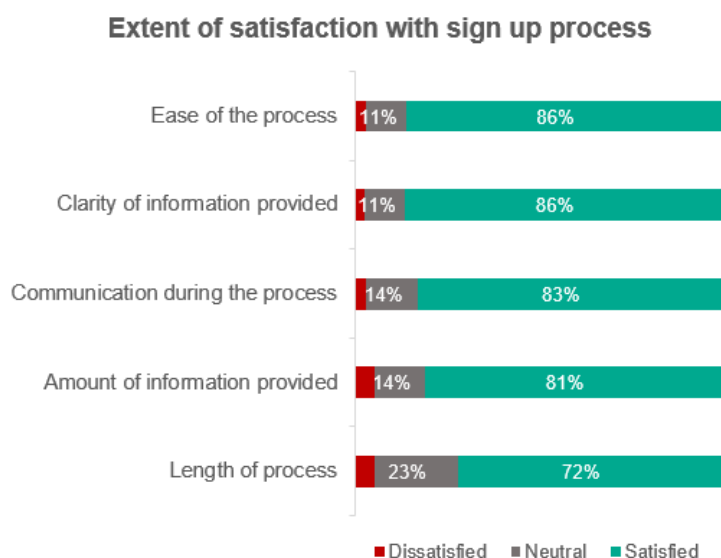
A limited number of heavily subsidised new assets such as batteries and hot water systems are being offered to selected pilot participants.



Be part of something bigger

Project Symphony will help pave the way for the future security of the network by potentially unlocking financial and environmental benefits for our customers and the wider community. By participating, you'll help shape the energy future for WA.

Figure 7: Satisfaction with sign up process



Source: Onboarding survey

Q: Thinking about the process for expressing your interest in the pilot and signing the contract with Synergy, how satisfied were you with the following aspects of the process? (n=122)

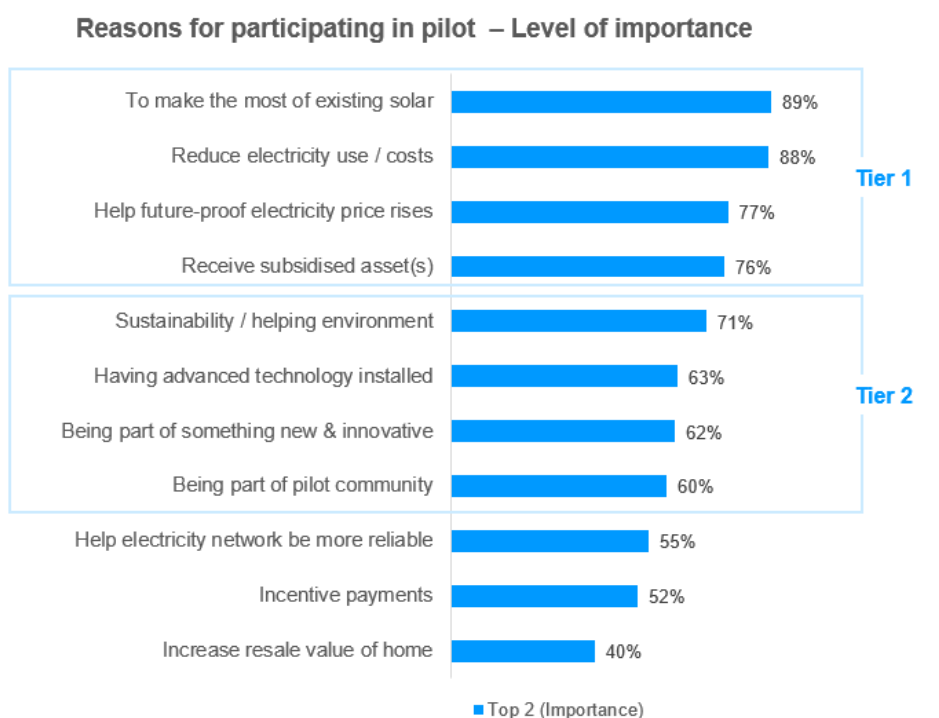
6.2.2 Key factors influencing decision to participate

Understanding motivations provided useful insights that may assist with ongoing participant engagement. This section briefly describes reasons for participating from the onboarding survey. Motivations to participate in the onboarding survey differed slightly to the interviews. This difference was influenced by the proportion of asset types represented in the onboarding survey versus the interviews (table 3); and how the questions were posed. Interviews had a higher proportion of battery participants who were motivated by the battery subsidy. Additionally, the surveys asked participants to rate the importance of predefined factors that influenced their decision to participate, whereas the interviews allowed people to state why they participated (Appendices 7 & 8). This is further examined in Section 11.1 participant motivations.

Within the Onboarding survey, participants were asked to rate the importance of 11 factors in their decision to participate (Figure 8). Results show that there are two tiers of importance.

- The first tier relates to individual household benefits, such as making the most of their solar, reducing electricity use and costs and receiving a subsidised asset (mainly battery). At least 76% of participants rated these as the most important factors for them.
- The ability to reduce electricity costs and maximising their solar generation were an even stronger motive among battery participants.
- The second tier is related to broader benefits, such as environmental sustainability and being part of a new and innovative pilot. Survey comments also indicated some participants were enthusiastic and excited about being part of the pilot.
- It is worth noting that the statement to "help [the] electricity network be more reliable" is one of the lowest rated reasons (with only 55% rating it as very / extremely important). In comparison, 71% were drawn to the pilot for environmental reasons.

Figure 8: Reasons for participating in pilot



Source: Onboarding Survey – Q: *How important were the following factors in your decision to participate in the Project Symphony pilot?* (n=93)

6.2.3 Quality installations but lacking participant consultation

Sentiment was reasonably positive during the installation phase. Responses from participants and the context these occurred in indicate that:

- Despite the time and effort required by participants in the installation phase, feedback about the overall experience was positive. Comments in surveys and interviews emphasised satisfaction with the quality of the installation work as well as professionalism of installers. (Section 10).
- Some participants expressed frustration with the lack of consultation and forewarning of the accompanying devices to be installed, where they would be located and how that section of their home would look like after the installation.
- Later surveys and interviews showed that participants were not always informed of the purpose of devices installed. In some instances, they were instructed to “not touch it” referring to the gateway device. This may have contributed to feelings of curiosity and for some, potential distrust about the devices.
- The lack of information about the equipment installed in homes also has implications for the pilot sentiment. For some participants, the large amount of accompanying equipment is seen as a downside of participating in the pilot as further discussed in section 10.

7 Introducing the participants

This section describes the pilot participants who were surveyed and interviewed as part of this social research. To introduce the participants, we discuss demographics, attitudes towards energy use and key factors for them to take part in Project Symphony. Descriptive and quantitative data is discussed here, as referenced. Demographics are included because understanding these are important before reading further findings. Social research generally needs to be understood with the characteristics of the people who were involved.

Summary

- All Project Symphony participants are homeowners, most with solar PV.⁸
- Homes in the suburbs of the pilot program are relatively new homes (83% of homes are aged between 1 to 13 years).
- Participants are mostly in higher socio-economic groups and tertiary educated households.
- The pilot area was chosen based on constraints on the network in the areas chosen. The location therefore influenced the demographic characteristics of the householders involved.
- Household types differed somewhat with young families and couples making up the majority of participants.
- From the surveys, people who identify as male were the most engaged with the social research.
- Participants' decision to be involved in the pilot is driven by individual benefits of maximising solar, reducing energy costs and obtaining an asset subsidy; followed by broader environmental and community benefits.
- Differences between participants and the average Western Australian were identified through the surveys, and this comparison will be helpful to understand so that scaling can consider technical and social parameters together, if pilot activity is to be expanded to a broader public.

Further discussions about participant motivations from the interviews and focus groups is discussed in section 11 – value for participants.

7.1 Demographic profile of participants

Based on the Onboarding and Orchestration surveys, Project Symphony participants included several demographic groups in terms of life stage, gender, education, age groups (30 years and above), work status and household income brackets.

In this section, we focus on the dominant characteristics of participants. This helps provide context of who the participants involved in Project Symphony are and provides some context for section 12, social equity. The pilot project was chosen based on solar PV penetration and load profiles in the area, and not based on demographics. Further information about the questions asked in the demographics section can be found in the survey questions (Appendix 7).

The location of Project Symphony was determined based on electricity network issues within the suburbs identified in the introduction, and not on demographics. Some comparisons with the

⁸ All interview participants were solar households; however, the broader pilot may have included participants without solar PV.

broader Western Australian community are provided here, simply for consideration in future projects.

- Most pilot participants are mortgage holders in high income households with income stability.
- Just over half (73/144 base) have an annual household income of \$150,000 and above. In comparison, just 17% of the WA households have an income of \$150,000 and above.
- A smaller percentage of households (6%) earned less than \$50,000 per year and 6% earned between \$50,000 to \$75,000 (Figure 9).
- Pilot participants are more likely to have a steady income stream with 70% (123/ 174 base) of participants working full time.
- All of the participants are homeowners due to the pilot's participation criteria. The majority (79%) have a mortgage on their home as opposed owning it outright (Figure 10). In comparison, 69% of West Australians are homeowners. Of this group, 29% own their home outright and 40% are mortgage holders (ABS, 2021).

Most pilot participants are in university-educated households.

- 72% (128/176 base) of pilot participants are in households with the highest level of education (41% with a bachelor's degree and 31% with a postgraduate degree) (figure 9).
- As a reference, 24% of the WA population 15+ have a bachelor's degree or higher (ABS, 2021).

Most participants are couples and/or parent households with young children in newly developed suburbs.

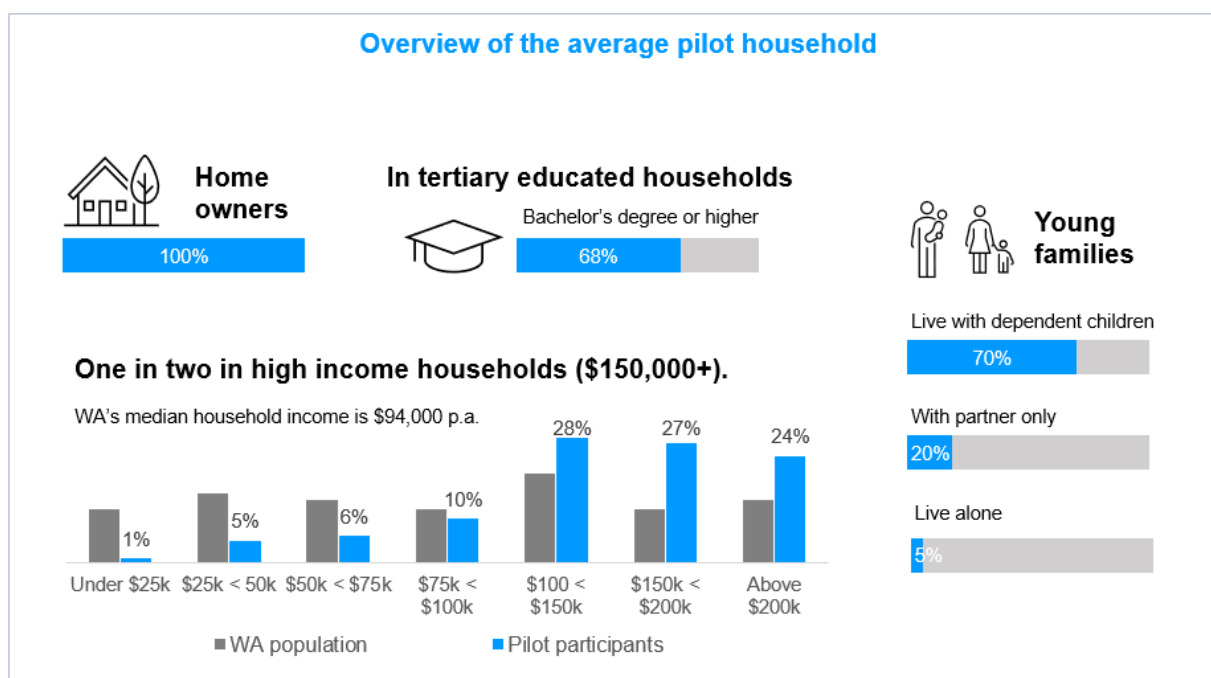
- The selected suburbs for the pilot (Southern River, Piara Waters and Harrisdale) consists of newer homes (10 years old on average, with 83% of homes aged between 1 to 13 years).
- A majority of participants (70%) are families with dependent children under 18 years old (123/ 176 base).
- Aligned with the 'young family' life-stage, two thirds of primary participants are aged 30 to 49 years old.

The majority of primary participants identified as male in the onboarding survey.

- The pilot was set up to have only one individual from the participating household receive relevant communications. The same individual is invited to partake in the research on behalf of the entire household - referred to here as the primary participant.
- Survey results showed that while 95% of participating households have two or more people, the majority of respondents to the surveys were male. That is, 68% (152/223 base) were males and 30% (68) of respondents are females⁹ (figure 10). This difference in gender ratio is considered statistically significant due to its robust sample of 223 participants answering the question, out of 360 total pilot participants.
- This skew towards males is also seen in other energy pilots. For example, of households interviewed as part of Project EDGE, 63% were males followed by an even split of females (19%) and joint, male and female (19%) interviewees (Australian Energy Market Operator, 2022).

⁹ Participants were asked how they identified themselves – female, male or non-binary.

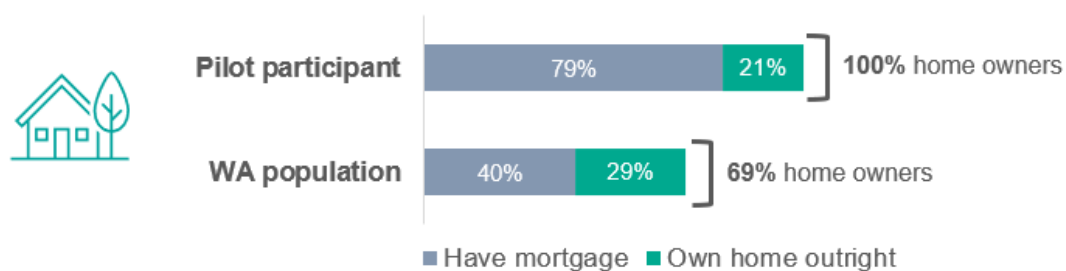
Figure 9: Participant household profile



Sources: Onboarding Survey, Orchestration survey, Western Australia Parliamentary Library (no date).

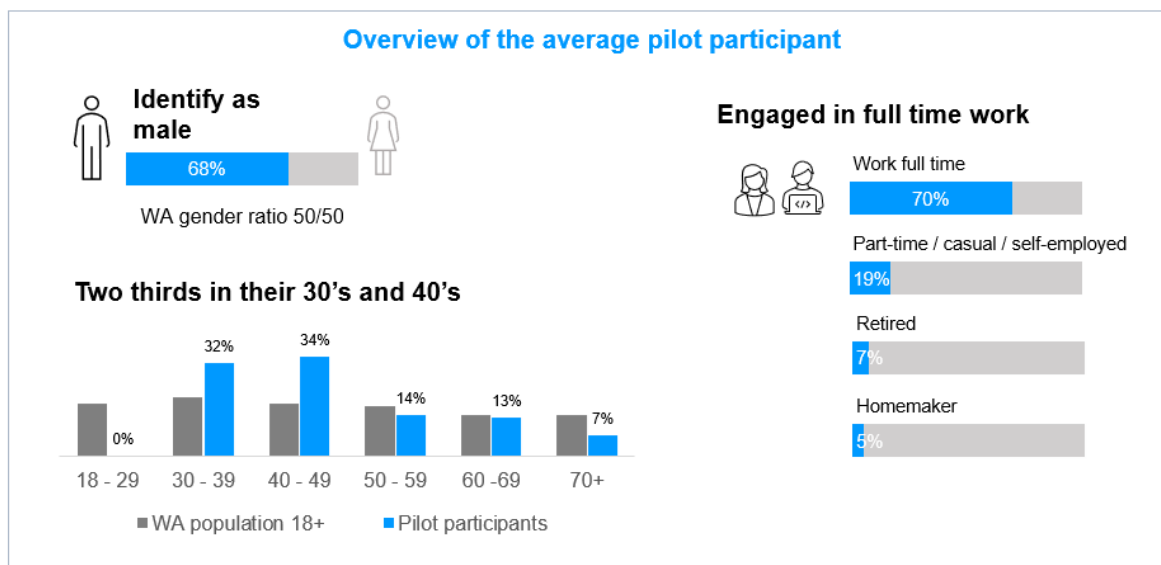
Figure 10: Home ownership profile

Home ownership: WA population vs pilot participants



Sources: Onboarding Survey, Orchestration survey, ABS 2021

Figure 11: Individual participant profile – Gender, age, work status



Sources: Onboarding Survey, Orchestration survey, ABS 2021

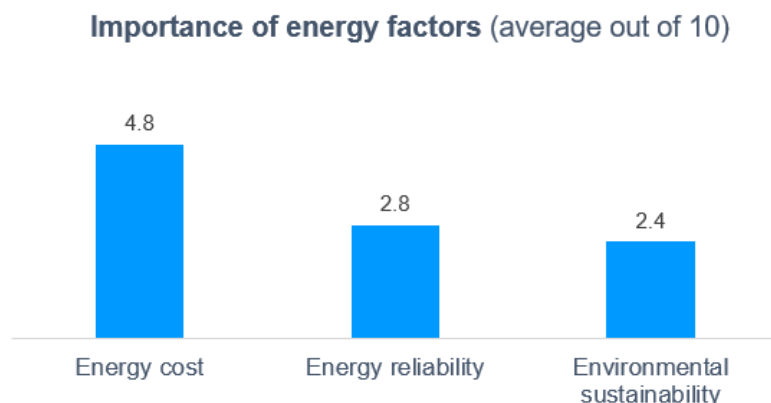
7.2 Importance rankings and motivations for reducing energy use

This section provides information on importance rankings from survey participants in relation to electricity costs, reliability, and sustainability. Participants motivations for reducing energy use in their home is also presented here from the onboarding survey. Synergy and Western Power clearly have a deep understanding of energy use of its customers from data that is sourced across multiple areas of their business (for example, through metering data), so we do not intend to provide information here that is known. However, further research on participants responses to their energy use with orchestration is new data, that is likely to be important for future projects to consider and is discussed in section 9.3.

Participants were asked in the onboarding survey about what is most important to them between cost of energy, reliability, and environmental sustainability (figure 11). The findings revealed that cost was by far the most important of the three. The SWIS is highly reliable with Western Power reporting a reliability rate of 99.91% (Western Power, 2022), and 98% of participants also rating the grid as reliable. Reliability is therefore a basic expectation for participants and is seen as less important compared to cost. One participant in the first interviews also reflected what most people expressed to us about reliability stating:

the reliability system is very, very good. I think it has to be 99.9% reliability and very rarely, we have any power outages. Now, in our little suburb here, because it's a relatively new suburb, it's all underground power. There's no power lines, except that where power comes into the suburb, you still got overhead power lines or high tension lead lines in that. So, they're doing things all the time to make it more reliable, but as far as I'm concerned, they are doing a great job (PI23, September, 2022).

Figure 12: Allocation of importance between energy cost, reliability and sustainability

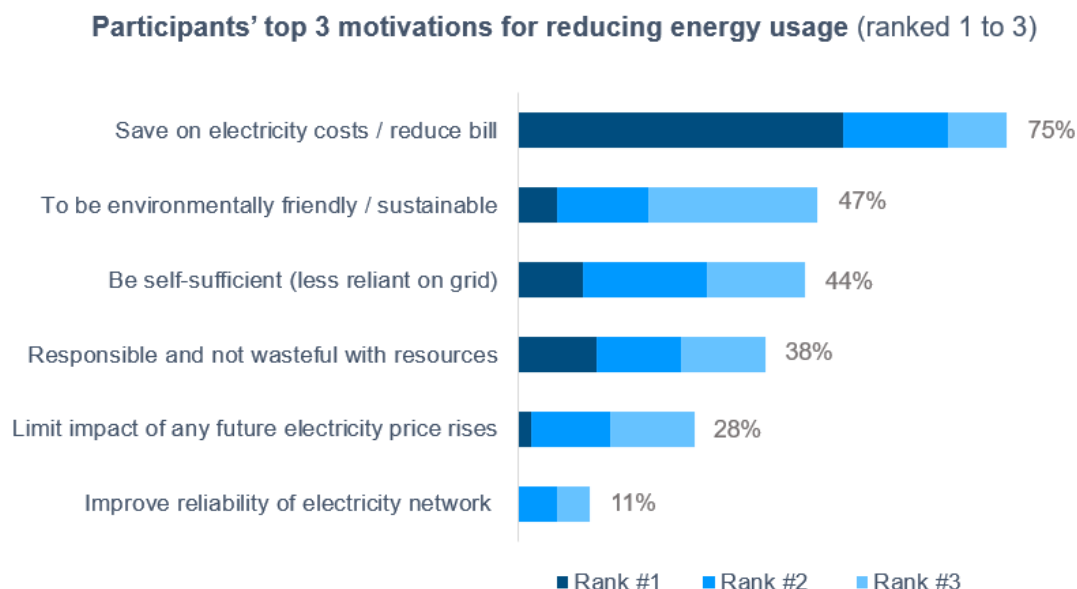


Source: Onboarding survey

Q: Imagine you had 10 points to distribute between these three factors. The more points you allocate to a factor, the more important it is to you. Enter the points you would allocate for each factor in the boxes below. (n=123)

Results from the Onboarding survey also indicated that over eight in ten (103/123 base) participants are interested in reducing their energy usage. This is again primarily driven by the desire to save on electricity costs, with 50% (63/126 base) ranking it as their number one reason and 75% ranking it as their top three (figure 12).

Figure 13: Participants' top 3 motivations for reducing energy use



Source: Onboarding Survey

Q: What motivates you to want to reduce your energy use? Please select the top 3 things that motivate you, where 1 is your main motivator (n=126)

Part C. Participant responses – key thematic findings

This section presents key thematic findings from participant responses. Numerous themes emerged from the interviews and focus groups in what is an extremely rich and informative data set of social responses. Data from the interview transcripts were coded into themes (Appendices 1, 2 and 3). These themes were further interrogated to determine recurring and dominant patterns and themes. This analysis formed the basis of the discussions outlined in Part C – key thematic findings. Due to an extensive list of coded themes and limited scope with timing for this social research report, we have selected the following key themes from our analysis. These are:

- Communication and engagement,
- Orchestration as intervention,
- Technology and systems and,
- Value for participants.

These themes were selected as they were clearly emphasised in participant responses across many of the coded themes.

8 Communication and engagement

Communication and engagement activities were mentioned repeatedly by participants as areas that were important and also that they thought needed further improvement. Communication and keeping participants engaged and updated throughout the pilot is a critical learning from Project Symphony. A range of responses were received about the communication and engagement provided by the pilot, through surveys, interviews and focus groups. This section presents results of the research as they relate to communication and engagement and contextual information from Synergy is provided where relevant.¹⁰

Summary

- A significant proportion of participants from the interviews and focus groups wanted more communication on the broader context of the project and what it was achieving.
- Most participants felt that orchestration was poorly communicated and was not well understood. This sentiment was heightened at the focus groups, when participants assets were heavily orchestrated in the first phase of orchestration (November 2022 to February 2023).
- Synergy communicated challenges to the social researchers in providing detailed information on orchestration to participants early in the pilot, due to the iterative nature of the pilot and the test and learn approach.
- Questions around how air conditioners were going to be controlled and whether they were actually connected was also frequently raised by participants who signed up to have their air conditioner connected.
- Time emerged as a theme in the research with the additional work that was required of participants to be part of the pilot. Participants were spending time trying to find information

¹⁰ It is acknowledged that information conveyed to participants is at times the outcome of a series of actions and decisions made by the project partners collectively.

themselves, through online technical forums, a Facebook group chat set up by a participant, and by reaching out to Synergy and the installers.

- Focus group participants provided suggestions for communication to be presented clearly, using less words, and with more graphic representations. Participants appreciated a video recording sent to participants after the focus groups with Andrew Blaver speaking about the scenarios tested as part of Project Symphony.
- Participants noted the improvement in overall communication (frequency, relevance, detail) later in the pilot.
- For a minority, there were questions and confusion about the connection of assets and which assets they had signed up to the pilot.
- There were challenges with getting support from the pilot team when issues arose – this was mainly during the initial phases. This support and knowing who to contact within Synergy improved later in the pilot.
- Based on observations at the focus groups and the participant-led creation of a Facebook group, participants appreciated a forum where they could gather and discuss their shared experiences.

8.1 Information provided to participants early in the pilot

Early information in any program provides a base on which participants and customers can form assessments and make decisions. This pilot was no different. Early pilot information consisted of invitations, expressions of interest and a detailed contract for participants to indicate their agreement to be part of the pilot. This was a challenging bundle of work for Synergy staff to compile as they were working with an emerging body of understanding and complex technologies and systems. Responses from participants to this early stage of information and communication were mixed and indicated where participants would have liked more support. Occurrences of complexity or lack of clear communication at this stage had impacts on participants understanding and responses at later stages of the pilot.

The initial stage of communications featured substantial paperwork, with fine print, and technical information that needed to be synthesised by participating householders. The initial interviews found that some participants felt overwhelmed by the amount of paperwork involved in signing up to the pilot. It was observed from the first interviews that not all participants were clear about the content and fine print of their contract with Synergy and found the paperwork difficult to understand (PI01, April, 2022; PI46, October, 2022). We know from interviews and later customer queries that not everyone read their contract in any detail before signing. This could indicate a form of trust at initial sign up. In the first interviews, we found that participants had a high level of trust in Synergy and Western Power as discussed in section 13.1 and the conclusion. Other reasons for not reading the contract in any detail could also simply be due to a lack of time to read large volumes of complex information.

Participants also expressed their need for additional information about the assets purchased, particularly the batteries, but also the hot water system and air conditioning units and how these will be controlled (PI01, April, 2022; PI10, July, 2022; PI22, November, 2022; PI26, July, 2022; PI49, September, 2022). Interviews with participants indicated that with the exception of a minor group of participants, the majority did not have the time or inclination to read each detail and fine print.

Participants were commonly not clear about what the pilot was doing and how their assets were specifically involved. This lack of clarity was seen in survey comments, interviews and in queries made to Synergy's customer service personnel. Participants were unclear about issues that spanned various areas, such as orchestration, technical information and payments to be made by participants for new assets. For example, in the first interviews, the social researchers became

aware that there was lack of awareness about orchestration being part of the pilot. Yet orchestration was stipulated in the pilot contract. The first phase of orchestration, and participants' own awareness that they were unclear prompted some to look into their agreement in more detail.

There was also a lack of clarity about what orchestration meant for participants and what they can expect of orchestration. It is noted that the clause in the contract (as well as communication about orchestration) was deliberately kept broad due to the uncertainties about exact orchestration events ahead of time. Figure 14 below provides an example of this clause in the contract.

Figure 14: Example of contract clause on orchestration of new assets

- g. subject to the terms in this agreement, You may use the New Assets during the Pilot Period;

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OFFICIAL

- h. during the Pilot Period:

- i. unless Synergy otherwise requires for the purposes of Project Symphony, You will have title to and be entitled to use all electricity stored in the Battery;

One interview participant mentioned "buried clauses" in the contract relating to the installation, stating:

...so the contract was reasonable, but there was one sentence that was kind of buried, and it was, "Please check with your installer to make sure that you will not incur any additional cost as part of the install." And again, because I understand power systems, I thought, that's a reasonable thing, because the installer can get here and they could say, "Oh, I'm sorry, but your solar panels don't meet the standard every day, you're going to have to pay extra." So, I got in contact with the installer, I had with them, and then got hold of a very nice person, and he said, "Yes, oh yeah, based on the information that we gathered from our visit to you all those months ago, you're going to have to pay the cost of the battery, such was the battery option, plus an extra one and a half thousand dollars installation cost (PI01, April, 2023).

It was noted by Synergy that non-standard costs were communicated to participants through the offer email, and again when agreeing to the contract. Customers were required to tick a box to indicate that they understood this requirement before the contract could be finalised. This is likely to further indicate that many participants did not fully read the contract provided, which points to some of the challenges for participants to read such a large volume of complex information, and also challenges for Synergy to provide a large volume of information in a way that is digestible.

Participants in the first interviews indicated that information on the products was lacking and discussed how they found information about the products through Google and the installer (PI46,

October, 2022). One participant also wanted further information about the context of why certain units were chosen over others, with one participant stating, "so if anything just about the units, why they have chosen that unit over anything else might have been a little bit interesting" (PI26, July, 2022).

Survey comments also indicated there was desire for upfront information about the new assets such as product warranty and technical specifications, with one survey respondent stating; "I found tech details lacking, particularly around air-con[d] and hot water systems...would've been good to have info at early stages to assist in making a decision quicker." This lack of information upfront often resulted in back-and-forth with Synergy and installers and a longer sign-up process for participants.

Feedback from the pilot team suggests that there was an inability to provide certain information early in the pilot. This was in part due to time constraints and different stages of the pilot occurring in parallel, as well as risks in explaining testing that may or may not occur. The recruitment of participants also occurred while decisions about technology and orchestration were still being finalised. This meant that there was no specific information available about orchestration. There was also a hesitation to provide information that might be inaccurate at a later date, leading to a decision to not communicate it.

8.2 Updates and support across the pilot

Pilot queries and obtaining support

In the second interviews, participants were still seeking further information, but they were also more aware of the information they needed and the gaps in information they were seeking. For example, several participants stated that when trying to follow up information with Synergy, there was no point of contact they could call to discuss issues. The information sheet for the social research interviews included an email address that went to the Project Symphony team, but some participants had a preference for making a call, rather than sending an email. Many participants the social researchers spoke with could not recall where the email address was located on their paperwork. However, a Project Symphony email address was provided in all pilot communications from Synergy, and this email address was also listed on the information sheet provided by the social researchers for the interviews.

Interviews as well as feedback from Synergy's customer experience survey show challenges with getting through to the relevant team when participants rang Synergy's general helpline. There was a lack of awareness amongst call centre staff about Project Symphony, but this did improve later in the pilot. This is further illustrated in a comment from an interview participant:

It's just finding someone within Synergy who has the knowledge around Project Symphony is quite painful. When you go through the frontline call centre, nine times out of ten, they're not really aware of what Project Symphony is and I have to give them a bit of a debrief and I can be referred through. But again, it's not seamless and I would've anticipated that the call centre would at least know who to direct me through to. It's one of those ones - I can do it but I've got to find half-an-hour to an hour of my life to make that phone call like the bank (PI03, March, 2023)

When participants did get through to the project team, they usually spoke with the same staff member, of which all interview and focus group participants spoke highly of. This was also mentioned in the surveys.

Participants also expressed confusion about who they needed to talk with for technical issues that arose, questioning whether it was Synergy or the installer they needed to contact. Concerns with the

first phase of orchestration and attempts to work out what was going on heightened participants' anxiety about trying to find the right person to speak with. As stated by one participant:

I did call up - I tell you, it's a really convoluted process to try and get a hold of anyone to speak to, and they said, "We just do these random tests where we have –" they control the solar panels and I hadn't realised. Again, it's probably remiss of me not to have read the full terms and conditions, but they essentially control your assets, and to make a long story short, you can see from here, it just dropped off. Bright sunny day, the solar panels were turned off (PI30, March, 2023).

There was a noticeable improvement in participants' ability to get help as the pilot progressed. Several factors contributed to this:

- The first orchestration survey included a question on whether participants would like to be contacted by a team member to resolve any outstanding issues. Of those who responded to this question in the survey, 36% requested to be contacted. This high request for further information reflected the need for further information. By Synergy's account, the requests were handled well by the pilot's customer service personnel, which appeared to play a role in easing of negative sentiment.
- In response to the orchestration survey and focus group, later communication to participants emphasised and promoted key contact points. This included an online contact request form, and an internal process of centralising participant requests with dedicated staff triaging these.
- Once participants were in contact with a customer support person, it assisted in getting help the next time, as there was a known contact person within Synergy. Furthermore, with the same personnel managing enquiries, there is knowledge retention and familiarity of each participant's background and history which contributed to a more positive experience.

Throughout the pilot, the Synergy team monitored feedback from participants and responded to requests for further information. Some key activities and changes to the communication approach during the pilot are noted here.

Desire for updates on pilot status and outcomes

Based on text responses in the first orchestration survey, there was a recurrence of responses discussing a lack of clarity and visibility of the pilot's progress and achievements. This had some impact on participants experience of the pilot with participants providing a neutral rating (5 to 6 out of 10). Survey data indicated there was a desire to know about the progress of the pilot, the broader context and what participants were contributing to. This correlates with participants' motivations for joining the pilot, that included being part of something greater, and for environmental reasons.

- For some respondents to the orchestration phase one survey, there was a sense that information provided was generic and not individualised to what was occurring for participants with orchestration.
- One participant stated that there was a "lack of detailed information on what is going on apart from we will be doing some testing over the next few months." (Orchestration Phase 1 Survey, Dec-22)

On this desire for information about the broader context in relation to environmental issues, an interview participant explained:

we would have liked a bit more information. I'm quite curious 'cause I'm a sustainability specialist, so would like to know a little bit more about how we can maximise or reduce

our coal-fired power intake and would just like a bit more information (PI43, October, 2022).

Changes with communication

- There was greater satisfaction with pilot communications in later phases. Survey results showed a 15% improvement for participants in getting sufficient information' (figure 15).
- Greater satisfaction with communication can be attributed to the Synergy team acting on feedback received in the first phase of orchestration.
- Key changes in the communication included, providing tangible information and statistics, updates on key achievements and learnings from the pilot, as well as acknowledging areas for improvement. Figure 16 provides an example of the updated that were sent to participants in response to feedback, which provided information on the technical challenges faced by the pilot and acknowledged issues faced by some participants.
- Participants also noticed the improvement in communications, citing more frequent and relevant updates. One participant said "Beginning of pilot - outcomes were not clear. Comms have improved since." (Orchestration phase 2 survey, May-23).

Figure 15: Communication rating between orchestration phase 1 and 2

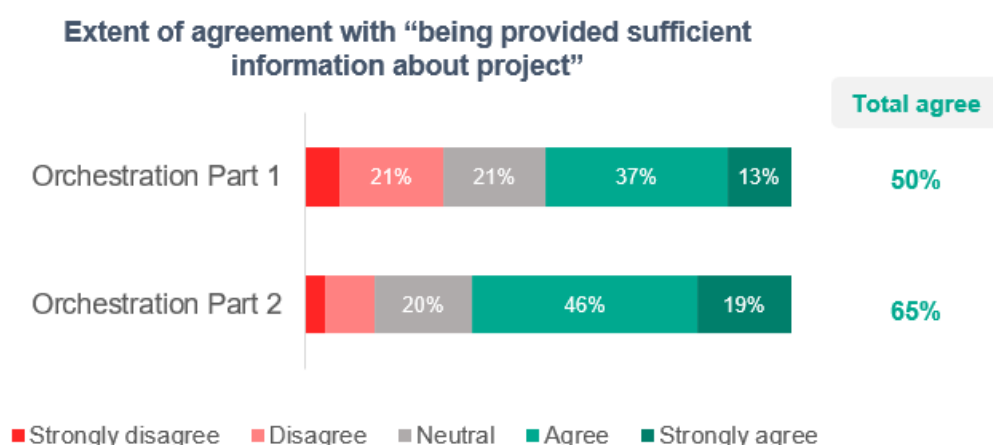


Figure 16: New communication approach in response to participant feedback ¹¹

Has everything gone as expected?

We're building new technology for the network to do completely new things – and this doesn't always go to plan. With this in mind, we have also identified many opportunities for improvement. We know for large scale orchestration to be successful beyond this project, some areas that will need to improve are:

Asset compatibility	+
Balancing asset usage	+
Customer home revisits	+
Forecasting customer consumption	+
Hardware	+
Providing you with updates and information	+
Understanding the impact on your electricity bills	+

One participant from the second interview indicated that they read everything that Synergy sent saying:

They're pretty well-communicated. I didn't have any doubts or anything. I mean they're so good that I actually haven't gone back to them asking more questions. It could be because I always read – I like to read things and understand mostly by myself, so there were lots of FAQs and quite a bit of documentation they send and all that. So, it could be my nature and sometimes my job type as well. I do a lot of reading from work-related as well, preparing documentation and things like that. Maybe that's why I have no problem reading it. So, I was reading, digesting information, mostly all straightforward. I didn't see much complexity there (PI20, March, 2023).

This participant further stated that they appreciated all the communication from Synergy, which included energy saving tips. For Project Symphony, this participant was unique in reading all of the information provided by Synergy and was the only participant to state this. However, another participant from the first interviews, remarked that "everything was quite clear on the email. Obviously, that initial document was quite overwhelming, but apart from that, everything has been pretty straightforward" (PI46, October, 2022).

¹¹ Screenshot from web page sent to participants in March 2023

8.3 Communicating technical terms and concepts

Participants from the focus groups clearly told us that the technical terms used were a barrier to understanding. It is recognised that the energy industry uses terminology that is often difficult to understand for both industry insiders and outsiders. Concepts, terms and acronyms such as, VPP, DER, constrain to zero (CTZ) and dynamic operating envelopes (DOE) are lesser known to the public and largely incomprehensible as to what these terms actually refer to. Within the Project Symphony pilot, there are added complex concepts such as orchestration and testing scenarios that were communicated to participants (table 1). Energy Consumers Australia (ECA), in a recent campaign declared they are no longer referring to DER, but instead to Consumer Energy Resources (CER), arguing that CER are consumer assets that are not periphery or distributed resources, but instead "sit at the centre" of where energy is consumed (Energy Consumers Australia, 2022).

Participants DER or solar PV being consumer assets was reflected by one participant at the focus group who was commenting about what was happening with their solar PV and battery system with orchestration, stating:

My main peeve was that they didn't give me the solar panels. Their mine. I put those in years ago. They just gave me the batteries and then you shut my panels off ahh - no. That's my main argument. It's my panels, I paid for it. You do whatever you want to the battery, store the energy, take the energy and the [inaudible] because you paid for [half] of that. [inaudible]. The panels are mine. Why should my house not benefit from it?
(Focus group participant 2, 2023)

The ECA article also discusses the use of the term orchestration and states:

Orchestration suggests coordinating these assets so that they are all working in concert, efficiently and effectively. But to what end? Orchestras generally come with a conductor and a set of sheet music. Implicit in this verb is the idea that such assets exist for the good of the system, that they share a common outcome, and that their primary purpose should be in delivering that outcome (Energy Consumers Australia, 2022).

Survey findings showed that some participants found the pilot information difficult to understand, mainly in relation to orchestration. Comments from the first orchestration survey, specifically highlighted the use of technical terms and jargon. One participant stated, "email regarding orchestrating [were] received but for someone not tech savvy like myself - will be hard to understand." Certain content used in Project Symphony is more relevant to an industry expert and less to the average consumer. For example, the use of terms and phrases to describe the testing scenarios that were provided in the frequently asked questions refer to, network support services, contingency raise, constrain to zero and wholesale market price signals. Most industry experts working within the National Electricity Market and the Wholesale Electricity Market in WA will recognise these terms, but they do not promote understanding for participants.

Synergy worked on improving communications throughout the pilot, including providing more explanation of the technical concepts and language used. The social researchers heard some indications in the second interviews that communication was improving for participants. However, the use of these terms in the first place is likely to need ongoing consideration for the industry as a whole, and it is not an issue for Synergy alone.

Survey and interview responses showed that some participants were not aware of what orchestration meant. One participant (Orchestration Phase 2 survey) summed up their lack of understanding about what orchestration was, stated: "...not much info given before signing up other than 'assets would be orchestrated'. Now that I know what the term means, would've put a lot more

thought into signing up.” Another participant commented (Orchestration Phase 1 survey) “too much jargon and tech-talk”, in response to their reason for their chosen pilot experience rating.

Across the four focus groups that were held in Southern River in February 2023, the most significant and frequent discussions related to communication about the project from Synergy, apps and monitoring, battery charging and discharging, and issues related to cost and bills (Appendix 3). Discussions about pilot information and communication occurred spontaneously as a direct result of the experiences participants had throughout the first phase of orchestration (before questions about communication were asked). When participants raised the issue of communication spontaneously, often it occurred in relation to the testing (orchestration) that was occurring and concerns about bill impacts. Participants were concerned about how generic the information about orchestration was and the majority of people wanted more information about what was going on as stated by one participant below:

I'd just like to know what's going on. So, what are you actually doing? You[re] pushing power into the batteries. You turn it off. When are you doing it? How is it going? You know what - we kind of - I understand my assets are being manipulated. But I don't know when and like I said, I've just given up. (Focus group participant 5, 2023).

Another participant expressed similar concerns about the level and detail of information stating:

I find Synergy were very vague. Because, ok they use that word orchestrate - I don't know what it means. I don't know what it is, so I didn't and even though I signed, I never spoke to someone to answer lot of questions because I'm not just going to sign up to something and not know what I'm signing up for. I found you never got a straight answer. They just orchestrate your assets - what does that mean?

Does that mean you're going to drain my batteries? What are you going to do? They didn't tell me. I now know. (Focus group participant 2, 2023).

The limited detailed information provided to participants about orchestration and what is happening with their assets resulted in some participants coming to their own conclusions about what is happening. Individual expectations and understanding of the project also varied greatly and were not always accurate, which led to further confusion for participants. For example, one participant in response to their battery storage charging and/or discharging at night stated:

For me, obviously, from my perspective, their strategy seems to be take it all out at night, then store it elsewhere at two cents kWh or whatever it is. And just to keep you happy take a bit out during the day, so you do get a bit more - but the volumes at night. (Focus group participant 8, 2023).

From other comments about pilot communication, it was clear that participants wanted transparency, they wanted more detailed information about when their assets were being orchestrated, and the broader context of what their participation in the project meant for the electricity network and for WA. Participants expressed a desire for this information to be presented simply, in diagrams or video format. On the communications that were being sent, one participant noted:

they give a booklet, and they give an email, but who's got time to read all that? A simple presentation or picture thing like that. (Focus group participant 15, 2023).

There is discussion within the industry and among project partners that the social researchers frequently hear about energy literacy and ensuring that customers are energy literate or 'educated' on energy issues. A typology of energy literacy was developed by van den Broek (2019), which

recognises different types of energy literacy. Where people identified as energy literate in one situation, they may not be considered energy literate in another. For example, someone can understand the energy consumption of domestic appliances and how to effectively save energy, which is identified as device literacy, but they may not have the same level of understanding about multifaceted energy issues, which encompasses, device literacy, action energy literacy (energy saving behaviour that leads to the highest energy savings) and financial energy literacy (rational decisions in relation to energy efficiency investments) as well as understanding broader contextual energy supply issues (van den Broek, 2019, pp. 2-6).

We would add that the energy literacy expected of participants in Project Symphony is perhaps beyond the comprehensive level of multifaceted energy literacy, identified by van den Broek (2019) and instead expects a detailed understanding of a multitude of energy issues and extends to issues occurring across networks in Australia with the energy transition, as well as an understanding of the energy market. It is questionable as to whether expecting such high levels of energy literacy is necessary or even desirable, particularly as discussed further in this report, there are issues with time and complexity for participants in trying to find information and "know" things that may be obvious to the industry but are not intuitive with the language used.

Through the interviews undertaken as part of this research, the social researchers found that participants were knowledgeable about various aspects of their own energy use, were increasingly knowledgeable about the VPP and testing scenarios (table 1) and had an expectation and understanding of what the project was trying to achieve. However, the testing scenarios that occurred in the first orchestration phase were confounding and not logical to what participants expected or understood.

8.4 Implications of findings

The following points note implications from the research discussed in this section.

- The majority of participants were unaware of exactly what they were signing up for and returned to their contracts and others in the pilot to find answers. Our findings suggest that specific information and clear parameters should be provided in contracts and in any marketing for future pilots or programs. This will enable clarity, set expectations and assist in decision making about involvement at the outset.
- Participants had good knowledge and understanding of energy saving behaviour, such as utilising their solar PV generation during the day to reduce costs; however, it cannot be expected that participants have, or will gain a multifaceted understanding of energy. Particularly, at the level of technical understanding of Project Symphony. Consideration of the level of energy literacy needed or that is desirable should be considered when communicating future pilots.
- Participants sought clear, graphical information about what was happening with their assets with orchestration, and a broader contextual understanding of what this meant for them and the broader benefits to the power system and the community. These findings support other industry research as discussed in the grey literature review, that customers should be kept informed through regular updates and apps, with easy to understand statistics.
- Our research showed that terms like orchestration had very little meaning for participants and the use of technical terms that lack explicit meaning, which customers can relate to is common within the energy industry as evidenced by ECAs campaign to change the use of DER. These findings suggest a much broader issue within the energy industry about the use of insider terms, that then make it out unfiltered to the customer.
- Synergy improved their communication approach after the first orchestration period based on feedback received from participants. This can be seen in figure 15, where 65% of

participants agreed they were provided with sufficient information about the pilot in the second phase of orchestration, in contrast to 50% of participants agreeing to this statement in the first orchestration phase.

9 Orchestration as a proposed solution

This section provides information about the research findings relating to orchestration, as these were the main intervention stages. The section below relates research findings on orchestration from the focus groups, second interviews and surveys as it was a key point of concern and discussion from participants.

Summary

- Participants frequently discussed how they were not given information on what orchestration was and when this would occur.
- In the interviews, some participants did not notice orchestration occurring and mentioned they were “too busy to notice”, but most participants noticed things happening with their solar PV, batteries and air conditioners (when connected to the pilot).
- In the surveys, 42% of participants noticed orchestration occurring. These were primarily participants with a battery who are more engaged in energy monitoring.
- Participants most frequently noticed their battery being drained or charged from the grid at odd times, such as the middle of the night or early morning. Almost all participants noticed their solar being “shut down” or constrained, often mentioning mid-morning when the sun was shining.
- Some participants who were knowledgeable about energy, felt that orchestration was not being optimised to their benefit and questioned the value to them as participants.
- Participants who had their air conditioning connected also noticed at times that their air conditioner would turn on. This was unexpected to the social researchers, but it was confirmed by Synergy that this was not intentional and was an unknown issue with the infrared control for air conditioners. Synergy thus took steps to resolve this situation.
- Participants also talked about how they thought they needed to implement shut down procedures with their batteries when testing was occurring, due to not knowing what to expect with the testing and not knowing when it would occur.
- Sentiment on orchestration was largely negative at the focus group conducted in February 2023 as shown in figure 17. This sentiment had improved when the social researchers conducted the second interviews in late March/early April 2023. However, participants still discussed orchestration and at times the disruption that occurred with orchestration, particularly around changes to their energy use.
- Most participants interviewed maximised their solar usage during the day and this was commonly mentioned. With the constrain to zero scenarios, a shift in how participants maximised their solar was needed, but it was not clear to participants how to optimise their energy use with orchestration. Some participants noted that they needed to shut all the appliances they had running off, when solar was being constrained to zero output (gross), rather than limited to zero export (net) where participants could still meet their household demand with solar.
- From the survey, 53% of participants stated that orchestration has changed the way they use energy at home. We were informed through the interviews and focus groups that participants changed their energy use behaviour to avoid times when solar was being constrained and/or when batteries were being charged from the grid.

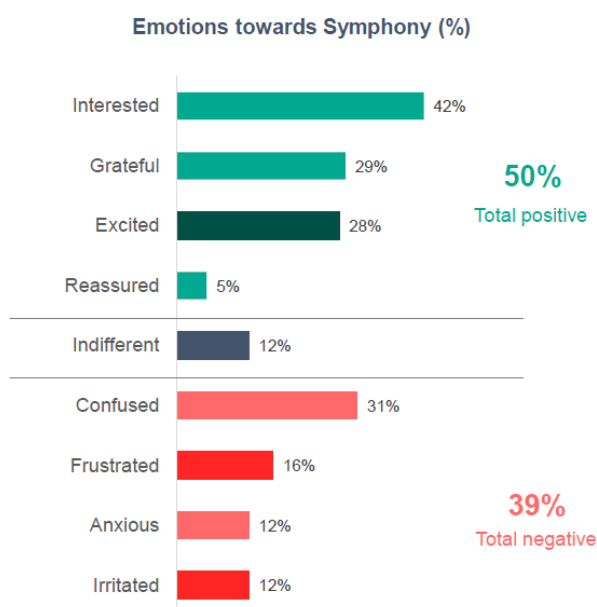
9.1 Awareness and perceptions of orchestration

Sentiment from participants was reasonably positive during the installation phase as discussed in section 6.2. However, as shown in figure 17, this sentiment became negative when orchestration begun for the first time. Results from this survey indicate that sentiment was positive for 50 percent of participants, with the majority feeling interested, grateful and excited. However, there were a significant proportion (39 percent) who felt negatively about the pilot, mainly driven by feelings of confusion. Some participants also reported feeling frustrated, irritated and anxious (Synergy, 2023c).

Prior to orchestration starting, email notifications were sent to relevant participants. The email outlined the scenarios to be tested and examples of what might occur with their solar and battery. Despite the information that was provided by Synergy prior to orchestration, there was negative sentiment expressed across the interviews, focus groups and surveys about orchestration due to:

- Limited awareness about what orchestration was, leading to queries about what might be occurring to their assets and why.
- Uncertainty about whether the observed activity (such as solar being turned off) was a technical issue, or an intended event as part of the pilot.
- Concerns about impacts to participants' electricity bills due to the frequency of orchestration.
- Mismatched expectations about the purpose of orchestration. For some, there was a view that the pilot aimed to increase the use of renewable energy, which conflicted with solar generation being turned off during the day. For others who expected the pilot to assist with grid stability, it conflicted with seeing their battery being discharged into the grid at odd times of the night and early morning.

Figure 17: Snapshot from Synergy consumer sentiment survey



Source: Synergy (2023c) - Q: *How are you feeling about Project Symphony? Select all that apply* (n= 98)

Comments from the survey indicated that participants had no awareness of what was happening with their battery and solar systems, with one customer stating:

Our solar was turned off when our usage was high enough that we wouldn't have been exporting so I didn't understand why you turned the solar off. I also didn't know whether there was an issue with our panels or our battery. I just assumed it was the pilot project. Would be great if there was a way to clearly indicate what is being done. (Synergy Orchestration Phase 1 survey, 2022).

The above comment indicates the confusion and limited information provided about the testing approach. Based on discussions with Synergy, there were additional tests conducted to understand the extent of the system's technical capabilities and how much load can be shifted by the batteries. In some cases, this meant charging and discharging participants' batteries at night. As discussed below, and in section 6.2, early testing pushed boundaries that revealed the limits of customer acceptance of orchestration.

The limited information provided to participants about orchestration led to some participants thinking that they had to implement shut down procedures that they were advised to do by the installer. As stated by one participant in the second interview:

Well, I thought something had gone wrong, so I was doing a shutdown procedure and startup 'cause I didn't know what was going on. 'Cause that's what they [installer] told me to do. So, when they first came they said do a shutdown if these things occur (PI50, March, 2023).

This participant eventually realised that it was the pilot's testing that was occurring after speaking with the installer. Participants were advised about orchestration from Synergy, but as discussed in section 8, the word orchestration held little meaning and participants had little to no expectation of what orchestration would look like. This example also indicates that there was no discerning of issues that might occur with the battery that needed shutdown procedures to be implemented, and what was expected to occur with orchestration. The installer was likely providing information of the shutdown procedure given their understanding, and not communicating orchestration implemented by Synergy. This is understandable from the installer, as it is not necessarily their role to communicate orchestration to participants. Ultimately, this example provides further evidence of where clearer communication about what to expect with orchestration was needed.

Discussions with Synergy on 14 March 2023 disclosed the testing approach that led to what was described internally by Synergy as "heavy orchestration" for participants. A key test hypothesis for the project was to understand the potential for the aggregator to meet the requirements of a scheduled generator, which requires a response to five-minute dispatch targets. During the first phase of testing, this was attempted without the benefit for customers of DER asset and behind-the-meter optimisation, leading to participant assets being orchestrated in unexpected ways (i.e., solar PV curtailed without explanation). As a result of this testing approach, DER assets were not optimising benefits for participants, and this was reflected in the negative sentiment and experience participants informed us of in the first orchestration phase survey and focus groups.

Synergy and AEMO has since confirmed that a key learning of the project was that this form of WEM participation (i.e., scheduled generator behaviour) will take a long-time to develop and is unlikely to be viable in the early years of VPP participation. In second phase of orchestration through this pilot, refined optimisation capabilities enabled customer assets to be dispatched within boundaries to optimise the benefits for participants, and maximise value for the aggregator (Synergy, May & July 2023 personal communication). Assets were also orchestrated less in the second phase of testing (1.4 hours per day on average, as noted in section 6.1).

There was significant agreement about the detrimental impacts from Project Symphony participants in the focus groups and survey throughout the first orchestration phase. As discussed above, the testing approach that was used in the first orchestration phase ceased very soon after the focus groups were held and before the second interviews were held. Only a minority of participants who

attended the focus groups (out of 33 in total) had a positive experience throughout this testing period and were seeing savings on their electricity bills. This was an expectation for participants as evidenced in figure 8 with 88% of participants involved to reduce their electricity costs. This is despite Synergy communicating that bills could be negatively affected with orchestration. This message appears to have not got through effectively to participants. For battery participants, we know that participants expected to be able to store excess solar in their batteries for use in the evening, thus leading to an expectation of reduced bills.

When participants were asked if their assets were working as expected in the first orchestration survey, 18% (17/95) said there were issues and 27% were unsure (26/95 total). This perception about participants DER assets corresponds directly to their experience (i.e., those who say there are issues or are unsure have a significantly lower experience rating of the pilot).

From the second interviews, one participant who works in the electricity industry and is knowledgeable about Project Symphony provided his perspective on orchestration as a participant.

I've been able to look at the behaviour of the assets and understand what it's trying to do. But if I'm not somebody that knows what's going on at how electricity markets work, it's just totally confusing. Why are you charging my battery at two o'clock in the morning? And I'm sure you got a lot of that.

So, I think from that point of view, I found it quite frustrating. It's like I know why you're charging my battery at two o'clock in the morning. You're doing it to try and test market mechanics. I understand the electricity is cheaper at two o'clock in the morning. But as a consumer, where is the value proposition for me? And that's the big struggle I think that Symphony's had. (PI01, April, 2023).

One other participant interviewed discussed how they thought something was "broken" with their system when testing was occurring, stating:

So, for me, I'm thinking the first thing is it's broken, but then, of course, realising now they're fiddling with it. And because I don't know what they will do and when they will do it, I just assumed that when things aren't working as how I would expect them to, they're having a fiddle (PI17, March, 2023).

Another participant from the second interview stated how the information about orchestration was not well explained and felt they may have been misinformed stating, "Most people - you call it orchestration to them and then explain, 'this means we're going to remotely turn your power off', they're going to say no" (PI28, March, 2023). It is noted here, that orchestration did not turn participants power off, but it did at times constrain participants solar PV as discussed by preventing any generation from their PV system.

Participants also noticed and expressed the following about orchestration in the second interviews:

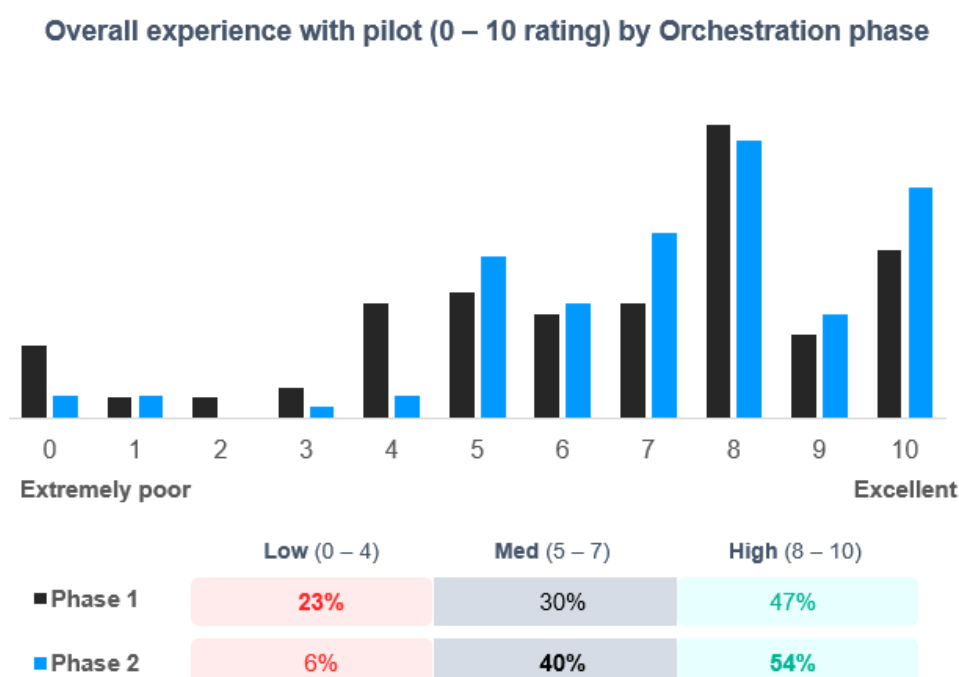
- Air conditioner turning off and on
- Solar being "shut down"
- Export of energy from battery, and

- An increase in electricity usage, which appeared to be mitigated by the orchestration payments.¹²

9.2 Changes in sentiment and growing awareness of orchestration

There was a shift in sentiment between the first and second phase of orchestration. Just under one in four (23%) rated their pilot experience negatively at the onset of orchestration for the reasons discussed in this section. This negative sentiment eased by the second phase of orchestration (with only 6% rating the pilot poorly in comparison). There was a noticeable shift for the social researchers in the second interviews in comparison to the focus groups. This easing of negative sentiment is shown in figure 18 below from the two orchestration surveys.

Figure 18: Sentiment shift between orchestration phase 1 and 2



Source: Orchestration Phase 1 survey, Orchestration Phase 2 survey

Q: How would you rate your experience with Project Symphony?

Several factors contributed to easing concerns about orchestration from participants that included the change in the testing approach as noted in section 9.1. The second interviews were also conducted when there was a break in orchestration in late March and early April 2023. There was a

¹² As the social researchers do not have visibility over customer bills, we are stating here what we heard from some participants that their bills were not as high as they expected and feared in the focus groups. From asking further in the second interviews, the lower than expected bills appeared to be as a result of the orchestration payments that were credited to participants.

palatable sense of relief from participants interviewed at this time; however, participants were also noticing some testing that was occurring, particularly with their solar.¹³

Information provided by participants in the second interviews found that many participants had received their latest electricity bill and stated that it was not as high as they were expecting. Some participants when asked, also noticed the orchestration payments (figure 4) that had been applied to their account. Unlike the battery and air conditioning up-front asset subsidies, which participants frequently discussed as their motivation for joining the project, the incentive payments for existing assets (figure 3) were not talked about by participants in the first interviews or focus groups, but participants confirmed that they did notice them on their bill, when asked in the second interviews.

Although, participants in the second interviews stated that their bill was not as high as expected, they also noted that it was not as low as they expected either with a conventional understanding of the savings that accrue through having a home battery system. Some focus group participants also discussed the information provided by the installers about the battery installation. The information provided by installers was of a general nature and came from a conventional understanding of how a battery works and the savings participants could expect. One participant stated:

The only face to face person we had contact with was [installer] when they came out and did the [inaudible]. Now the communication was - the battery would give you a guarantee of \$1000 because basically you would load the battery up, and the depleting and loading of that should give you \$1000 savings.

The battery is guaranteed for 10 years. And so it has a 5 year payback on it. Yeah, so the reality is that we haven't seen that - because with the project, and it's probably the only forgiveness that we can have is the fact that we did get a subsidy. (Focus group participant, 2023)

When discussing the issue of battery charging and discharging through the orchestration period, another focus group participant discussed information provided by the installer of the benefits of having a home battery system, stating:

When they came out [installer] and talked about the module and he goes - well it's a no brainer, it's guaranteed for 10 years. You'll get a pay back in five years because there's \$1000 there. But, if they're forcing and taking power from there, and you're paying that - at the time that it was - if they [Synergy] said look you won't pay - you know you're like, you get it at the seven cents or something - if we're forcing it, it would probably be different, but we don't have that communication. (Focus group participant, 2023)

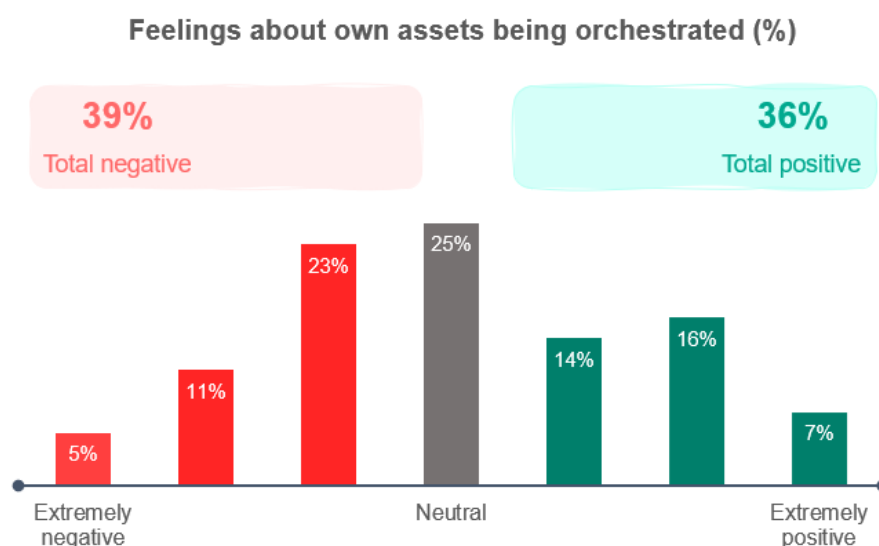
The second phase of orchestration began in early April, after the second interviews, but it was noted by participants in the orchestration phase 2 survey that this testing was less frequent and intense. Synergy provided updates in communication to participants after the first orchestration phase survey, and focus groups, which directly addressed some of their concerns. For example, participants frequently asked for someone to contact within Synergy for support and queries, as well wanting more information about the status of the pilot and pilot learnings.

Despite greater awareness about what to expect with orchestration, further information from Synergy about orchestration and an easing of concern as noted in figure 18 above, there was still mixed sentiment about orchestration amongst those who observed it (figure 19 below), with 39% of

¹³ Participants at this time noted that they could see their solar being constrained, but this time their household demand was being considered (net). This was in contrast to what we heard in the first interviews when participants reported that they were importing electricity from the grid, at mid-morning on a sunny day.

participants expressing negative sentiment due to the same concerns seen in the first phase of orchestration. That concern being that their DER assets were being orchestrated in a way that disadvantaged them. In contrast, 36% felt positively about orchestration, a sentiment that was not observed previously in the pilot. Among some participants (7%), there was extremely positive views about orchestration and a perception of the broader benefits of this.

Figure 19: Sentiment about assets being orchestration (orchestration phase 2)



Source: Orchestration Phase 2 Survey, May 2023

Q: And how do you feel about your appliances being remotely controlled (or orchestrated) as part the project? (n=49)

The orchestration phase two survey also indicated that:

- Participants went through a learning curve of awareness about orchestration, going from dissatisfaction to a form of acceptance for the period of the pilot.
- As stated by one participant, "If tests need to be conducted then so be it!" (Orchestration phase 2 survey, May-23) and further "Might not always agree with when my appliance is being managed but since this is what I signed up for. I will accept this for the duration of the project." (Orchestration survey, May-23)
- The orchestration activities were noticeably less frequent and intense as discussed in sections 6.2 and 9.1. This was noted by participants in the surveys.
- Despite reduced negative sentiment about orchestration, concerns remained, with bill concerns, and lack of reasoning or understanding about orchestration being key themes.
- There were noticeable frustrations with air conditioners being turned on and off remotely. This was later found to be a technical issue with the infrared control as previously noted. As stated by one participant, "I'll come home, and my air conditioner is already turn[ed] on.. I don't know for how long, it's a waste of electricity as no one was home." (Orchestration Phase 2 survey, May-23).

9.3 Changes in electricity use with orchestration

Throughout the surveys and interviews, we collected significant quantitative and qualitative data about how participants engaged with energy and make decisions related to it, as well as what participants observed happening to their energy use through the orchestration phases and how they attempted to shift their usage with orchestration. Orchestration had a particular impact on participants daily energy use. For example, we heard from participants who maximised their solar PV during the day, that they had to then turn off appliances when their solar PV was being constrained in the first orchestration phase as they stated they were needing to import electricity from the grid at times.

Participants were engaged with their household energy use through their bill and conscious of their energy usage. Participants were asked in the first interviews about their energy use, with the majority of participants maximising their solar generation throughout the day, by using appliances such as washing machines and dishwashers during the day, rather than at night. As stated by one participant:

I normally will set to do things during the day, so I'll put our wash in our washing machine, set our dishwasher, that kind of thing. So, I'll try and do that during the day just to use as much as possible. I think it is just to be more conscious as well, because if I've missed putting something on, I'll actually wait until the next day rather than put it on at night, so I guess it does make you more conscious of the way you're using it to make sure you're using it to its full capacity (PI46, October, 2022).

In the second interview, a participant noticed her electricity use had increased, with her most recent bill in March 2023 showing increased usage of approximately 700 kWh in comparison with the same time the previous year, despite having newer energy efficient appliances. The participant was asked further if she had noticed any of the incentives on her bill as despite the extra electricity usage, her bills were lower. The participant states:

I have and I think that's probably why it's come in as a little lower because the last bill I did get some incentive credits, and then there's a little bit of solar buyback through the paybacks in there. It's still higher for a three-person household on a cottage block with the amount I've spent on my – I've spent about 12,000 on solar and assets. I'd expect for my bill to not be going up and it is, so that's concerning (PI03, March, 2023).

This participant did not necessarily see the value of the orchestration payments immediately, as the first point discussed was the increased electricity usage on her bill, in comparison to the previous year, despite having energy efficient appliances. It was not until further questions were asked about incentives on the bill, that she stated she did notice them. As stated, her bill was still higher than expected and for what was spent on the assets purchased, there was an expectation of a reduced bill – not compensation (orchestration) payments and other bill incentives (figure 3).

Another participant who would normally utilise their solar during the day to do things like washing, dishwasher, etc noticed that the solar PV was “off” and had to subsequently turn all their appliances off.

I use the sun as much as I can. There was an incident about six weeks ago and I spoke to Synergy about it. Basically, what happened was I went oh the sun's beautiful, put everything on, I'll just check the app. They had turned the solar powers off and were charging from the grid at – I think it was about 11:00 in the morning. Yeah, I have to stop it 'cause I literally had dishwashers, washing machines, tumble dryers going, the whole lot. So just turn off as much as I possibly could (PI33, March, 2023).

We also saw intentions from some participants to minimise the amount of power they were importing from the grid and make changes to their daily electricity use, in response to orchestration. The ability to control how they were using electricity in their home was disrupted by the orchestration when they noticed that their battery was being drained.

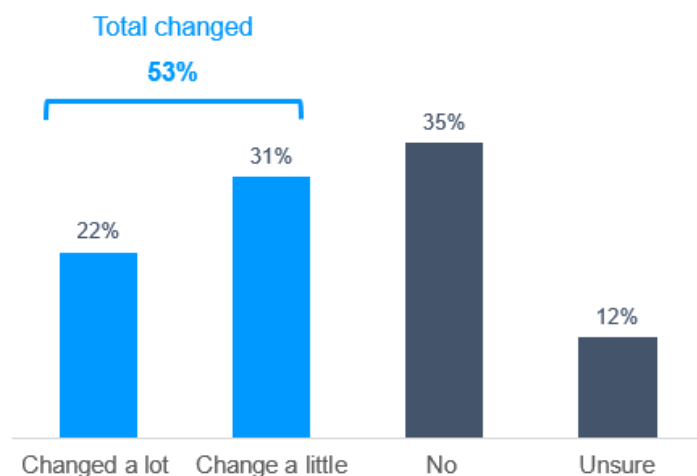
Yeah, we weren't too sure how things were going on. Things have started happening so we were pretty keen to see if we could minimise the amount of external power we use and so we were manipulating when we use certain appliances. One day I happened to notice that all of a sudden, our battery was being drained and so oh I hadn't expected that and so all of a sudden we're now using power and paying a lot more for it than – it should have been free. So being aware that those sorts of things could happen would be helpful (PI43, March, 2023).

We also found an awareness of energy use and ways to manage energy through the surveys. The surveys indicated that:

- Nearly all (97%) say they pay attention to and try to manage their energy usage. Slightly more (53%) use what they want whilst 44% use only what is needed (n=123).
- A vast majority (81%) understood how their energy use impacts their electricity bill (100/123).
- Of those who noticed orchestration occurring, more than half (53%) say it has changed their routine / the way they use energy at home (26/49). Survey comments show that participants have an established routine of how they maximise their solar energy (e.g., using their washing machine, dishwasher and for one participant, charging their EV during the day).

Figure 20: Changes to energy use due to orchestration

Changes to routine / energy use due to orchestration (%)



Source: Orchestration survey, May-23

Q: Has orchestration made you change your routine / the way you use energy at home? (n=49)

We also heard that participants wanted some form of notification with the orchestration as many people could see on the apps they were using that orchestration was not being optimised for their benefit or for their household usage.¹⁴ One participant noted:

One of the craziest things that was happening with – happened for a few nights – our battery would be fully charged, they take everything. They drain the battery completely (PI30, March, 2023).

The lack of control over the timing of orchestration events caused considerable frustration and concern for participants, as there was no clarity over when it would occur, for how long or why it was occurring. Most projects that we found through the grey literature review had some form of notification for participants and an ability to opt in or out of orchestration events. However, we understand that Project Symphony is a complex VPP testing various grid and market scenarios, in comparison to other projects and there were difficulties for Synergy to provide notifications about orchestration events. Given the experience of Project Symphony participants, the social researchers would suggest that any future VPP projects or similar demand response programs include notifications and opt in or out functionality for participants. We would consider this functionality to be essential for participants to have some level of control and visibility over what is happening to their solar PV, batteries and other assets.

9.4 Implications of findings

- Our findings showed that orchestration was an unknown for participants, and as discussed in section 8, the word itself carried little meaning. Therefore, there was no understanding of the effects of orchestration on participants assets, or for their household energy use. These findings, along with those discussed in section 8.3, suggest that there was limited social licence sought from participants, even as participants signed a contract saying that Synergy will use their assets for the purpose of Project Symphony (figure 14).
- The research found that many participants expressed concern about the constrain to zero scenarios, particularly when this was operating at the zero output (gross) level, which required participants to import electricity from the grid. Participants were less concerned when constrain to zero (net) was operating as it enabled household demand to be met from solar generation.
- Participants discussed having notifications when orchestration events would occur. The social researchers understand that there were challenges in providing notifications for Project Symphony, due to the range of testing that was occurring, but also that some testing was triggered at short-notice or required flexibility from the aggregator (to respond to wholesale prices for example). Given the potential for value of this level of flexibility, these opportunities need to be considered alongside customer acceptance and consideration needs to be given as how to engage customers who may be interested in such projects or products.
- Incentives for existing assets (figure 3) offered for participation in Project Symphony were not necessarily valued by participants who formed part of this research, most of who had a battery asset (table 3). The value of the project for participants was hindered by orchestration when there was an expectation at the outset of bill reductions. Other measures of value such as battery back-up were based on a conventional understanding of the individual benefits of having a battery to store excess solar generation or use in the evening.

¹⁴ The social researchers were aware of the difficulties for Synergy to provide notifications.

The issue of value is discussed in more detail in sections 11 and 13, but suffice to say in this section that "value" from the customer perspective needs to be considered.

10 Technology, systems and their retrofitting

This section relates a range of findings that emerged about technology and systems used, including their installations. Findings about technologies, systems used, the hardware and the software, provides useful information for technology design, including the feasibility of certain retrofits in homes. Technical and house related context are also provided in this section to support other project findings in this report. Technology and systems discussed here includes the assets involved, the electrical set ups in homes, and the decision-making software and platforms used in the pilot.

The findings are grouped into themes of:

- Retrofits and making changes to existing infrastructure
- Installations and revisits
- Battery related findings, and
- Monitoring and feedback.

10.1 Retrofits – making changes to existing infrastructure

While Project Symphony utilised existing assets (mainly solar), the pilot required many assets and technology to be retrofitted into (and onto) existing houses. Retrofits of existing houses can be difficult in general, and in the building industry this is a commonly understood challenge. How the retrofitted pilot technologies interacted with the design and set up of the houses was observed by researchers as impacting and therefore important to record.

The recent Australian Standard (AS/NZ 5139) for batteries and inverters, guided requirements for installations in homes, with most in this pilot retrofitted into garages (Reddaway, 2020). All battery installations we observed were in closeable garages that were attached to homes. Some inverters were on outside walls with a shade or shelter above them, but the majority of the installations were inside garages. As part of the regulations and due to potential combustibility and safety issues, batteries and inverters need to be sheltered. If the battery is sharing a wall with habitable rooms, the wall must have a non-combustible barrier that extends at least 600mm either side and 900mm above the battery, unless the wall is already concrete, cement brick or concrete (Reddaway, 2020). Bollards, an unusual feature in a home garage, were also installed for safety, further filling the garage space.

For the more complicated installations there was significant electrical and data cabling retrofit requirements as stated by the following interview participant:

I was a little bit perturbed at why we were paying for two days for that install, but it seemed that the work that they started the next day went for a fair bit of time putting all the cables in... (PI50, October, 2022).

Figure 21: Example of inside garage install with bollard and cabling



Source: PI07 (March, 2023)

Certain features of the houses (that we observed) supported the retrofits needed, but others required more complicated retrofits. The initial pilot area of Southern River was chosen based on high solar PV penetration and load profiles in the area. Homes in this area are generally newer. The houses in the local area of the pilot often took up a large footprint on the land, with minimal space between houses, and the homes with attached garages. There were not many separate sheds because of limited access to the small backyards. Garages were often used for sheds, workshops and storage areas.

In most instances, in these homes, the technologies and assets had limited places they could be installed in the garages. Retrofitting into double story houses was reported as a particular extra challenge by householders and pilot partners (PI05, May, 2022; Project partner interview, October, 2022).

Figure 22: Example of houses in the area using most of land area and close to neighbours



Figure 23: Space constraints led to outside inverters for small number of cases



Source: PI28 (March, 2023)

The limited space available for retrofitting in batteries is important for scaling of VPPs, and grid integration and management solutions. The implications of the significant areas of wall space needed for equipment relate back to feasibility and potential social acceptance at scale. Participants with more than just their solar connected commonly noted the significant level of equipment installed in the first interviews; and then often joked about it in the second interviews with the social researchers. Their sentiment about the equipment was mostly neutral or positive, with some

negative sentiment towards the equipment installed. Technology retrofits were asked about in interviews as their material presence emerged as being significant.

I: Is there quite a lot of things in there now or how do you feel about having all that in your garage?

A: Look, it's not too bad because the battery just sat sort of on the side, and then on top of the battery, as I told you, they had to put that new inverter, another inverter for the battery specifically, and then next to the old inverter, they put the gateway box. And everything goes through the roof basically. So, there's no wiring – visible wiring or anything. And they also installed I think a heat sensor and smoke sensor just on top of where the battery is. So, all in all, it's not too bad actually because it didn't take that much space. It's all on the wall, just the battery, and it's on the side. So, it's not bad. (PI19, August, 2022).

The high levels of engagement and retrofitting in of technology was noted by pilot staff as an issue as the pilot progressed. The extensive need for equipment is therefore seen as something that needs more resolution for scaling by pilot staff (Partner interview, September 2022).

Figure 24: Pilot technology installed in garage with other technology and storage



Source: PI06 (August, 2022)

Figure 25: Example of external wall of pilot technology



Source: PI29 (March, 2023)

We also saw and heard about related material adjustments and practices that occurred over time after installation of pilot technologies, or that were planned for the future. These include:

- Storage being built around the batteries,
- Items in the garages gradually encroaching on the installed technologies,
- Bollards being installed to prevent cars from hitting batteries (in one instance with reminder string attached), and
- Plans for batteries to be expanded (while noting also that inverters above stackable batteries were in the way of vertical battery expansions planned).

End of pilot and end of life considerations were also discussed with interview participants, and this is discussed in section 10.5 on gateway devices.

Figure 26: Bollard with string and pegs added for driver check



10.2 Installations and revisits

Installations are known from previous trials to be critical points where the long-term sentiment of participants can be established (Watson et al., 2019). While sentiment can and often does change, early interactions do have a lasting effect over time. Therefore, whether installations are successful or not can strongly influence consumer's sentiment about the whole pilot, or a whole program in the future, and in turn may affect their choice to be involved or not. This is especially because there are physical reminders of the installation experiences in their homes (Watson et al., 2019).

In this pilot installation and related revisits included:

- Initial visits for assessment of installation plans,
- Installation visits (which could be more than one),
- Quality assurance checks visits (for some), and
- Follow up visits for additional installations, for example installation of high-speed data recorders, connection of the air conditioner to the pilot, and other hardware installation.

Overall installations went well, but there were issues reported by participants that can inform a scaled approach to grid management and integration. We report here on the findings from the interviews, and surveys about the installation process. The data here was rich and the findings are therefore reported in summary.

Installations ranged from simple to complicated. Simple installations were a couple of hours duration and tended to only involve connecting an existing solar system in a house to the pilot via a gateway device, with one or two contractors/installers on site (PI46, October, 2022). These simpler installs were much less complex, and householders did not have issues with them. Interviews indicated that more complex installations needed a significant number of installers in the house, with 6-10 tradespeople reported as turning up for some installs. A staff member explained that higher numbers were needed on site for the complicated technical installs to get the job done (Project partner interview, October, 2022). Complex installations also required significantly more time (seven to 10 hours) to complete, during which power had to be shut off. The numbers of installers on site appeared in part to ensure the long installs were undertaken in as timely a manner as possible, and because multiple types of skills were needed during the installations.

The technology and interoperability capabilities, or lack of them, were being realised by the pilot team, in parallel as people were being onboarded, due to short project timelines, the scale of recruitment and the complexity of technical issues being processed (Project partner interview, October, 2022, September, 2022). Pool pumps were removed from the list of possibilities in the early stages of onboarding. Air conditioning installs were delayed due to compatibility and interoperability issues, noted by pink conduit that was hanging from participants air conditioning units, which the installers had tucked away neatly (as observed on home visits).

In parallel with realisations of technical capabilities with the assets, platforms and communication hardware, contracted installers and tradespeople were developing their consultation, planning and installation capabilities and processes as they went. This was evident from interviews - there was a change over time in what participants were reporting about installations and a distinct lessening of reporting of issues around planning installations and installation communications after a few months of interviews. Over time householders were noting less time and communication challenges with installations. Additionally pilot staff reported and observed, installers becoming more efficient, with the average time for a complex install reducing from 10 to 7 hours. Installers were getting better at installation activities – with time, planning the installations and checking with householders about specifics (communications). As a result of these improvements, there also seemed to be fewer unknown barriers onsite on the day of installation with later reports.

Through the first and second interviews, installations were generally described or implied as having been ok or good. A high proportion (25/33) reported the installations generally went well. Some participants in this group noted things they described as relatively minor concerns (in relation to the installation process). In particular, some participants reported not knowing how long the installation would take, and some were slightly confused after installation and/or wanted more information. A few participants said they had good installations but some minor breakages, such as sprinklers knocked off or a meter board cover cracked. One participant said the install went well but that problems with existing installed technology made it challenging for the installers. Two participants had some major issues from the installation activity (described below).

Positive components of installations included:

- Pre-checks of the house.
- Clear communication and engagement with householders about requirements, where technology was to go in the house, what was involved and how long it would take (including the time that the power would be switched off).
- A booking for attending the house and mobilisation of a full team so the installation was as straightforward as possible.
- Participants reported that installers were professional, polite and cleaned up before leaving.
- Explanations of the equipment installed was provided upon leaving the home.
- Quick approval and commissioning of the battery (within a day or two).

Issues that occurred with installations included:

- Having issues on the day, with things not going to plan. For example, if the participant knew the plan wouldn't work, or the installer saw a hidden hurdle.
- No prior communication of the installation plan in terms of where devices would be installed.
- No explanation of the equipment installed.
- Installation taking longer than expected.
- Disturbance of other technology and infrastructure in the roof, such as air conditioning ducts (PI41).
- Roof work not properly waterproofed. The example shared was of a substantial leak in the roof, which caused water to leak into insulation, draining down a ceiling and a wall with noticeable water marks (PI05).
- The wrong equipment delivered to site for a replacement (example of panels PI50).

Overall, the technology was reported as working, and in that sense the installations at homes are successful. Issues of consideration for future programs include:

- Complexity of the technology and multiple interactions between technologies affected compatibility. For example, an install could include solar panels, a heat pump hot water unit, air conditioning, an inverter, a battery, a high-speed data recorder, home internet, pilot internet, and a gateway device.
- A large number of the complications observed were related to compatibility between technologies (Project partner interview, October, 2022, September, 2022). Compatibility was a technical challenge examined by project organisations, in depth over the course of the pilot.
- Responses in interviews and later surveys indicated there was a lack of communication about additional devices installed to support the pilot activities, such as the gateway device and high-speed data recorders. The extra devices were repeatedly reported as being unexpected.
- In some interviews, participants described being instructed by installers to 'not touch' the gateway device, but not being informed about what the device was or why it was needed. The lack of clarity left some participants curious, with the lock on the box amplifying curiosity.
- A lack of understanding about the purpose of devices added discomfort and a sense of distrust for some participants. Some participants expressed concern about the monitoring that was occurring with devices. One participant from the second orchestration survey, for example, stated they felt "uneasy about having something put into our house living room and not really knowing what it does."
- For participants who signed up for a battery in the pilot, there were extra accompanying devices installed in homes, such as bollards, high speed data recorders and heat sensors.
- Some participants reported feeling overwhelmed and/or surprised with the number of items installed. On reflection in interviews participants reported a lack of communication before installations about what the area will look like after installation. There was a desire from

participants to be informed and to be consulted beforehand. For example, having a sketch of the area in advance was of interest to some.

- There were occasions that necessitated multiple visits to participants' homes to install or replace hardware, quality checks, installation of devices and troubleshooting and diagnosing issues. The time needed to schedule additional installs was mentioned as difficult or some participants.

Quality and safety considerations are worth noting here:

- There were quality assurance checks conducted by Synergy on installs. A proportion of participating householders were contacted by a Synergy quality assurance specialist and asked if they would like this check. Many took up the offer and installations were checked according to rules and regulations.
- From a quality assurance and electrical safety perspective, installations were going well at the time of our enquiring about this (in October 2022 with a relevant Project partner staff member).
- Bollards were installed in front of batteries in garages where it was deemed that the battery would need protection from a car being parked. These are unusual in homes and are more commonly used in public spaces for safety purposes.
- Heat sensors have been installed. These are new to participants homes, and they were thought to be smoke alarms. Participants most often only mention these as smoke alarms. From participant interviews, it appeared that no explanations were given about heat sensors during installations. For example:

And one other little thing after the installation, they didn't mention was probably like – I think it was a smoke detector they said that was put in the garage. So, we didn't know why there was a new circle thing at the time. We thought it might happen, but that wasn't explained to us either. (PI41, September, 2022).

- Some further explanation was given during quality assurance visits about heat sensors and also about other poorly understood aspects of installations (Project partner interview, October 2022).

10.3 Battery related findings

Batteries provide a particular function and the functions that batteries provide can differ according to the household, and DER orchestration actors. Batteries provide useful functions for the energy system and the network, such as frequency and voltage support, and can provide value for the aggregator when trading on the WEM as discussed in section 11.4. We heard from participants that batteries were useful to store solar energy that may not be used in the day from their PV system, for use in the evening. Participants also mentioned the benefits of having power in a power outage, although these expectations were not realised for participants in the pilot, as discussed in section 11.2.1. Batteries are a focus in this report because participants with a battery made up the majority of people who were involved in this research through the interviews, focus groups and surveys (table 3). Home battery systems were also new assets installed for the pilot, were a key motivator for householders to become involved with the pilot as discussed in sections 6.2.2 and 11.1 and were a significant retrofit (and intervention) for homes physically, conceptually and systemically. Input provided about batteries were a microcosm of larger themes and highlighted a range of critical factors that scaled programs will need to consider.

10.3.1 Battery use and function outside of testing periods

Various aspects of use outside of testing emerged in interviews as useful to understand and are discussed below.

Early expectations about use

From a content analysis of coded text from the first round of interview for battery related themes it was apparent that participants anticipated having ample power to draw on in the evening, because daytime generation would exceed use at night. Participants in the first round of interviews discussed day versus night-time use and the effect that this may have on electricity bills. The effect that air conditioning would have on energy/battery use was also mentioned in relation to batteries when analysing the content from the coded text. For example, one participant PI33 (March, 2023) explained that when not involved with pilot testing, their battery gets them through the peak evening use relatively well, depending on how many occupants are there for the night (they have mature children who visit).

Monitoring, understanding, awareness of use of batteries

Survey findings revealed that three in four battery participants changed their monitoring behaviour since joining the pilot. That is, 74% were monitoring their use more often compared to before the pilot which is in stark contrast to those in the pilot without a battery (Orchestration Phase 2 survey, 2023). See Figure 27 below. This shows the heightened engagement amongst battery participants.

Participants did seek to understand their batteries and indicated significant awareness, mostly in focus groups and in second interviews after they had time to become familiar with the batteries. At the second interviews in March and April 2023, participants were able to tell us about what type of battery they had, the best percentages to charge to, and in multiple cases the chemistry of their batteries in interviews (PI17, March, 2023). Many people followed battery performance and learnt about charging patterns through the battery apps (PI17, March, 2023; PI30, March, 2023). They thought through the detail of battery performance and assessed batteries in conjunction with their energy use.

Despite this knowledge, participants reported wanting more early information and communication about batteries. There was very little explained at the installation stage. Participants reported that instructions for use were not provided at installation in multiple cases and were wanted. In some case this was noted as, in part because the installers were busy, and at other times because the installers did not have answers that participants were seeking. One participant expressed the lack of information gained from the installer, stating:

Probably post-install is where I've had the biggest cause of frustration in that we were never really given any instructions on how to operate. I had to ask the installer what do we do, and how [unclear 2:11] or anything like that and he told us how to turn it off and turn it back on. That was all the instruction we got. The questions I asked him about, well what happens if there's a power cut? Do we keep our power? Do we lose our power? He had no idea. (PI43, March, 2023).

Moving into the pilot further, participants were also still appreciative of communication and information about their batteries. For example, information provided through emails (PI10, April, 2023). Participants were also keen for information about why their batteries charging from the grid at night. Checking of apps and checking the battery charge commonly provided applied 'training' and information to participants. Participants also sought manufacturing information and talked with manufacturers and suppliers of their assets. Battery manufacturer communications and interactions

(sometimes via the app) were reported as assisting with knowledge levels. Participants learnt as they went through the pilot and got to know how the battery performed.

Participants commonly reported monitoring battery storage, charge and discharge "because we have the tools now to actually see what's happening" (PI30, March, 2023), and critically to ensure everything was working well with their battery system. That the system and battery was working well appeared to matter to participants. With gathered knowledge, participants could specifically talk about details they needed to look out for to ensure the battery was functioning. The following participant provides an example of someone with detailed knowledge of how and when their battery charges and what percentage the battery reaches at certain times of the day.

A: I would open up the app, like in my computer. I would open it up in the morning and then throughout the day. I would refresh it and then see how the battery is generating. ... I normally just look at the battery, I don't look at the consumption. Just want to make sure that the battery's charging 'cause sometimes it's not charging so for whatever reason then I can contact the QCells provider (PI31, March, 2023)

I: So, have you noticed it not charging at any point?

A: There was a few times and what they say is it's because of the Project Symphony.

I: So QCells is aware that -

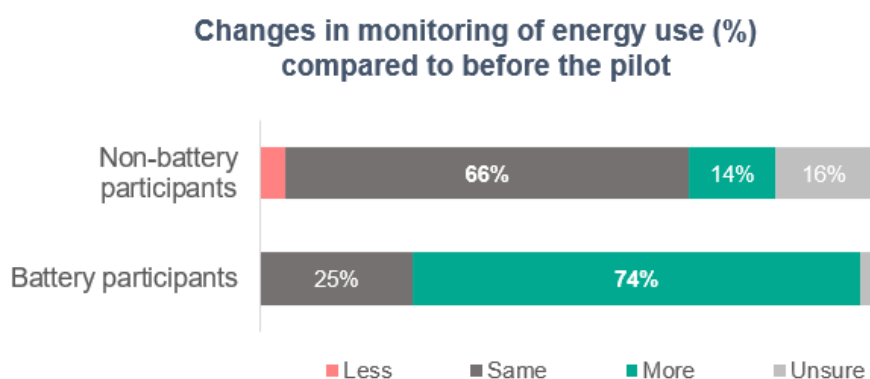
V: Yeah, they know. Then there were a few times that there was a problem with the software so that's -

I: So, you've had quite a few times by the sounds of it.

V: Quite a few times, yeah. (PI27, March, 2023).

From experience on other trials (Watson et al., 2019), battery companies are known to help with checking that batteries were functioning and could change maximum and minimum charging levels (PI31, March, 2023).

Figure 27: Changes in monitoring of energy use



Source: *Orchestration phase 2 survey - Q: Since joining the pilot, have you changed how often you monitor your energy?*

Monitoring and understanding

Energy use behaviours changed as participants tried to get the most out of their battery. This was part of being strategic and resourceful, and part of coordinating batteries in household energy systems. Participants applied their understanding from monitoring to adjust their energy behaviours and use. For example, noticing the quick draining of energy in the battery with evening use when using heating and cooling (PI02, May, 2022). Other participants were coordinating their home and battery charging with solar, via apps that provided home energy management (PI17, March, 2023; PI31, March, 2023). Others worked out energy use around the batteries without as much automated coordination. One participant discussed their learning curve with the batteries stating:

We have changed - so we've spoken to someone who has been running with batteries for quite some time and he's gone through this learning curve so he's not with Project Symphony but he gave us an insight as to what he learnt in terms of this is awesome so let's do that. So, we've changed our practices accordingly to try and get the best out of our battery. We've heard some anecdotal evidence from him as to when the batteries – apparently, he says there's settings that Synergy have put into the infrastructure to say that they will not start, the batteries won't start charging 'til after 10:00 or something like that. I haven't noticed that, I think they start charging straight away... (PI43, March, 2023).¹⁵

I just didn't know if the credits were enough if we're utilising the battery 'cause, ideally, I don't want that battery turning on until 6 PM. Even between four and six, I'll utilise all power if I had to, but between five and six, that battery, all the way to zero 'til 11 o'clock at night. You don't want to have to use energy during that time 'cause that's when you don't have solar. Even if it was four to 11, ideally you wanna have that battery go from 100 to zero, all the way through. You don't wanna use your battery when you don't have solar.' (PI07, March, 2023).

10.3.2 Responses to use of batteries by the pilot during orchestration phases

Responses to batteries that were orchestrated through the pilot were notable. The first substantive discussions about how the pilot was interacting with batteries at participant homes came through the first orchestration survey, customer service calls and then through the focus groups in February 2023. In the focus groups the collective conversations made it clear that pilot activity using the batteries was concerning and did not seem logical. Participants also indicated that their use of batteries during the first orchestration phase was limited, with how their batteries had operated prior to orchestration. Some participants were able to utilise their battery several months before orchestration began, which inadvertently set a precedent and standard for how much they can optimise their energy usage with a battery, external to being part of a VPP.

Participants found the inconsistent patterns of charging and discharging that occurred in the first phase of orchestration confusing and stressful. They saw the testing approach as unreasonable with their battery being used in ways that did not make sense to them personally, thus setting up a negative sentiment for many people. This sentiment, as we have noted, did shift somewhat at the

¹⁵ Western Power places limits on the times that batteries can be charged and discharged as part of their connection agreements. However, this does not apply where the battery is externally controlled by the DSO or an aggregator as part of a VPP. Hence the situation this participant was describing from his neighbour, would not apply here as this participants battery is part of the VPP. Source: [Basic Embedded Generator \(EG\) Connection Technical Requirements \(westernpower.com.au\)](https://www.westernpower.com.au/Basic-Embedded-Generator-(EG)-Connection-Technical-Requirements)

cessation of the first phase of orchestration as noted in section 9.2. While observing battery use was not enough for them to understand the overall picture of what was occurring, viewing things through the battery lens was both useful and clearly stressed many participants when they saw unusual use, and when they did not understand it.

As discussed in section 9, when there was a need to import grid electricity due to the constrain to zero (gross) testing, this caused particular irritation and confusion for participants. This was clearly something that did not seem logical to householders (for example PI02, PI17, PI22, PI27). One participant, like many others asked for and suggested better forewarning and detail.

... Because we have the tools now to actually see what's happening. And I found it ridiculous that you're draining the battery completely and then recharging it immediately. You're gonna recharge it and only done at night. Why not let it run during the day? But during the day, you kill the solar panels. (PI30, March, 2023).

Battery use was often the way participants with batteries knew about the pilot conducting testing. We were able to capture feedback from testing in the first stage of orchestration and then in very early days of the second stage of optimization. Participants with batteries were able to show us when the testing was occurring because they could see a drop in solar generating to their batteries on sunny days, and reduced battery storage as stated by one participant:

'It's more of a global switch so they said they can't do it individually so they must have flicked a switch somewhere that says turn off the solar panels for everyone and now I'm drawing down from my battery. I think they said the reason being is like [a] person across the road has only got solar panels so I'm actually compensating for them pushing back into the grid 'cause they're not on the system.
... the fact is that my battery's not being charged.' (PI33, March, 2023).

Stress about orchestration occurred as many participants were caught off guard, and they requested more detail about what might happen, closer to when the orchestration events happen (PI22, November, 2022; PI27, March, 2023; PI30, March, 2023).

Values and expectation affecting responses

Values, needs and expectations filtered responses to battery use by the pilot. Responses of two people in one household provides a good example of these influences and how perspectives could differ.

Interviewee 1: It's just we have a difference of opinion on a particular point and basically that it has to do with the battery. Some days when you look at the battery, you can actually see that the battery stays at 100%, and it's a hot day, and they're actually drawing power to the grid, with our battery, as well as the grid because it's obviously required whatever, and I've always believed that the battery belongs to us, and we should have full access to the 100% power to run our house, not be supplying the grid. That we generate power through the solar panels, fair enough, you go for your life, but once the battery reaches 100%, that belongs to us, not being taken....

Interviewee 2: Well, the way I see it is Synergy are giving us a rebate to cover the cost of them taking the power from there. So as far as I'm concerned, they're evening out everything and, until such time as the Synergy project finishes, which is September, we don't have control over what's going into the battery and what's getting taken out and we can use and all those sorts of things. So as far as I'm concerned, we've signed up to Symphony, and they control what is happening with everything. And at the end of the day, when we get a power bill, it's no different anyway, because they're giving us 42

cents a day or something. I can't remember what the amount is, for two things now. So we're getting at 82-84 cents a day to cover the panels and the heat pump – no, the air-con and the heat pump, I can't remember which one it is now. (PI29, March, 2023).

10.3.3 Assessing viability and fit

Participants in the interviews commented on the viability of their choice of battery by talking about battery life (durability) and about size and storage. There were no direct questions asking about viability and fit in the social research, but participants offered notable levels of information about these topics anyway, indicating there was interest and consideration of these topics driven by householders.

Battery life and sizing

Participants are thinking about battery life and are aware that battery life will reduce over time, with use. 'And I'm thinking, "How am I gonna use that?" 'Cause that asset will last me nine, ten years and then it will die. Sealed, whatever they are, lithium ion batteries.' (PI01, April, 2023). PI44 (March, 2023) was dubious about the pay back of the battery when the life of the battery was taken into consideration, stating: "Yeah. 'Cause, again, what's the life span of the battery – is ten years. And then you've only just paid for it. What's the point of getting it in the first place?"

Utilisation was also brought up in relation to battery life, in relation to the regular testing that was occurring as part of the pilot.

'The other one is maybe questions around the battery utilisation. So, Symphony have been driving the battery hard, charge, discharge cycles. So I've been thinking about that and thinking – oh, a battery finite charge-discharge life.' (PI01, April, 2023).

Social researchers are aware that use of batteries by the pilot and how pilot activity affects overall battery life has been considered by multiple organisations involved in the pilot. That householders were thinking through these factors, and in some instances were concerned, about battery use, life and viability indicates that further communication is required from pilot organisations about this concern in the future.

Some participants wished they had installed a bigger battery. (PI01, April, 2023); PI07 (March, 2023) questioned whether the 11 kWh battery they purchased was enough storage to meet the needs of their household. The stackable nature of the battery they purchased was important to them as it meant they could add extra capacity over time. Understanding the framing battery owners have about their battery capacity and enhancing capacity and storage over time is useful to understand and then address during scaling of pilot activities, so they do not become barriers to participation.

The issue of having battery back-up during supply interruptions is related to the above findings and is discussed in section 11.2.1 – expectations of battery back-up.

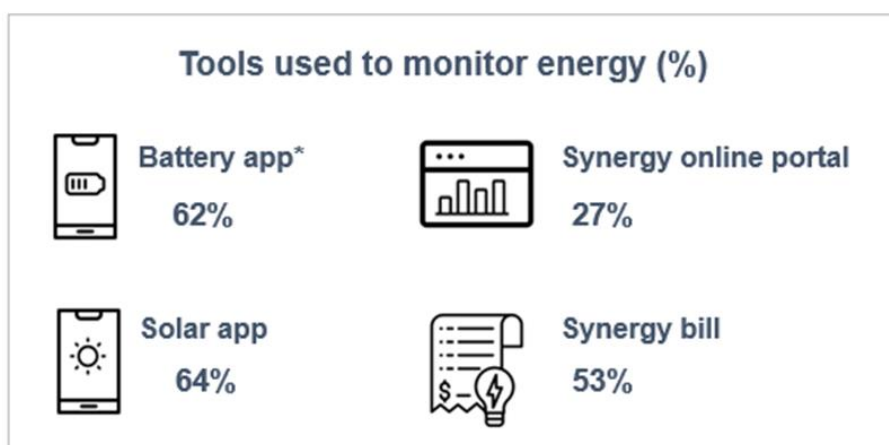
10.4 Monitoring and feedback for participants

Collecting and synthesising information about energy system performance on site and online was important to participants overall. Participants were mainly interested in energy generation, storage, use and the health and safety of systems. Information available on site and in the realm of the householder to monitor, included applications (or apps) that came with the solar inverter and battery installations, the retailer's online portal, electricity bills, and physical indicators, such as lights on

batteries, meters and inverters. Householders were also aware there was potential to use notifications in conjunction with other ways of monitoring. This section relates indicators in data collected about ways applications (apps) and online data were used, physical checking of systems and notifications, to provide some insight into energy system monitoring by households and their monitoring practices. As with many sections in this report, these points provide indicators to a much richer set of data that can provide further insights in the future.

Orchestration phase two survey findings showed that both battery and solar apps were the most common tools used by responding participants to monitor energy data, with over six in ten using these apps. App monitoring was followed in popularity by use of electricity bills (53%) as the traditional energy checking method. Figure 28 shows tools participants reported using to monitor energy. Further conversations in interviews identified physical onsite checks of equipment that also occurred. Checking of actual meters was rarely mentioned by participants in this pilot. Previous research also showed that meters were only rarely used for monitoring energy, for example with the Get Bill Smart research¹⁶.

Figure 28: Tools used to monitor energy



Source: Orchestration Phase 2 survey - Q: *And what do you currently use to monitor your energy?*

*Question on battery app asked amongst battery participants only.

Over half of participants indicated they used Synergy's My Account to view their electricity usage, before installations occurred. Based on survey comments, just under one third use other tools such as solar apps and third-party home energy apps such as Home Assistant. Participants indicated that there was more frequent monitoring of energy (mainly via battery and solar inverter apps) after installations for the pilot, particularly the battery installations, indicating that the pilot technology influenced and shifted monitoring practices, levels of interest, and accessibility to data.

The popularity of apps appears in large part to be because apps provided access to a data source that many had not used before. The apps provided detailed and diverse interpretations, for example, graphed data and, close to real time data. Synergy's My Account provided energy use and solar generation down to 30-minute intervals and while this was not quite real time, it was still seen as a helpful place to gather information and monitor what was occurring with participants' assets. The Synergy's My Account was also considered useful, with one participant stating: 'the Synergy app is great 'cause I can see import, export at any time.' (PI01, April, 2023). Difficulty with comparing data

¹⁶ Sustainable Living Tasmania [Get Bill Smart - Sustainable Living Tasmania \(slt.org.au\)](https://slt.org.au)

across different apps was a challenge that participants noted, which is detailed further in this section.

That apps used for monitoring were highly valued, indicates that various aspects of energy information were valuable for participants. Some participants paid for extra history from their solar and battery inverter apps (or were considering purchasing it) because of its value.

Apps also enabled understanding of various aspects of energy. For example, PI01 (April, 2023) explained: "I just use [it] primarily to see the amount of electricity that's produced in a day, how much we have consumed during the evening time, how much of battery power is left." Another participant highlighted how apps and monitoring of systems provided a new level of information, providing further options for understanding:

For me, I'm a lot more aware of how quickly the air-con[s] can suck juice. I was never that aware. I knew it's <inaudible> *0:23:31 but not as quickly as it does and, plus I've seen how it can balance out. Like if you get it to cool down when you had the sun and then it's not draining it so much' and when we first got the app, and it must have been winter, ...because we were running the heating and so [partner's name] would be on the thing going, "Oh, look how much we've got on our battery," and then we'd put the heating on 'cause we're cold, going, "Oh no, no, no." But it was really interesting. (PI12, March, 2023).

Once participants used an app, or various apps, the use of these continued in some form over time. Many participants reported using apps regularly or easing off over time due to reaching a reasonable level of comfort with the system, or because they had less to monitor at certain times. Orchestration in the pilot was something that participants monitored.

So I've been using the app. When I first went in, I was watching it every couple of days. Now, I'll go in once a week and just see what's happening. 'Cause again, I've kind of learnt what the orchestration behaviours are and that has eased off recently. They're not doing as many tests. So, once a week, I'll go in and look at it. And if I wanna see history, I just jump on the Synergy website and look at what's happening there. (PI01, April, 2023).

Participants checked their batteries, solar and home energy monitoring systems to ensure everything was functioning as it should, and this was also communicated as a driver of monitoring in interviews. This type of monitoring occurred through apps and physically on site as one participant in the second interview explained:

I: So when we get out the driveway, our job is to make sure the light is on, 'cause that neighbour was saying – he told me last week that he didn't even know that it wasn't switched on.

Interviewer: The what wasn't switched on, sorry?

I: The battery. (PI04, March, 2023)

Another participant similarly noted in the second interview they monitored to check the system: "I guess via the app. So, I'll look at the Fronius app, just to make sure that batteries are working, how much solar is coming in, how much I'm exporting to the grid." (PI05, March, 2023).

Participants reported that lights on batteries were noted by installers and battery manufacturers as indicating the batteries were functioning. Lights were therefore mentioned in interviews by participants when talking about the function of the battery. Checking lights appeared to be woven into monitoring, but in some cases, recollection of what lights meant wasn't clear.

I mean it was only later – I think we've got an update, from you guys, about how the thing actually works. Because sometimes, the lights come on. I think it was a blue light, or the red light, whatever.... Yeah. We were told that if that comes on for a while, we need to reset the thing. Then we later learned that, well, we don't really have to, it's because it's being controlled remotely, so I just let them know. (PI10, April, 2023).

Evidence in the second orchestration survey shows that participants with a battery tended towards more app use and had stronger tendencies to use more granular data from more direct sources, such as from apps and Synergy's My Account. In contrast, those without a battery tended to rely much more on their electricity bill. This difference in monitoring practices likely reflects:

- The increased awareness from the battery installation and having a physical battery around likely created, and the positive disruption in practices this could have caused.
- User-friendly battery apps and their accessibility influencing exploration of data, and
- Intentions expressed by participants to maximise energy usage with their new battery.

Compatibility between the battery and solar inverter apps was lacking and participants often talked of having to move between these apps, often expressing frustration about this. It is noted that this is a broader industry wide issue. Data from Synergy's My Account also did not provide sufficient real time data on orchestration. In the focus groups and the second round of interviews, participants discussed a strong desire to see all the data in one spot and to have it correlate. Related to the lack of compatibility between apps was the need for participants to have an additional inverter installed that was compatible with the software used in Project Symphony. This is an industry wide issue as noted and limited interoperability between battery and solar systems leads to a lack of communication between devices and is likely to lead to reduced benefits for customers in the future (Cutler Mertz, 2020, p. 16).

A participant in the focus group found an inventive way to get more information to try and work out what was happening to his system by scraping data from the battery manufacturers site, he states:

So there's just, it has an IP address. Yeah, just I just googled around the model and some people were just talking about oh, one scrape data from this model. The what's it called? The Q cells? Yeah, and you just put this other one number in or whatever. And then I just thought, oh, let's just give it a try - a bit of a shot in the dark. And lo and behold there's actually a table with values that are constantly updated in live time (Focus group participant 14, February 2023).

Through doing this troubleshooting, the participant was able to find out that over the previous 30 days, his solar PV system was sitting on 200 watts of power. He then states:

So, when I emailed Project Symphony, I just emailed the graph of, here is my solar output and here is - Yeah so that's how I got a response (Focus group participant 14, February 2023).

Synergy was aware of the challenges and incompatibility with the apps not correlating with participants online data. Synergy also understood that participants were seeking visibility of their DER assets with a single platform that included electricity consumption, solar generation and battery charge and discharge.

The Synergy team explored the option of providing access to a third-party dashboard to address participants' desire for better visibility into their energy demand and DER assets. The third-party dashboard considered is designed for participants of VPP projects, but it is only offered with administrative settings. If these administrative settings were available to participants of the Project Symphony pilot, it would have provided access to areas where essential settings could be changed, along with other sensitive information.

There were also concerns about the accuracy of the usage data presented in the dashboard, as it did not always match with other apps participants were using to monitor their assets, or billing data from Synergy's My Account and had the potential to confuse participants. To address these issues, Synergy has been collaborating with the third-party provider to find a solution that allows participants to access the dashboard, while ensuring data accuracy and maintaining privacy. Synergy acknowledged and are aware that providing customer access to a consolidated view of their energy usage and DER assets is an important goal for future DER pilots (Synergy, July 2023).

Enthusiastic monitoring was not for everyone with a handful of interview participants explaining that they only looked for brief checks and didn't look too closely, as stated by one participant, "We don't use the app actively. It's more of curiosity more than anything else. Once in a while, we have a look at it and see"(PI10, April, 2023).

The range of monitoring behaviours indicates that anything at scale likely needs to factor in the range of information needed and or the types of information preferred. As discussed in this section, participants wanted visibility to understand what was happening with their assets and the online platform that was shelved, is likely to have been welcomed by participants. Having a variety of information also appears useful, with opportunities for cursory checks through to more detailed involvement, with both energy data and costs available to enable assessment. Householder monitoring of the 'health' of their energy system can arguably assist the viability of VPPs and is essential for ensuring that there is social licence to operate VPPs.

10.5 Gateway device and end of pilot technology management

An intriguing aspect of Project Symphony from the social researchers' perspective was the installation of hardware in participants home, referred to as the gateway device. These devices were grey boxes with a combination lock (figure 29) that were used as a 'communication piece' to remotely control participants solar PV, batteries and loads (air conditioning, hot water) as part of the pilot.

Figure 29: Installed, locked gateway device in garage (PI28)



The social researchers asked participants in the first interviews if participants had this device installed and if they were aware of the purpose of this device. The common response to this question was that participants did not know what it was, and they were told little about the device. Some participants were aware that it was a communication device, saying, "I think it's got a data communication thing or whatever. I'm not sure because it's locked. I can't even look" (PI19, August, 2022). One participant was curious about the box and after being told not to open it by the installer, decided to crack the combination lock to open it. Another participant was amused at the lock that was on there, saying:

Now, in the garage, there's obviously the battery, the new inverter, but also a lovely box that says, Project Symphony Trial, and amusingly, they've got one with little – you know, like, you've got on your luggage a travel lock? It's one of those, and amusingly, they've stuck one of those on that, and I thought, what are you trying to hide away from me? (PI01, April, 2022).

Most participants were told not to open the box by the installer, and the social researchers are aware of a participant who was not interviewed as part of this research who made a video about the project, with the text "top secret" over the gateway device box. Another participant referred to all the boxes as "black boxes" (PI30, March, 2023). It was a point of curiosity and amusement for many participants, but for the most part, it did not cause a great deal of concern.

The additional devices and complications with retrofits as discussed in this section raises another point about the "accumulation" (Günel, 2022) of material devices in participants homes. Günel (2022) among other scholars such as Smil (2016) and York and Bell (2019) discuss how energy transitions are not a neat replacement of one fuel or technology to another, but in fact are largely additions to older sources of energy and infrastructures, and with those additions comes further energy use and consumption of materials. One participant when asked if they had any thoughts or concerns about the installation or the assets installed, describes a form of accumulation occurring in their home with the addition of another inverter saying:

P: Only that I've got lots of boxes in the garage now that I didn't have. But I found it a little bit odd that we have another Fronius inverter separate to the Fronius inverter that we've got for solar panels. I would've thought you would provide one that does both. My understanding you can get inverter that does both, but I'm guessing that's been part of the Synergy requirements for that to remain separate to existing assets.

I: I'm not sure about that.

P: I'm not sure what a couple of the boxes do.

I: Did they say anything to you about the gateway device?

P: Not a lot, no. Really just a link between us and Synergy is my understanding.

I: So, there is a lot of equipment there, is there, in the garage?

P: And I guess what happens to that once the program is finished.

Several participants through the research also questioned the additional inverter, and why their existing inverter could not be used, with a significant concern being the accumulation of boxes and the space they took up. There was also little explanation provided about why their existing inverter could not be used. Concern about the environmental credentials of batteries was also raised in the first interviews, with some participants wanting to do the right thing environmentally but questioning the resource consumption of minerals and materials needed in the production of batteries.

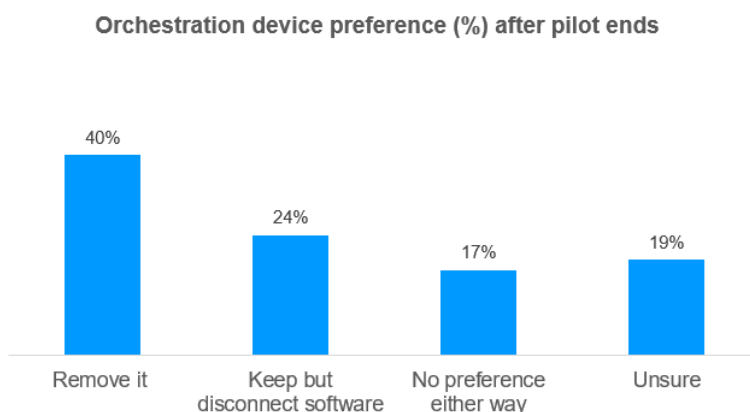
In the second interviews, we asked more specific questions about the gateway device and the high-speed data recorders that were installed later in the pilot, and what people thought, or would like to happen to these boxes at the end of the pilot. There were indications in the first interviews that participants expected the boxes would be removed at the end of the pilot, and some participants stated that the contract included that the boxes would be removed at the end of the pilot. There was a mixed response of what people wanted to happen to the boxes, including the gateway device at the end of the pilot. Some participants had a clear preference, expectation and understanding that the boxes would be removed at the end of the pilot. Other participants were less concerned and ok for it to stay, but asked questions about future projects and what they could be used for.

Several participants had additional questions about the boxes, asking if the mysterious box will still monitor and control things in their home. Other questions that arose related to what will happen if the boxes stay and who will maintain them? If the boxes are removed, what will happen to the holes in the wall? Will Synergy or the installer fix these? These were questions that the social researchers were unable to answer, however, Synergy are working through the logistics of these questions and have been in contact with participants who are nearing the end of the pilot.

Synergy also sought to further understand what people expected or wanted to happen with the extra devices installed and this question was also asked in the second orchestration survey. The survey findings on end-of-pilot preferences included:

- The majority of participants (40%) wanted the orchestration and high-speed data recorder devices that were installed removed and disconnected from the software when asked their preferences for management at the pilot end (figure 30). There were expectations that Synergy will also restore the area upon removal. One participant stated “Would very much like the orchestration boxes to be removed and any holes be filled up and patched up as a result of the drilling” (Orchestration phase 2 survey, 2023).
- Participants indicated that they wanted more information about the pros and cons of each end-of life option to help them make an informed decision. For participants who were ok to keep the devices, they still wanted assurance that the hardware will be disconnected. Others assumed there would be benefits such as enabling them to participate in future pilots or being able to use the devices themselves for their own monitoring.
- Other participants had caveats to whether the devices stayed or not, with one participant commenting: “Selected to leave devices with possibility of future programs that have incentives. If this isn’t the case, would like them removed” (Orchestration phase 2 survey, 2023).
- There were a range queries and thoughts by participants in response to the question of keeping or removing the orchestration devices. This included:
 - The cost of removal of devices in the future if they chose to keep it now.
 - Assurances about whether their device would be reconnected in the future without their consent.
 - Whether they could safely use it for their own data monitoring.
 - The pilot’s own intent of the fate of the devices, and
 - Impact of keeping the devices.

Figure 30: Orchestration device preference at pilot end



Source: Orchestration Phase 2 survey. Q: *There are devices installed in participants’ homes to allow assets to be remotely controlled (orchestrated). These are gateway devices and some have additional data recorders. Let’s imagine the pilot has ended and you are given options regarding these orchestration devices. Which of these would you prefer?* (n=115)

How participants were thinking in relation to the end-of the pilot and the technology installed at their homes was of interest to project partners and is useful to understand strategically moving into the

future. The end of pilot opinions were useful directly for this pilot and could assist to understand if the pilot was at scale phenomena that might occur at the end of asset life. Findings from participants were therefore sought in the final interview and the second orchestration phase survey. Thoughts from participants about both the end of pilot and after pilot were sought.

Discussions in interviews about end of the project varied but tended to cover what would be taken out and what would be monitored after the pilot. At the time of interviews, the project partners and social researchers were unclear about what would occur with the technology at the end of pilot and discussion included some uncertainty and provisos. The level of technology installed not only created something very tangible to discuss, but showed the relatively large scale of physical change needed if technology was to be removed.

10.6 Implications of findings

Implications of these findings can be used to provide strategic support for planning next steps for and scaling of solutions and technologies in programs. Overarching implications from the installation and technology findings are therefore listed here as points that can support planning for future programs. Implications include:

- Installation processes evolve over time and this may impact planning in the early months of a large program. Refinement is likely to occur and systems and processes for installation are likely to change accordingly.
- Quality assurance checks are a very positive part of the process, not just to check safety but as an intervention ensuring high quality installation activity and householder understanding of the safety aspects of their systems. Including these as both safety and understanding checks in future is worth considering.
- Installations overall were positive, but there were also challenges with installation. Processes to resolve challenges will be important moving forward. Positive installation processes can be described in best practice guidelines so that these can be shared more widely.
- Installations became more complicated with each asset connected and there is a lot of technology being installed, taking up significant space in already often highly utilised garages and service spaces. The level of technology involved could become a major challenge for larger programs. Removing this technology must also be considered.
- Accumulation and consumption are mentioned above and are important considerations as they relate to often strongly held household values such as house pride, neatness, simplification and environmental care.
- Installations were in part successful also because they were being installed in comparatively new housing.
- There are safety features such as bollards being installed due to batteries being retrofitted in garages. Bollards are not a common feature inside garages but are used here so cars do not touch the batteries. That such a safety feature is needed is an indicator that further considerations about having batteries in garages is important to undertake.
- Householders require detailed explanations of what is being installed in their homes in future programs.
- There are limited places for assets to be installed into houses like the ones involved in this pilot. Certain housing is going to be more suitable for retrofitting of larger assets, like batteries. Understanding the features that support or challenge DER installations will be useful for planning future programs and for understanding how housing feature might block people being involved.
- Consideration and a strategy related to checking on accumulation of 'things' around batteries (and battery maintenance) will be needed for any future program.

- Strategies for end of involvement related to either leaving a program, or a program stopping and people moving homes, need to be included in future programs.
- Battery expectations can be proactively managed and further communication around how batteries are used in programs would help to ease concern around battery use. Battery charge and recharge is an example of an issue that could be engaged with through further communication. Consideration of the technical parameters of batteries is needed to ensure that the manufacturers guidelines for charging and recharging cycles are considered.
- Householders value home battery systems for the personal control it provides over energy use and storing solar generation for use in the evening. These values and the way a battery is useful for participants, clashed with the use of the battery for the testing scenarios enacted (table 1). An intention of Project Symphony is to determine the financial value for customers, and a cost benefit analysis for the project is in progress at the time of writing. As discussed in sections 11 and 13, participants motivations were broader than cost savings and they valued energy arbitrage, therefore these broader aspects of value also need to be considered for future projects.
- Participants monitor their technology if they think it is, or have been told it is, a useful practice and the risk of unmonitored systems may grow over time. Programs likely need householders to monitor and maintain their systems over time. We know from other battery integration trials (Watson et al., 2019), that battery companies monitor batteries too and this observation and control may or may not work with a future VPP.
- Unpredictable use of the batteries by the aggregator is stressful and confusing for householders and is assessed as a risk by householders. This stress and concern could see people leave a future program. Strategies will be needed to counteract unexpected or unknown battery use.
- Participants with access to new apps, particularly those who had also installed a battery, increased their monitoring via apps and Synergy's MyAccount. Increased checks and learning about energy can be assumed when programs like this occur.
- Householders were keen to have data between apps align and moving forward this could be a sticking point for householders in program. Managing the confusion of this could become time consuming for a program and is therefore a risk worth exploring. This issue is already quite well understood, and solutions are currently being explored for this by project partners.
- That there were a range of monitoring behaviours is important to recognise in any future program as householders showed that they used a range of information to check on and understand systems and this was useful.

11 Value for participants

This section presents findings relating to the value of participating in Project Symphony – actual and perceived - and responds to research question 2b. Value discussed here includes financial value such as the asset subsidies (figure 3) and orchestration payments (figure 4), as well as other values based on participants motivations and expectations from participating in the project. Tariffs are also discussed here but were infrequently mentioned by participants. As there are a lack of price signals for participants in Project Symphony, we have not discussed modifications in behaviour in response to price signals.

Summary

- The value of the project for participants includes their motivations and expectations.
- Key motivations to be involved in Project Symphony among participants who were interviewed and at the focus groups were the asset subsidies (mainly battery), environmental

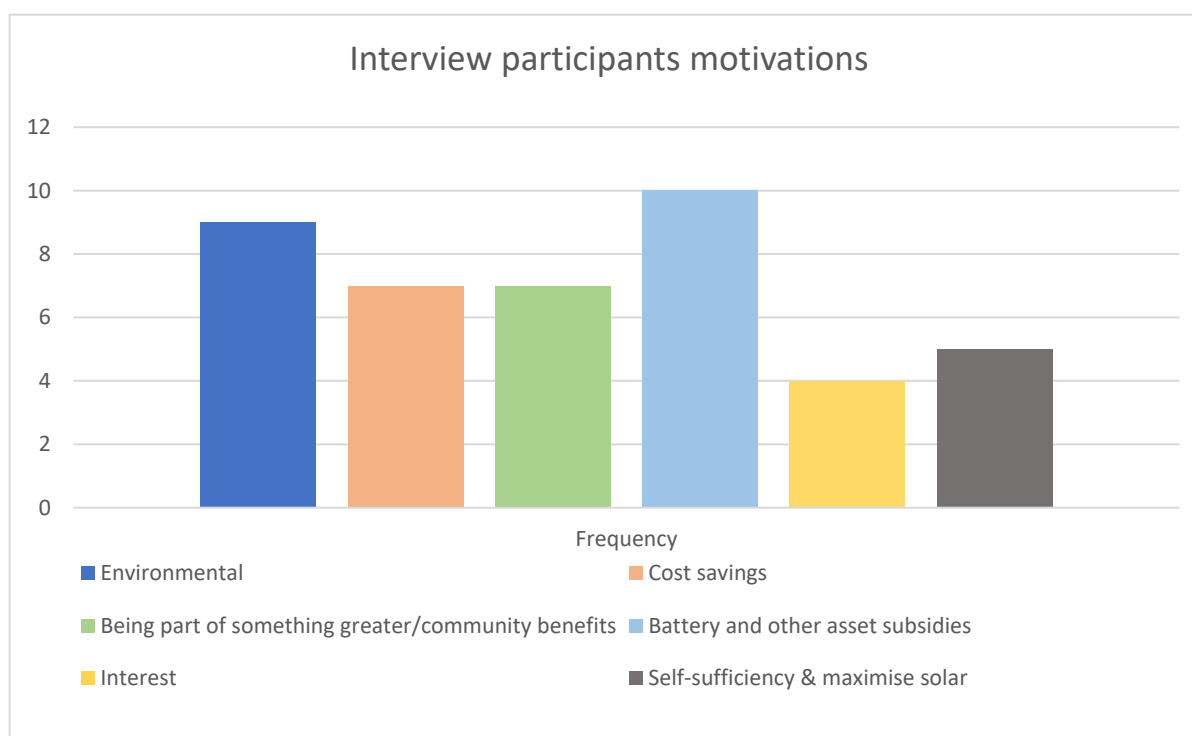
reasons and cost savings. Survey results also indicated that 87% of battery participants were motivated to participate for the battery subsidy (table 4).

- Key reasons for participating from survey respondents (figure 8) included maximising the use of solar, reduction of electricity costs, and future proofing against electricity price rises.
- Participants were also motivated by broader community benefits and being part of something bigger.
- Expectations in the first interviews related to being able to utilise battery storage in the evening, battery back-up in the event of a power outage and reduced bills.
- Participants with a battery expressed an expectation in the initial interview that they would benefit by having energy stored in their battery to utilise at night and reductions in their bill.
- Battery back-up was also frequently brought up by participants and disappointment was expressed when they realised that their battery did not offer protection (back up) in the event of an outage.
- Survey participants without a battery were motivated to participate to reduce electricity use and costs (80%), maximise the use of existing solar (78%), future proof against possible electricity rises (78%), and to be more sustainable/help the environment (74%).
- Tariffs were rarely mentioned by interview participants – however, one participant discussed his experience on the midday saver, and another on the EV tariff.
- Overall, interview participants were satisfied with the asset subsidies, but participants did not have a clear picture of the overall value of the project, particularly when factoring in their experience from the first orchestration phase.
- Results from text input in the second orchestration survey indicated that when non-battery participants were asked their thoughts on the value of participating in the pilot, they mentioned the incentives (figures 3 and 4), followed by their ability to contribute to the future energy needs, the community and the environment. For 23% of non-battery respondents to this question, they stated they did not know or were unsure of the value of the pilot.
- Orchestration was where participants expressed the most dissatisfaction, as it negated personal benefits and expectations.

11.1 Participant motivations

Participant motivations to join Project Symphony were consistent across the first interviews and focus groups. Some participants had several reasons for joining, such as environmental, cost savings and community benefit. As noted in table 3, there was a high proportion of participants interviewed and surveyed as part of this research with battery assets. For survey respondents who received a battery, 87% indicated that they were motivated to participate for the battery subsidy (table 4).

Most Project Symphony participants the researchers spoke with through interviews also said they joined the Project Symphony for the battery and other asset subsidies such as air conditioning and heat pump hot water systems (24%). This was closely followed by environmental reasons, with 21% of participants stating they were motivated to participate to “help the environment”, future proofing and contributing in some way. Being part of something greater or community benefits was also frequently mentioned as a motivation in the interviews (17%), and cost savings were equally mentioned at 17%. Figure 31 below shows interview participants motivations to join Project Symphony.

Figure 31: Interview participants motivations to join Project Symphony

Cost savings were an expectation for participants, and this was the case for both battery and non-battery participants (table 4). Cost savings were not explicitly promised by Synergy and participants were advised that their bills may increase. However, the idea of "financial rewards" were stated and implicit in earlier communications, specifically the expression of interest for the pilot (figure 6). For non-battery participants, survey comments indicate that the expectations of cost savings may have arisen due to the offer of financial incentives (figures 3 and 4) and for a minority of participants, the incentive payments (figure 8) were a factor to participate. Further clarification of the financial incentives as an influence on expectations of cost reductions would require further research.

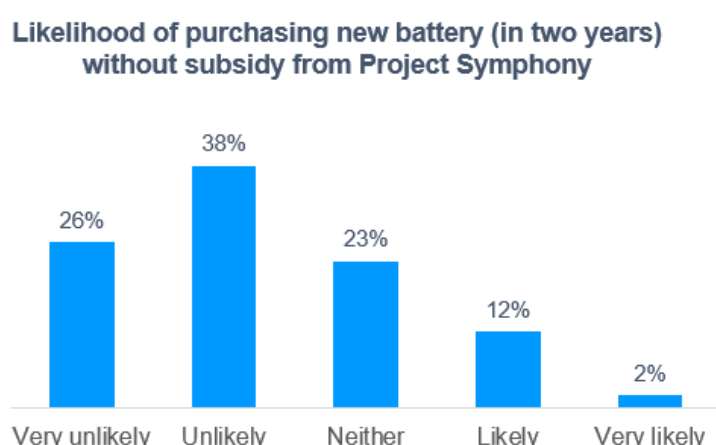
Table 4 Key reasons for participating in pilot by battery vs non-battery participants

Key reasons in participating in pilot	Top 2 most important reasons*	
	Participants with battery	Participants without battery
Wanting to reduce electricity use and costs	94%	80%
To make the most of my existing solar PV system	96%	78%
Help future proof against possible future electricity price rises	81%	77%
Being more sustainable and helping the environment	72%	74%
Receiving a subsidised asset(s), e.g. battery or hot water system	87%	59%

Key reasons in participating in pilot	Top 2 most important reasons*	
	Participants with battery	Participants without battery
Being part of something new and innovative	70%	65%
Having advanced technology installed	68%	62%
Being part of a community of pilot participants	62%	64%
Helping the electricity network to be more reliable	57%	67%
Receiving the incentive payments	49%	58%
Increasing the resale value of my home	45%	36%
Total sample size	53	69

Approximately 43% of participants (150) received a subsidised battery through the pilot, but this percentage was higher for participants who were interviewed and surveyed as part of this research (table 3). For participants who stated this was the reason they became involved, many had already considered getting a battery, but felt that it was not a good investment to pay the full upfront cost of this, due to the long payback period. Results from the onboarding survey also showed that, in the absence of a subsidy, 86% (57/66 base) of battery participants were either unlikely or unsure about purchasing a full price battery in the next two years. Some participants also stated that their hot water system was due to be replaced, so they took the opportunity to be involved and receive a subsidised heat pump hot water system. Subsidies were clearly a notable motivator, which may not be available when scaling pilot activities, which could mean the appeal to be involved could reduce.

Figure 32: Likelihood of purchasing new battery without pilot subsidy



Source: Onboarding survey

Q: *Without the subsidy through Project Symphony, how likely is it that you would have purchased a new battery within the next 2 years?* (n=66)

Where cost savings were a motivating factor to be involved, interview participants who stated this motivation often had families and used their heating and cooling consistently. One participant who referred to costs as a motivation stated:

..a big thing with having a young family, is that costs are going up, so if I can do something to help with that, that's obviously a big thing for most people. Everything's just going up and electricity is something that's quite a big chunk of your bills as well, so that was really important. And, as well, learning a little bit more about our solar usage as well, because we try and do as much as we can during the day, so you can make use of that, but it gets a bit harder. (PI46, October, 2022).

Secondary motives related to the environment and broader community benefits. Participants often talked about being involved and doing their part to help with these types of projects as well as concerns about climate change. However, interview findings show that for some participants, environmental reasons and being part of something bigger was more important than cost savings. As stated by one participant:

I suppose the environmental and sustainability stuff, again, is this whole thing about green energy and renewables... I think it's quite important. And unless people participate in that, it's not going to happen. So, I thought when the chance came up, why not. (PI17, June, 2022).

Another participant stated:

.. sometimes we think, "What can I do? I'm only one person." But I think if we all think that way, then nothing will happen. So, I definitely think it's, at least from my point of view, something to try to see whether I can make a difference for myself and maybe for the environment. (PI19, August, 2022).

Another participant who had an understanding of energy from prior work in the sector felt that Synergy were being proactive in trying to resolve issues on the grid stating:

Because of my background, I'm more conscious of what's happening. I know where all of this comes from, I know where it's all going. And if we don't do something about it now, it's going to be too late. Maybe it is too late now, but at least Synergy is trying to do something or the state government's trying to do something. (PI23, September, 2022).

For participants who were motivated by broader community benefits, there was a sense that the pilot was doing something for the broader community and the participants involved wanted to be part of that in some way. One participant stated:

that's one of the things that did draw me to it.. that and the incentives, but Synergy wanting to do a whole transformation of how they provide energy to the public and how they use that energy, I just thought it'd be really good to be part of something like that. (PI39, September, 2022).

Several participants also mentioned being in a position to help financially.

So it's like for the greater good - and we've always wanted to support the project that's a community benefit rather than just for ourselves. And if that benefits other people who are in a worse situation than we are, then that's what we're about. (PI50, October, 2022)

11.2 Interview participant expectations

Hopes and expectations for the project arose as a theme through several different questions asked in the first interviews before orchestration around participants' views on cost benefits, environmental sustainability, and reliability. Participants' hopes and expectations also arose when we asked about their appliance use, and if they felt it would be affected by orchestration. Responses from interview data were not categorised according to asset type, so it is noted here that the below expectations refer mostly to participants with a battery, which comprised 81% of interview participants (table 3).

The main expectations participants expressed in the initial interviews (before orchestration) were:

- Utilising battery storage at night
- Bill reductions, and
- Having battery back-up in the event of an outage.

A report conducted on the economic value of a VPP in the SWIS by Oakley Greenwood (no date) as part of Project Symphony reporting discusses the value of battery storage for customers. The report notes the assumption that the battery is able to be "exercised by the VPP every day of the year" with a margin always available for the participating customer. The report also states that "how much control the participating customers will be prepared to allow the VPP to exercise over their battery storage systems is a different matter" (Oakley Greenwood, no date, pp. 13-14). The discussion about orchestration in section 9 provides some insight into participants' experience of, and the following discussion on expectations provides insight into how prepared participants are to allow their battery to be orchestrated.

The idea of a VPP is to provide services to various markets, of which a share of the value is then transferred to the customer. As stated in an interview with a project partner, WA is "looking to change fundamental economics by unlocking the market – unlock the value stack" (Project partner interview, October, 2022). The project partner also discussed how there was limited desire to provide subsidies for batteries to people who did not necessarily need the subsidy.

As discussed in the literature review (section 5), the reasoning provided by the project partner "to unlock the market" provides little indication or insight into how the value is then transferred to the customer. We know that "unlocking the market" has the potential to provide value to project partners, but it is not as abundantly clear to Project Symphony participants, where the value sits for them, particularly when interview and focus group participants' expectations at the start of the project included, battery storage, battery back up in the event of an outage and bill reductions.

One of the project partners succinctly described what Project Symphony was attempting to do, which is likely to have assisted in communicating the 'pilot' nature of the project and how value was to be determined. The value of the project was described as providing a "nominal value" for orchestration, in the form of orchestration payments (and other incentives) to "determine the actual value of market participation" (Project partner, July, 2023), through the testing scenarios described in table 1. There was also a need for the recruitment of participants to occur, before Synergy knew what was involved and what the actual value of the project was. Therefore, it was difficult to set expectations for participants upfront, and hence why it was necessary to offer large incentives to ensure that project partners had enough assets installed to test the technical capabilities of the pilot.

11.2.1 Expectations of battery back-up

Despite the fact that 98% (123/125 base) of participants rated the grid as reliable in their area from the onboarding survey, still a significant number of participants felt some comfort, prior to orchestration, about having battery back-up in the event of an outage. Participants expressed their

hopes in the first interviews that the battery would provide back-up power in the event of an outage and did not realise that this was not configured on the batteries purchased, or they were not sure if they did have back up as expressed by the participant below who stated:

So having a solar battery – I think being part of the pilot and the batteries will be, I guess, a bit of ease of mind knowing that if the grid does go off, perhaps my device – appliances can keep on running on battery. But again, I'm not too sure. I could be assuming, but that's what I'm hoping (PI05, May, 2022).

And further:

The idea of, you know, for example, having a storm or a blackout and thinking we have not a full battery, because, you know, how it goes through the days, but knowing we might have some battery that could get you through the night, that was an incentive to me. Just the thought of – like I know it's not going to last you forever, but it's something that if need be, we can really cut a lot in our house, and still run our fridge and cook dinner and little things like that (PI09, August, 2022).

The expectation of having battery back up in the event of an outage was also evident in the Bruny Island Battery Trial, with households placing value on this. The value of battery back-up for households in Bruny Island was significant due to being located in a rural area with frequent outages (Watson et al., 2019, p. 7). Although participants of Project Symphony had very infrequent outages, value was nevertheless placed on having the security of power should an outage occur.

There were three different battery brands being tested by Synergy through Project Symphony. This includes the brands, QCell, Fronius (GEN24) and Sonnen. Synergy have communicated that the reason for choosing three different brands was to “understand how each respond to orchestration as well as general performance” (Synergy, May, 2023a personal communication).

Synergy have stated that the QCell batteries do not offer blackout protection as a standard feature in the event of a power outage. Configuration of the QCell battery is needed for this brand to offer blackout protection and this would be at the participants' own cost, similar to the SA VPP mentioned in the literature review. It is not known if any participants went ahead to configure their batteries to offer blackout protection, but several participants have expressed an interest in doing so. One participant in the second interview summed up their frustration with this stating:

So, when I had a look at the battery the other day, it's not configured for back-up power. That is a functionality that's offered on the battery. I'm not sure why that was not configured and whether I'm able to configure it. I'd like to but I don't wanna' mess up your data. So that's another question I have 'cause I don't feel like I'm getting maximum return on investment out of the battery. There's some functionality there that's not being used. And I don't understand why that wouldn't have been enabled at the infancy unless there's a technical reason within Project Symphony. It wasn't a cheap purchase even with the discount, so I would like to see maximum return on investment. (PI03, March, 2023).

Participants interviewed at the installation stage were surprised to learn that their battery did not provide outage protection in blackouts. Some participants were told this at installation, while others learnt of this when a power outage occurred in Harrisdale and Piara Waters on 9 September 2022. This outage occurred for 3.5 hours and was attributed to someone running into a power pole. As a result of this, around 6 to 7 participants called Synergy stating that their battery did not provide back-up power in the outage. The Synergy team at this point let participants know that additional installations would be required to allow battery back-up in the event of an outage.

One participant, PI18 (March, 2023) said they were wanting to get the back-up feature and thought it would be easier to get when the technology was not connected to the pilot. As with other participants, they realised after installation that they did not have back-up functionality with their battery and went through a process of gathering information themselves to find out how to enable back-up. We do not know whether this perception of back-up being easier to do when the pilot is over was widespread but could have implications for post pilot scaling.

My point of view was that I was told, and I don't know if it's correct or not, that the battery I have won't work as a back-up battery if there's a power outage because of the way it's currently wired up, and for it to become a back-up battery, they need to change the wiring, so however it was wired up, whatever the situation. I'm not sure exactly what it is, but then I don't know how that works with Synergy's control device. So whether or not the two are compatible or not, I don't know. (PI18, March, 2023).

The work by Star (1999) on the ethnography of infrastructure is instructive here and is of relevance to various issues we have discussed in section 10 and 11 of this report in relation to the "invisible work" and the barriers that were in place with "fixed choices" (Star, 1999, pp. 385-389) of the technology in the case of limited battery functionality. Participants also sought information from Synergy, installers, manufacturers of the technology as well as others in the pilot. This required time and knowledge to understand the details of the technology installed in their homes and to provide functionality that participants expected to be standard when purchasing a home battery system.

11.2.2 Expectations of bill reductions and battery storage

From the research, we know that most participants interviewed and surveyed, participated in the pilot due to the battery subsidy that was offered, and often participants who decided to take up the offer were already considering a battery. The value proposition for participants, particularly for those with a battery largely centred around having energy storage (arbitrage) to utilise their stored energy in the evening, and this expectation was disrupted with orchestration. As discussed in the orchestration section, participants told us that batteries were being charged from the grid with several participants mentioning that this occurred in the early morning around 2am. This caused considerable concern for participants and led to a questioning of value of the project, particularly for participants who were motivated to participate in Project Symphony for environmental reasons.

Kuiper (2022, p. 1), in an analysis on the state of VPPs in Australia notes that savings for householders involved in VPPs, where an aggregator has unlimited access to a battery is approximately \$200 per year, which is far less than the savings that could be gained from solar energy storage and arbitrage. For participants who purchased a battery, they expected to see bill reductions, with one participant waiting to see if having a battery would reduce their bills more than having the higher payback on their solar generation through the Renewable Energy Buyback Scheme (REBS), as opposed to the lower export price with what they were now on with the Distributed Energy Buyback Scheme (DEBS) stating:

I think the next bit is more to we just have to see now like by having the battery, does that reduce our paying the bills more than the payback [buyback] scheme? (PI41, September, 2022)

As mentioned, energy arbitrage was an expectation for most battery participants interviewed. Participants informed us that they believed they would have sufficient power to draw on as daytime generation would exceed usage at night as stated by the following participant:

And from a home point of view, using the batteries basically to smooth out the usage – as I said, we're exporting a lot of power during the day and a lot at night. So really, it's just retaining that for later usage. I did some maths with the guy next door and we were

working out our usages, and I worked out that I can basically keep the house powered until two or three o'clock in the morning. (PI33, August, 2022)

And further:

.. so the way I see it is traditionally when we had the solar unit without the batteries we had to load everything up during the day so that way so that meant that even the dishwasher and the washing machines, we originally tried to really set the timers so that they were coming on during the peak day when we were having batteries. So that's going to change quite dramatically and probably develop as we understand how it works because one thing I want to try and work out is how long will it take to charge that 11kW[h] battery just doing a normal business. So the idea would be is that we would just live normally now because where previously we were pumping 7c worth of electricity back into the grid and then paying it back an hour later at 30c the idea now is we would live and it'll draw from the pump. (PI26, July, 2022)

11.3 Financial incentives

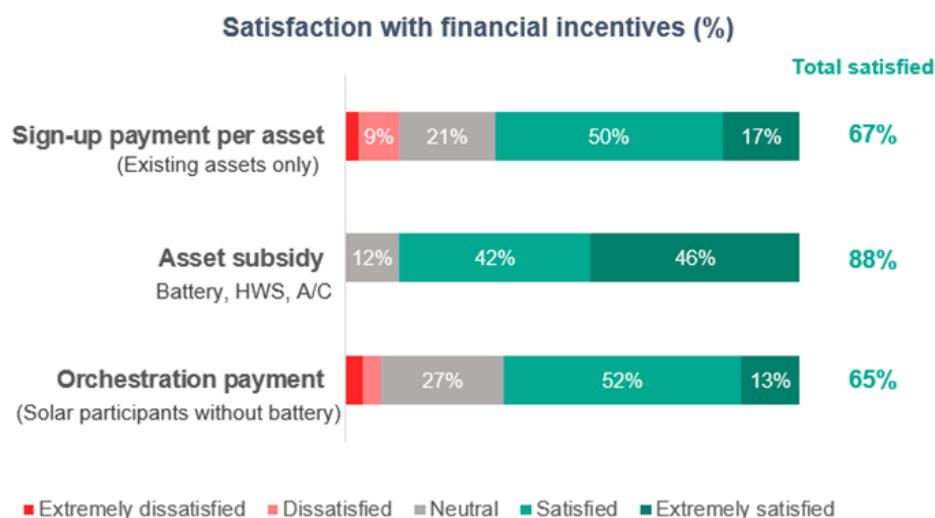
In a bid to attract participants, several incentives were offered, as previously discussed and shown in figures 3 and 4. The incentives for existing assets were offered, along with the asset subsidies to recruit participants. The orchestration payments (figure 4) were provided soon after the first orchestration phase started (as a nominal value), with the intention to mitigate the effects of orchestration on participants' bills, while the actual value was determined as discussed in section 11.2.1 above. The asset subsidies were appreciated by participants, and the financial incentives for existing assets and orchestration payments were also welcomed, but they were not a strong point of discussion in the second interviews, until asked. Even as participants were asked about the incentive and orchestration payments on bills, there was not a strong recall about their value.

It is noted here that the orchestration payments only applied to participants with solar PV connected, and those without an asset subsidy, thus excluding battery participants. It is not clear to the social researchers why this decision was made, as battery participants were a crucial part of understanding the "actual value" of participation with orchestration, and they were the largest percentage of participants that formed this social research. It is also indicative that interview participants clearly told us, in various ways that the value for participating in the pilot was difficult to determine, particularly in the first, more intense orchestration phase (when most battery participants were having their assets orchestrated for 9.7 hours per day). It is therefore not surprising that we saw significant negative sentiment at this time.

The second orchestration phase survey, of which the split of battery and non-battery respondents was 52% with a battery and 48% without. The survey results indicated that:

- Approximately two-thirds were satisfied with the incentive payments for existing assets and orchestration payment (figures 3 and 4).
- A large percentage of participants, (88%) were satisfied with the asset subsidy and no participants expressed dissatisfaction with the asset subsidies (Refer to figure 33 below).

Figure 33: Satisfaction with financial incentives



Although participants were mostly satisfied with the incentives for existing assets, we know from the interviews that participants did not have a clear picture of the overall value of the project, particularly when factoring in their experiences of orchestration. Most participants appreciated the additional payments, but there was minimal value placed on the existing asset payments for participants with a battery, particularly in the first orchestration phase. Orchestration payments were also credited to non-battery participants bills pro-rata, so this was a small amount per bill. Some participants stated the incentive and orchestration payments had no significance, while others just considered it a bonus for being involved. As stated by one battery participant:

Look, I don't think it's a big incentive. If it was only about the incentive, I don't think I would do it. If I remember correctly, it's 150 dollars per year. I mean, I'm telling you I'm paying 400 to 600 dollars a bill. So, what is – 150 a year would do? But if I would have looked at it only from that point of view, I'd say, no, it's not worth my time. I'll just wait until the battery will be more affordable and there's more technology, like smaller size, bigger storage, and so on. I would have done it myself and that's it. At least for me, when I look at my bill, I don't think I would say the incentive was a very major driving factor for me. No, definitely not (PI19, August, 2022).

Another participant noted:

That's a good question because the incentives really weren't an issue in signing up for the project, alright. That was just maybe a tacked-on all bonus at the end, and matter of fact, we just received our first electricity bill and there was a small incentive there, but as I was saying, and I'm reading it now, I think the air conditioning system, the incentive is \$150 a year. The solar system was another \$150 a year, and I think there's one more somewhere. There's another one of \$150 a year, so really, and I think that just comes off your electricity bill. But the bottom line was that, yes, even though that it's appreciated, it definitely wasn't an incentive for me to sign up to the project, definitely not. I think if those incentives weren't there, it wouldn't have made any difference. I still would have signed up for the project (PI23, September, 2022).

The electricity credit provided for all WA residents from the WA government was often mentioned by participants who had received these over two years. The WA budget in May, 2023 announced that the electricity credit will be provided to all WA residents again in 2023 and this was credited to all WA residents in July 2023.

I mean – I don't know about – you've heard here, but the WA government keeps on throwing 400 dollars a pop into our electricity accounts. We just had one go through. It's the second one we've had this – because of the surplus budget, so that does help. But it all depends on those other figures that I need to work out. It's a token offer, which is fine. And for the project, that's fine (PI23, September, 2022).

11.4 Tariffs

Tariffs did not emerge as a strong point of discussion among participants, with only three participants mentioning tariffs in the second interviews and one person discussing his experience on the midday saver tariff at the focus group. There is acknowledgement from the project partners that Project Symphony was not specifically testing customer tariffs, and there was awareness of the risk that participants could experience negative bill outcomes. Orchestration payments offered were an attempt to mitigate any negative bill outcomes; however, as discussed further in section 13.2.1, the overall value of participation in the project may not have been perceived by participants simply through the orchestration payments or through the incentive and asset subsidies (figures 3 and 4), when considering the effort, time and care expended to participate.

The social researchers do not have visibility over what tariffs participants are on, but we are aware that the majority of interview participants are on the standard flat A1 tariff¹⁷. One participant discussed his experience on the EV time of use tariff, in which he incurred significant costs with orchestration stating that “Western Power were ramming power into my battery on the 50 cents a kilowatt hour time” (PI17, March, 2023). The 50c kWh time is the peak time from 3pm to 9pm (Synergy, 2023a). This participant called Synergy and asked to go back onto the A1 tariff as unsurprisingly he stated he received a huge power bill, and as a battery participant he would not have received the orchestration payments to compensate.

For this participant, the value of the project when he was on the EV tariff was not being maximised, given his statement that his home battery system was being charged from the grid at peak times. He also had no ability to opt out of the orchestration. Instead, he called Synergy to change the tariff he was on, as he could see that being charged 50c kWh to charge his battery from the grid was detrimental.

At the focus group, one participant with significant technical knowledge was proactive in trying to make the project work for him. He did this by trying various ways to get information (through ‘scraping’ data from the battery web site as discussed in section 10.5) and testing the midday saver tariff while on the pilot by directing his battery to be charged at the off-peak time. The below discussion details his experience with this:

Speaker 14

So, there's three tariffs. There's like a 9PM to 9AM. Then there is a 9AM to 3PM, which is the cheapest time and then it's 3PM to 9 PM, which is the 50c a kilowatt of this.

Researcher

Right. So, you're trying to avoid -

¹⁷ This is the default regulated tariff for households on the SWIS.

Speaker 14

I'm trying to avoid that. So, between the 9AM to 3PM, I'm just saying fill up the battery to 200%.

Researcher

So, you can say that? You can direct?

Speaker 14

Yeah. So, on the QCell app, it has this thing called user control and just type in the number as a negative number. That's the number, yeah.

So, like I set it that there will always be reserve at 20% (focus group participant 14, February, 2023).

Another participant knowledgeable about the energy sector stated:

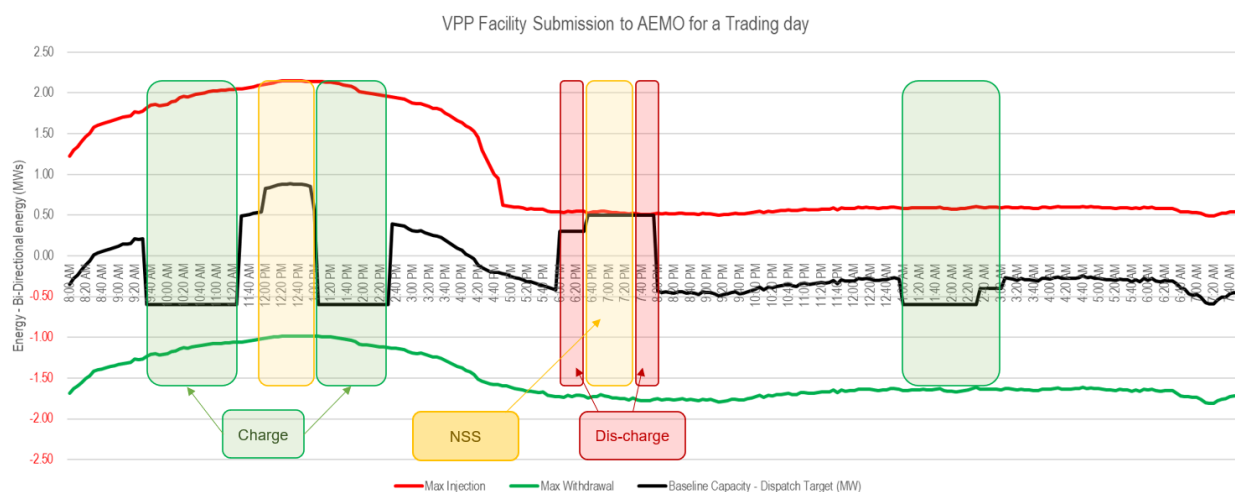
But for me, it's like you need to get the tariffs right. Fix the tariff. In the UK, you can actually sue your aggregator. You're actually bidding into the market, and you can see – they're doing it on your behalf, of course, but you can choose when you want to bid your assets into the market.

So, I think as a consumer, it's going to be a really, really hard sell unless you can – sorry, I keep going back to what is the customer value in this, and that is the market benefit, which is going back to the aggregator and actually the aggregator allowing you to take some of the profits that they are no doubt taking through taking advantage of negative pricing or whatever else. Flat tariffs kill you in terms of that respect (PI01, April, 2023).

Information shared by Synergy at a presentation in June provided an example of a day when there were high prices on the WEM due to forecast high demand and generator outages, which meant diesel generation was expected to push wholesale prices up in the afternoon. Figure 34 below, shows how on this particular day, participants batteries were being charged from the grid in the morning, afternoon and early morning from 1am as the aggregator sought the benefits of energy arbitrage. In parallel, the DSO sought to undertake an unusual testing scenario for network support services in the middle of the day, which would be unexpected in future conditions.

Given that the majority of Project Symphony participants are on a flat tariff, they would be charged for import of electricity at approximately 30c kWh. As discussed in section 11.3 and in the executive summary, the intention of Project Symphony is to value this service to the grid. However, this still raises the question about the value to the customer, as well as questions around visibility.

Figure 34: Charge and discharge of batteries in response to market and network signals



Source: Synergy (July, 2023b)

This example raises several points discussed in this report, such as visibility and awareness for participants, and having an appropriate tariff – or assets that are optimised for the benefit of participants. It also raises issues around social licence to operate, due to the private risks to participants (of orchestration) to deliver a public benefit of a more secure, reliable and lower overall cost electricity system (Cutler Mertz, 2020). The issues that have been mentioned around value for participants are also highlighted in this example. It is the case that participants signed a contract to allow their batteries, solar PV and other assets to be remotely controlled and operated, but the question remains about whether participants were informed or aware of test scenarios like those depicted in figure 34 above, as the aggregator sought to optimise participants assets to maximise participant and broader electricity network benefits. There are private risks associated with the orchestration that occurred from Project Symphony in relation to increased electricity use (and potentially cost), as well as concerns from some participants about the parameters for charging and discharging of the battery according to manufacturer recommendations (Massachusetts Institute of Technology, 2008).

As mentioned by the participant PI01 (April, 2023) who described an understanding of profits being made by the aggregator through orchestration, there needs to be more visibility and understanding for the customer of what they are actually signing up for, or options as suggested by PI01 to have the choice to bid into the market or not in the above scenario.

The participants mentioned here were unique in being the only participants who discussed tariffs and attempted to maximise their financial value of the project. The noticeable absence of discussion about tariffs indicates that most participants took little notice of the tariffs they are on, let alone try to understand the optimal tariff to be on with the myriad variables of the pilot. It is reasonable to conclude that on the issues of tariffs with any future VPPs, the responsibility for ensuring that participants receive the most cost-effective tariff is indeed the aggregator, as stated by the participant above. The 'optimal' tariff in the case of Project Symphony does not currently exist for customers on the SWIS engaged in a VPP and the social researchers have no visibility of the "actual" value proposition for the scenarios that were tested (pilot 1).

As discussed in the Bruny Island Battery Trial, 21 out of the 34 households switched to the time of use (TOU) tariff. However, there was confusion for householders about which tariff would be beneficial for them with the trial. The confusion was not necessarily mitigated by the installers

advice either as they had limited experience of the optimisation of the batteries with tariffs. Further confusion entailed for Bruny Island participants as they then had to notify the aggregator, Reposit of their new tariff, so Reposit could ensure that their assets (solar PV and batteries) were optimised accordingly (Watson et al., 2019, p. 37).

The DER roadmap discusses tariffs and provides guidance for retail pricing structures noting that they should encourage customers to move their electricity use to the middle of the day to utilise excess solar PV, incentivise the uptake of battery storage, provide export payments for energy that reflect the value of that energy, and "ensure all customers contribute their fair share of the costs of access to a safe, secure and reliable system" (Energy Policy WA, 2019, p. 62). This is obviously very broad and is almost solely targeted to customers that have solar PV installed. The research conducted as part of Project Symphony clearly shows that households with solar PV do maximise their use of solar during the day and in fact had to shift their energy use to avoid importing grid electricity when their solar was being constrained at the zero output (gross) level. Recent research by Snow et al. (2022, p. 10) also found that participants with an ability to access real time monitoring with solar and battery storage, have a greater potential for proficiency in optimising self-consumption of solar.

Our research has found that the value of participating in Project Symphony, even at the second interview stage has been intangible and difficult to evaluate for the majority of participants, despite relative satisfaction with the financial incentives, particularly the asset subsidies. Few participants could understand what the value proposition of the project was. There is inherent difficulty in valuing orchestration of course, as is evident by offering a nominal value to determine the actual value of operating DER assets on the WEM. Project Symphony and other VPP projects could be considered as being high in credence qualities as described by Bedggood et al. (2023). When the service being provided is high in credence qualities, the power dynamics is usually unbalanced (Bedggood et al., 2023, p. 5). Furthermore, Bedggood et al. (2023, p. 5) quoting Jensen and Meckling (1976) note that when agents are trying to maximise their utility, that the retailer, will not always act in the best interests of the energy consumer. We saw this occur in real time in the first orchestration phase as discussed earlier in this report.

11.5 Implications of findings

- A broader definition of value is suggested that includes consideration of expectations (such as battery back-up, bill reductions), motivations for participation (such as environmental, costs savings, community benefits) and the time and effort required of participants (section 13).
- As noted, the financial and broader benefits for participants of the pilot were intangible. The project partners, and industry more broadly often state that there will be benefits for customers and for the broader network if consumer assets such as solar PV and batteries can be utilised through a VPP service, and the intention of Project Symphony is to determine the financial value for customers. However, the financial and broader benefits remain largely theoretical, intangible, and high in credence qualities (Bedggood et al., 2023, p. 5). There is therefore a risk, that benefits for the aggregator may be prioritised over the customer.
- Given that the orchestration payments were only applied to participants with existing assets and not to battery participants, this requires further interrogation around the value of participating for future battery participants. As discussed in this section, the frequency and duration of orchestrating assets intensely in the first phase of orchestration, may have led to a perceived (or actual) loss of value for battery participants. The generous battery subsidies were an attempt to mitigate this loss, but as the research shows, this was not necessarily communicated or understood well by participants.

- There is a need for increased visibility and understanding of what participants are signing up for at the outset. If participants had the type of visibility and understanding of how their assets would be orchestrated as shown in figure 34, some participants may have chosen not to participate. This then raises issues of social licence to operate and a need for visibility.
- A social licence to conduct orchestration, which considers the private costs and risks for participants is needed. Visibility of orchestration (and the meaning of orchestration) is needed to assist in creating value for participants.
- Concerns about the first phase of orchestration, issues that may have arisen with installation and the general time and effort required to participate as discussed in section 13.3 led to unclear value propositions for participants. This was particularly the case for battery participants who make up the majority of this social research.

Part D. Situating research findings – implications and meta-themes

This section steps through key implications of findings from the research by describing implications for social equity (section 12), framing the findings in terms of care, value, trust and acceptance (section 13), and finally listing implications and considerations for policy (section 14). Social equity (RQ3) and policy (RQ4) are being considered and highlighted as they have been identified as critical considerations during any scaled application of orchestration, or market solutions that are being tested.

12 Considering social equity

The following section steps through social equity considerations emerging from Project Symphony social data. This section directly answers research question 3, which asks: What are the social equity implications for residential and small use commercial customers of Project Symphony VPP technologies, systems and pricing? How can understanding of these social equity implications inform larger scale roll-out of VPPs and DER aggregation?

The WA Government's DER roadmap proposes to address the issue of social equity through retail electricity tariffs and maximising network capacity through the use of "active DER" to allow future customers to connect solar PV to the network and encourage energy use to the middle of the day (Energy Policy WA, 2019, pp. 47-48). The roadmap also notes that DER exports should be effectively priced to reflect the value of that generation, as providing high feed in tariffs in the middle of the day for excess solar generation effectively places the burden of additional network costs to non-DER customers (Energy Policy WA, 2019, p. 49). Thus, social equity in the energy sector is about ensuring all consumers can benefit from the energy transition.

Summary

- When participants were asked about their views on fairness of the project, the majority of participants stated they were not aware what the criteria for inclusion in the project was.
- 21 percent of interview participants in the first interviews mentioned the \$400 credit provided from the WA government to all electricity customers in WA and appreciated this.
- Some participants were in credit on their bills through a combination of previous high feed in tariffs and the generous \$400 credit applied to all WA residents' electricity bills from the government over 2 years, which was also applied in 2023 as announced in 2023 WA budget. Some participants also paid their bills in advance, and thus had credit on their bill.
- The majority of participants did not have major concerns about their bills, with the exception of families who tended to use more electricity with heating and cooling and were conscious of their electricity consumption.
- Participants who had high usage due to heating and cooling with families prioritised comfort for their family over costs. These participants recognised their ability to cover that cost due to higher incomes.
- The fact that participants used enough energy to keep warm or cool, and prioritised comfort over cost indicates that Project Symphony participants were not facing an energy equity gap (Cong et al., 2022).
- Not all participants were on a high income, some participants received government concessions on their bills, which included pensioners and one carer.

- The majority of primary participants (68%) identified as male from the onboarding survey (figure 9).
- There was an inherent power imbalance between Project Symphony participants and Synergy as the aggregator. The lack of information and visibility, particularly about orchestration compounded this power imbalance.
- One participant who was a sole parent received their solar PV system through finance and was making fortnightly repayments on this.
- Housing quality and the space needed to accommodate the technology in homes is a critical factor and a social equity consideration for future projects. Further detail is discussed in section 10.1 and section 12.4 below.
- The majority of participants were in the higher income bracket; however, as discussed in section 7.1, six percent of participants earn under \$50,000 per year.

We provide a discussion below of the types of households at risk of energy poverty in the Global North, of which some participants of Project Symphony, although not at immediate risk, fall into some of the categories listed, for example, single parents, elderly households, women, migrants and multi-occupancy family households.

12.1 Ability to pay for energy and assets

The majority of Project Symphony participants recognised their ability to pay their electricity bills, with 93% of respondents in the onboarding survey stating they had never required financial assistance from Synergy to pay their bill in the last 12 months (113/122 base) and 89% of respondents stated they always pay their bill on time. In relation to bill payment concerns, again the majority (52%) stated they were "not concerned at all" about paying their bills. However, there was some variation in this response with 48% of participants indicating some level of concern with paying their bills (Table 5).

Table 5: Bill payment concerns

	%	n
Not concerned at all	52%	64
Somewhat concerned	16%	19
Concerned	14%	17
Extremely or very concerned ¹⁸	18%	22
Total	100%	122

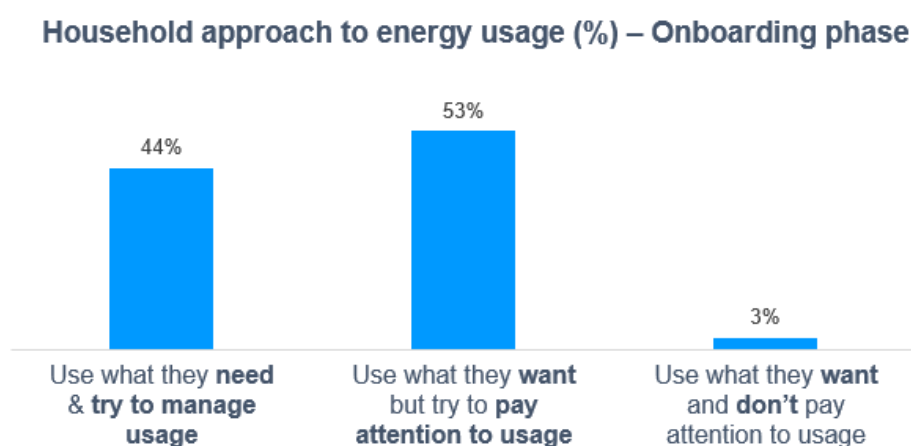
Source: Onboarding survey, March, 2022

Q: How concerned are you or other members of your household about being able to pay your household electricity bills?

¹⁸ Due to the similarities in the levels of concern, 'extremely' and 'very concerned' are combined, with 6% of respondents stating they were extremely concerned about paying their electricity bill.

The majority of participants interviewed indicated that they prioritised comfort over cost when it came to the use of electricity to keep their homes warm in winter and cool in summer. The results from the onboarding survey also indicated that the majority of participants (53%) used electricity as they wanted but tried to pay attention to usage with only 3% of participants saying they used what they wanted and didn't pay attention to usage. The onboarding survey results also indicate as discussed previously that participants pay attention to their energy use, and as would be expected, some participants engaged in more energy conservation than others, but most participants used electricity in their home when wanted or needed. Refer to figure 35 below.

Figure 35: Household approach to energy usage



Source: Onboarding Survey, March 2022

Q: Which of the below best describes how your household usually use energy? (n=123)

Middlemiss (2022) outlines the types of households in the Global North that are at risk of falling into energy poverty in table 4 below. Based on the typology identified by Middlemiss (2022), Project Symphony participants are not considered at high risk of falling into energy poverty as the majority of participants in higher income brackets (figure 9), use the electricity they want and need (figure 35) and largely don't have concerns about paying their electricity bills. However, there are some types of households participating in Project Symphony identified through the interviews that could be considered to be at higher risk of falling into energy poverty. These include, single parent households, unemployed adult, multi-occupancy family household, migrants and elderly households.

Table 6: Types of households in the Global North that are at risk of falling into energy poverty

General category	Specific feature	Evidence	Provenance
Income and employment prospects	Low-income households	This is a common feature found in all energy poverty research	Universal
	Unemployed adult in household	(Bienvenido-Huertas, 2021; Curl & Kearns, 2017; Kearns et al., 2019; Kose, 2019; Romero et al., 2018)	ES, UK, TU
	People with limited education	(Jessel et al., 2019; Kose, 2019)	INT, TU
Ethnicity and immigration	People from ethnic minorities, and indigenous people	(Bednar & Reames, 2020; Churchill et al., 2020; Churchill & Smyth, 2020; Jessel et al., 2019; Riva et al., 2021; Robinson, 2019; Q. Wang et al., 2021)	US, AU, UK, CA
	Immigrants	(Oliveras et al., 2020)	ES
	Low proficiency in English (in UK)	(Robinson, 2019)	UK
People from specific demographic categories	Near-elderly or older people	(Day & Hitchings, 2011; Eisfeld & Seebauer, 2022; Hitchings & Day, 2011; Oliveras et al., 2020; Riva et al., 2021; Tonn et al., 2021)	US, AT, UK, CA, Southern EU
	Disabled people	(Cronin de Chavez, 2017; Ivanova & Middlemiss, 2022; Riva et al., 2021; Robinson, 2019; Snell et al., 2015)	UK, EU, CA
	Women	(Feenstra & Clancy, 2020; Galvin & Sunikka-Blank, 2018; Jessel et al., 2019; Oliveras et al., 2020; Petrova & Simcock, 2021; Robinson, 2019; Sánchez-Guevara Sánchez et al., 2020)	INT, UK, ES, Southern EU, PL, GR, CZ
	Young people, and full-time students	(Butler & Sherriff, 2017; K. C. O'Sullivan et al., 2017; Petrova, 2018); (Bouzarovski et al., 2013; Morris & Genovese, 2018; Robinson, 2019)	UK, NZ
Particular household types	Single parent families	(Eisfeld & Seebauer, 2022; European Fuel Poverty and Energy Efficiency Project, 2009; Jessel et al., 2019; Kearns et al., 2019; Riva et al., 2021; Robinson, 2019; Sánchez-Guevara Sánchez et al., 2020; Sunikka-Blank & Galvin, 2021)	AU, INT, EU, UK, ES, CA
	Socially isolated people (infrequent family contact) or people living alone	(Kearns et al., 2019; Middlemiss et al., 2019; Riva et al., 2021)	UK, CA
	Large household size	(Robinson, 2019; Romero et al., 2018)	UK, ES
	Multi-occupancy/family household	(Bednar & Reames, 2020; Cauvain & Bouzarovski, 2016)	US, UK

Source: Middlemiss (2022, p. 5)

12.2 Views on fairness

The social researchers asked participants in the interviews about their views on fairness, inclusion and exclusion for the project. The most common response to this question was that participants did not know what the eligibility criteria was for the project. The criterion for eligibility of Project Symphony was specific to geographical location and limited to homeowners, almost all with solar PV. It was also limited to those with an account with Synergy, which would exclude homeowners on embedded networks for any future projects. As this network area was a relatively affluent suburb, due to the pilot nature of the project, our ability to research equity issues with the data we obtained was limited; however, the secondary observations are also useful for further scaling.

Fairness is being considered in the development of Dynamic Operating Envelopes (DOEs) for household solar PV, which is described as "dynamic export/import limits at the customers connection point" (AEMO, 2023). DOEs are calculated by the Distributed Network Service Provider (DNSP), for example, Western Power in WA. The University of Melbourne recently undertook detailed modelling on six different methods to consider fairness in the allocation of capacity on the

network (AEMO, 2023, pp. 2-4). We will not discuss those results here, but it is noted to highlight that the continual increase in solar PV on the power system has the potential to lead to equity issues in the future, if there are limits on the amount of capacity that can be installed. This has the potential to exclude people who may wish to install solar PV in the future. Hence, lessons from Project Symphony may ultimately lead to broader community benefits.

Several participants involved with the pilot expressed their views about the broader benefits, mentioning that their contribution to the pilot was of benefit to the community. Participants mentioned things like sharing power with the grid through their battery storage, doing something for climate change and bringing down the cost of electricity for everyone. Most interview participants purchased a battery through the pilot and several participants noted the high upfront cost of purchasing a battery, mentioning that not everyone could afford to participate.

Synergy's criteria for who could be invited to participate in Project Symphony included the following:

- Homeowners with a Synergy account;
- Customer has solar PV installed;
- Property is located on desired transformer within target suburbs;
- Property has advanced metering infrastructure that enables hourly tracking of usage;¹⁹
- Customer is not on life support; and
- Customer has not opted out of marketing communications.

The final point may explain why some participants talked of their neighbours who were not invited, and they could not understand why this would be the case. It may have simply been in some cases, that they opted out of marketing communication, or that they were on a different transformer that was not included in the pilot.

The second stage of assessing eligibility, once the above criteria was met, involved a site assessment that included specific details related to the home, such as – available space for a battery, condition of the meter box and make and model of solar inverters and air conditioners. The third stage of assessment related to specific assets in the home, such as the air conditioner, solar PV and the hot water system (not electric). These requirements also depended on the assets to be installed, for example to receive a home battery system, the participants solar PV had to be no less than 5 years old and greater than 4kW (Synergy, May, 2023b).

12.3 Power imbalances and socioeconomics

There was evidence through the research of a power imbalance between Synergy and Project Symphony participants. The power imbalance was evident by:

- Participants were non-contestable customers;
- The pilot intended to determine the value for customers, but through the testing period there was a lack of optimisation of participants assets for their benefit (most relevant for battery participants);
- The financial value for participants was intangible and difficult to determine, despite the incentives and asset subsidies offered (figures 3 & 4);

¹⁹ This was not a criterion for recruitment within the original pilot area and Western Power had proactively installed Advanced Metering Infrastructure (AMI) in the area. The area was expanded beyond the original pilot area to meet large customer numbers. As such, properties with AMI were included in the criteria of who could be invited to participate at this stage.

- Limited information was provided to participants about what to expect with the pilot in the first orchestration phase;
- The use of industry insider terms that did not convey meaning for participants;
- Inability to opt out of orchestration events, have visibility of orchestration or be notified about what was occurring;
- Return visits for installations that some participants reported as being time consuming and somewhat disruptive;
- Contracts that were complex, used vague terms and stated that participants "may" be required to pay back a portion of the assets (battery or air conditioner), if participants left the pilot before the contract end date.²⁰

Section 11.4 relayed the limited social licence provided by participants to orchestrate their assets in the manner that occurred, and this is directly related to the points made above about lack of information of the meaning of orchestration and the time and effort required of participants, which led to financial benefits being difficult to determine due to the "service" (of a VPP) being high in credence qualities (Bedggood et al., 2023, p. 5).

There was complexity with the contracts and language used in Project Symphony with a higher than usual expectation of energy literacy as discussed in section 8.3. Much of the terms that are used in Project Symphony are energy industry insider terms, that tend to make it out to the broader public unfiltered. When these terms reach the broader community, they lack meaning and context without an understanding of what is behind these terms and what they are referring to. Take for example the testing scenarios as described in table 1 of this report. The descriptions used to describe the testing scenarios are limited in their understanding, without also having an understanding of the electricity market.

Project Symphony is seen by industry as having the potential to reduce electricity costs broadly for everyone across WA and mitigate the need for increasing expenditure of network augmentation. As mentioned in section 12.2 above, it could also be viewed as testing the ability of VPP projects to address issues on the network with increasing solar, and thus ensuring the fair allocation of network capacity for a broader cross section of the community. Singer and Ron (2022, p. 657) discuss this thinking in terms of the market failure approach, which seeks profit in pursuit of the "efficient allocation of goods and services to benefit everyone." Yet, as also discussed in section 11.4, there is a private risk for participants in being part of a solution that benefit others.

Some participants also saw their contribution as benefiting others in the community but questioned why they personally had to carry the cost of it. As discussed by PI03 who recognised their fortune to be able to work from home and, their attempts to become somewhat self-sufficient. However, this participant also felt a burden of responsibility for managing grid issues stating:

So, we're generally a more socioeconomically solid area in our surrounding suburbs. I think we were probably selected for that reason, but then it means the burden and the responsibility falls with us to support our neighbours with less means, which I don't know is necessarily fair. Obviously, we wanna work collaboratively and, as a team, make sure everyone in Western Australia has power, that's another reason I participated, but when it's our lives that are constantly being disrupted and once the project ends, we're then responsible for all of the maintenance costs for the infrastructure. If something goes

²⁰ Synergy used their discretion with this clause, and we have been informed that no participants who left the pilot were required to pay back any of the asset subsidy provided.

wrong with that battery, I'm left to pay for that, yet everybody benefits from each installation. (PI03, March, 2023).

The issue of time also came up regularly in interviews with participants and this can be considered to be an equity issue and a potential barrier for involvement for further scaling. Time was discussed in relation to the following:

- Personal time of participants to work out what was happening with orchestration, with the assets and with the products purchased;
- Time trying to find answers from installers, Synergy, manufacturers and other project participants;
- Time with installations and additional installs with installers coming to homes, and the need to take time off work;
- General time impositions.

One participant discussed the personal time imposition and the cost of this, which included having to take annual leave to be available for the installations stating:

I think if you broke it down to an hourly rate for the amount of investment I've put in personally, it would almost be below minimum wage. It's just not reflective of the amount of time and disruption to my life. I'm fortunate that I work from home four days a week, but if I had to take annual leave to account to these visits which a lot of people would, that would have a significant impact and you're not remunerated for it.

As I said, I feel like I was promised more than what I actually received, and in the infancy before they started monitoring things, the credits were good. Now, I'm left with the payment on the battery and a significant bill. I know short term pain and long-term gain. I still have the infrastructure once I've paid for it, but I almost feel like I'm [working out] *0:27:21 twice and I'm not getting the full efficiency because I don't have back-up power. Not just the power goes out but every time there's a disruption to the Wi-Fi, that then interrupts my ability to monitor remotely. I said I just don't feel like the credits are reflective of the expense and personal commitment that we make as part of the project. (PI03, March, 2023).

This participant was also a sole parent, received finance for their solar PV system, and also purchased a battery through the program. This example is used to highlight that not all participants were in higher income brackets, and if further VPP projects were rolled out to the broader community, consideration needs to be given to ensuring that benefits accrue to customers. As a single parent household, this participant was already at higher risk of experiencing disadvantage with energy costs, despite living in a higher socioeconomic area. Having a battery through the pilot would not doubt mitigate those risks for this participant in the longer term, but this was not necessarily considered based on her experience with orchestration.

This participant also felt that being involved in the project was not worth her time and expressed thoughts of leaving the pilot in the second interview. The experience of this participant highlights several issues with Project Symphony that have been discussed throughout this report. This includes the lack of communication about the value of the project, the limited information on the technology, orchestration and the time taken by participants to work things out themselves. This clearly was not expected, as the participant discussed here went to significant lengths to finance the system, to contribute to the broader benefit in Western Australia and to mitigate any future risks to become self-sufficient.

The above experience also highlights challenges for any broader rollout of VPPs in Western Australia and the risks of energy vulnerability that need to be considered, particularly if future VPPs

aim to be more inclusive. This research should be instructive in understanding the crucial elements of information, power dynamics, time and complexity that need to be considered and that investment in infrastructure and systems alone are not sufficient. Bouzarovski et al. (2017, p. 21) view energy transitions as "broader processes of systemic change in the patterns of fuel production, transport and demand." Bouzarovski et al. (2017, p. 20) also discuss how energy vulnerability evolves and is multi-layered – through institutions and organisational practices and processes. Any future roll out of VPPs would need to consider these aspects and interrogate organisational practices and processes, to avoid risks of producing and reproducing inequalities in the broader community.

Despite the power imbalances discussed here and the challenges participants told us of in the first orchestration phase, there was an overall sense of goodwill from participants in the second interviews. This was likely a result of the cessation of orchestration at the time of the second interviews, a change in the testing approach as discussed in section 9.1, and an increased understanding of the project due to improved communications and discussions among other pilot participants and the social researchers.

Also, it is important to note here that we saw evidence of Synergy taking on feedback that was provided through the social research and making changes accordingly. This is encouraging and indicates a reflexive approach. However; it is suggested that this approach could go further and consider a democratic process that as described by Singer and Ron (2022, p. 659) is "open to revision and context" with a "social commitment to empowering those affected by social schemes to be included in both the formal and informal processes of context and revision." It is therefore suggested that there may be benefits for Synergy to involve the participants of Project Symphony in further focus groups or engagement post pilot, to assist in developing any future programs for the broader community.

12.4 Gender equity

The research did not investigate gender differences in participation; however, clearly there was an imbalance with male dominated participation and existing research indicates a tendency for males to engage in energy and technology pilots – more so than females. As noted in figure 9, 68% of primary participants in the onboarding survey identified as male and 30% identified as female.

Within this pilot, households with two or more occupants, made up 95% of the participants. As noted in Section 7.1, there could only be one individual receiving pilot communications and representing their household in the research. This is likely reflective of the male householder being the account holder, but we also know that there is an imbalance towards male participants of energy pilots, which was also the case for Project EDGE as noted in section 7.1 (Australian Energy Market Operator, 2022)

The tendency for men to be more engaged with energy technology is described by Strengers (2014) as "designing for resource man", who is "an efficient micro-resource manager", representative of the energy industries techno-rationalist approaches. Resource man understands all aspects of his energy use data and rationally responds to price signals (Strengers, 2014, p. 26). Designing for resource man in the energy industry, is likely to directly correlate with the under-representation of women in areas of science and technology, with only 15% of females employed in Science, Technology, Engineering and Mathematics (STEM) related occupations, compared with 85% of males (Department of Industry Science and Resources, 2021). Societal norms and gendered roles can also lead to lower confidence amongst females in the areas of math and science (regardless of ability) and this also plays a role in later involvement in these professions (Department of Education, 2022; Dicke et al., 2019).

The gender disparity in income and home ownership also impacts access to the pilot. Statistics indicate that males earn 39% more than females on average (ABS, 2023). Among sole property owners, more males than females are homeowners (Core Logic, 2023). Males also tend to own detached homes, whilst females were more inclined to purchase units and apartments due to their lower cost (Core Logic, 2023). Reflecting on the pilot's eligibility criteria of homeowners with an account with Synergy (excluding embedded networks), this may indirectly limit the participation of females in the pilot and exclude other demographics, such as renters and those in public housing.

Overall, the skew in demographics has social implications. There is a lack of ability to research and understand any differences in experience amongst under-represented groups such as lower income households and females. This gap could result in solutions that are designed with a skewed average participant in mind and as a result continue to benefit a particular demographic group (UNESCO, 2021). Such risks are evident in research in fields such as voice artificial intelligence (AI) with biases resulting in poorer user experience for some groups (Koennecke et al., 2020; Tatman, 2016).

It is noted that the gender balance of those who participated in Project Symphony is a result of an organic process, with no specific targeted intervention or intentional design to engage or exclude certain groups of people. Thus, it is instructive that males were over-represented and reflects the inherent design of pilots (Strengers, 2014) like Project Symphony, as well as other limitations discussed here that impact on the participation of females.

12.5 Implications of findings

- Although participants who were involved in Project Symphony are mostly in the higher income bracket, there was a power imbalance for participants as discussed in section 12.3. The implications of that power imbalance would significantly increase if the project was scaled to include the broader community with people who may be experiencing disadvantage, or who are at risk of falling into energy poverty (table 6). It is therefore suggested that the factors, which contributed to the power imbalance including intangible financial value, limited information and visibility, the use of terms and contracts that were complex and lacked meaning, and the time involved for participation are addressed.
- As discussed in this section, and elsewhere in the report (sections 11 and 13), the value for participants was difficult to determine. It is therefore suggested that results from Project Symphony clearly articulate any value going forward that includes other forms of value as discussed in this report.
- The under-representation of females in the pilot could result in a solution that is designed for males and thereby risk not considering the needs, interests, and preferences of females. As discussed in this section, societal norms are known to discourage female engagement in energy and technology, followed by actual low participation rates in early-stage research and pilots (such as Project Symphony). This lack of representation of females will serve to widen the gender equity gap if there are no interventions to address the issue.

13 Key considerations – acceptance and mutual values

This section presents frameworks for consideration that emerged through this research as key considerations – trust and acceptance, and value and care interchange.

13.1 Trust and acceptance

Acceptance of VPP and network management solutions by consumers is widely viewed as an important step to scaling these solutions (Ellabban & Abu-Rub, 2016; Patterson-Hann & Watson, 2021). Acceptance of the pilot changed over time, according to what was happening at any point in the pilot. This was in part described in part in section 6 (participant journeys) and is further related in this subsection.

Mixed responses

There were mixed responses to the pilot, which suggest mixed levels of acceptance and trust. Initial expectations of the personal benefits that would accrue with the use of a home battery system and the broader ideas of the project led participants to feeling a sense of trust about being involved in the pilot. Trust and acceptance changed in first phase of orchestration when expectations (and values) were not met as discussed in section 9.1 and 9.2. The focus groups occurred at a difficult time for participants in the period of first orchestration, where assets were "heavily orchestrated", with the reasons behind the testing approach used at that time discussed in section 9.1. Focus group participants expressed limited positive views at this point in the pilot project.

We saw a positive shift in acceptance in the second interviews when some participants reflected on the fact their bills were not as high as they expected, presumably from the asset incentives on bills and orchestration payments for non-battery customers. There was also reflection from participants with a battery, about the subsidy received. Contextually, the second interviews also began at a time when minimal to no orchestration had occurred in the proceeding period, and just as the second phase of orchestration began. This provides some context to the reduced anxiety around orchestration in the second interviews. The general code from the second interviews shows both positive and negative attitudes. One participant discussed how their views on the project improved since receiving further information and meeting other participants at the focus group stating:

..at first I kept on really questioning why they were shutting down but they were still going through the commissioning process, I suppose. But then I did actually find that we were getting credits for them to shut our system down and export and things like that so that was really good actually to see. Then when you think about it as well I was like these guys did actually subsidise our assets so it probably sharpened my focus to actually go hey look, this is something we signed up for and I've probably been a little bit more understanding of it because we actually were able to meet (PI26, March, 2023)

The Facebook group and focus group discussions enabled further understanding for participants, with some participants in the group, tempering the negative feedback and reminding people about the subsidies and reasons for signing up (second interviews).

So, the Facebook group, it's not been high volume. I mean, it's kind of hard. So, people aren't sharing daily <inaudible> *0:22:45 or anything, but I think most of the conversations I've seen on the Facebook group, there was a lot of complaining and then there was a lot of people going, "Well, hold on a second. You got all these assets from – very, very cheap." and people are going, "Yeah" (PI01, April, 2023).

Participants' understanding of what the project was trying to achieve also led to acceptance (or not), particularly around the issues with solar shut down. Participants who were strongly motivated by environmental reasons, experienced a significant lack of trust in the second interviews due to the constrain to zero (gross) testing, which required importation of grid electricity during the day. This did not match with participants expectations that the pilot was beneficial for the environment.

In a question where we asked participants to step back in the second interviews, we found a more accepting perspective. We asked about VPPs and household responsibility. In response, interview participants, while critiquing the pilot in detail with us in their interviews and expressing negative reactions in instances where they experienced unpredictable testing, at the end of interview they did indicate acceptance at a conceptual level. That is, they believed that householders had a role to play in ensuring DER integration is effective in supporting and managing a renewable network. The caveats are contained in the detail that we have discussed throughout this report. For example, participants are agitated at a personal level if they feel like they are not being informed, have their bill impacted and see irregular or high impacts on their battery. As discussed in section 12.3, this lack of visibility and information created a power imbalance between the aggregator and participants.

For some participants it was less about acceptance, and more about resigning themselves that this is what they signed up for and that it would soon be over. Some participants were also considering removing themselves from the pilot, even at the second interview stage in March 2023, as noted by the participant below.

I think this could've been fantastic and it still could be. If the communication was better and the incentives were revised, I think there's still a lot of scope for people who walk away happy, but they need to prioritise that, otherwise, my concern is people are gonna start dropping out of the project. Because from my point of view, I've already got the subsidy. Synergy can't <inaudible> and for me, I'd almost be better withdrawing myself for the amount of incentive I get if I came out of the pilot project. I would actually save more money because then the battery wouldn't be compromised, and I would be running isolated. For me, that's something I'm really weighing up at the moment. I'm committed to it and I would like to see it through but unless the incentives change and my bill reflects that, I'd silly to continue, wouldn't I? (PI03, March, 2023).

The above comment indicates that the participants saw the value in receiving the battery subsidy but did not see value in continuing with the project because of a perception of the battery being "compromised" from the orchestration that occurred. The contrast for some between what they were told at the beginning and the expectations they had, compared with what happened, took away potential trust relationships:

I: is the experience you have had with Project Symphony what you expected when you first signed up?

G: No. I think the expectation – I think given what we were told, given the story we were sold was going to be rainbows, lollipops and unicorns (PI43, March 2023).

Overall, these indicate dynamic responses according to situations people were in, in relation to the pilot. So, we saw trust change with specific actions on the pilot organisations' part and according to people's access to useful collective conversations and to technical and customer support.

Trust dynamics

One aspect of trust that we heard from participants was in relation to brand recognition. Fronius inverters were mentioned consistently through the first and second interviews, and participants

knew and trusted this brand. SMA (Sunny Boy) inverters were also mentioned. Both brands were recognised and trusted. Assurances were also sought about the products from the installer.

We know from the first interviews when asking about participants understanding of the involvement of the project partners, specifically Synergy, Western Power and the WA government that participants' expressed trust in both Synergy and Western Power and expressed some gratitude for being in WA, comparing the energy market here to the high prices experienced in the "eastern states" on the NEM, as stated by one participant:

Well, I think the WA government with Synergy or Western Power more so have done a great job compared to what we see with the eastern states, reliability, cost, all of the above. I think we're in a far better position than everyone else. (PI44, September, 2022).

Some participants directly correlated the position that WA is in, with relation to costs with the fact that Synergy and Western Power have not been privatised, like other states as stated by one participant who said how, "the current labour government had been very, very, very clear that Western Power and Synergy will not be privatised. They're very, very clear on that" (PI01, April, 2022). In many ways, this is a credit to WA, to retain that public ownership and the public good, where most states have privatised the sector, with some detrimental effects for customers.

Synergy's Brand Health survey (2023) also points towards trust in Synergy and indicated strong brand presence in the SWIS market, with around 70 to 80 percent unprompted brand recall when asked to name an energy company. This is likely due to Synergy being the only retailer for the majority of residential customers on the SWIS, but the recognition of the brand may also assist with scaled acceptance. Synergy also has a positive reputation when compared to other WA brands in energy, finance, insurance and telecommunications.

We heard from participants in the second interviews, that trust was challenged if things went wrong with the installation as discussed by one participant who experienced issues with their ducted air conditioning, after installation occurred:

So one of the negative things I wanted to mention was when Project Symphony – obviously, when things were installed, workers had to go up the roof and all of that, which is fine. So, I didn't think it was with Project Symphony, but no one else has really gone up the roof since. So what happened was when summer hit and we really need to use our air con, that's when we really noticed it. So we try and turn our air con on and we noticed a good portion of our house wasn't having air con. Then obviously I had to get an air conditioning gentleman to come out, help me look at it. So what happened is the ducts of my air con all came off, so they had to duct tape it back up. So I can't a hundred percent say it's from Project Symphony. It was really obvious in summer, whereas in winter – we did say that in winter as well. We did notice the heating wasn't as great when normally we get hot quite easily just from turning on for a very short time. So we did think about but we didn't look too much into it because you can just rug up really in winter. But when summer hit, we really noticed it and then we thought – so I'm not sure was that part of from the installation's <over talk> *0:01:16 but no one else really goes up. Like my husband don't go up. (PI41, March, 2023).

Negative sentiment, that also occurred with concerns about bills, may destroy trust even if it ends up that the impact (bill increase) was not there. There are questions around how much people are willing to be involved to help the grid, even as some participants in the second interviews indicated that they had a role to play to assist to manage issues on the electricity network. As discussed in section 12.3, Project Symphony has some underlying assumptions and value propositions that are being tested. This includes the ability of VPPs to support the network and participate in the wholesale market, with an objective of mutual benefit for participants, the electricity network and the broader community. The broader community benefits include the maintenance of network capacity

(to allow for future solar PV) and the reduction of spending on network augmentation to meet peak demand, thus theorising lower costs across the WA community. Synergy were seeking to determine the value of orchestration (to make the project commercially viable), and it was done in the spirit of the efficient allocation of goods and services to benefit everyone (Singer & Ron, 2022, p. 657) as discussed in section 12.3.

How much then are participants willing to pay (or risk) to be part of a solution that may personally come at a cost to them. We saw in the second interviews a willingness to continue and be part of grid solutions, but also a questioning of the personal toll by one participant (PI03, March, 2023) discussed in section 12.3. After the difficulty for participants in the first orchestration period, many participants were reflective and open in the second interviews, with a willingness to stay involved. Some participants also reflected positively on having the asset subsidies in the interviews and reminded other participants of this in the Facebook group, thus moderating negative sentiment. Ultimately, we don't know the extent of sacrifices to be involved in similar pilots and projects.

Some implications of these finding suggest:

- Acceptance of the ideas of DER integration and VPPs are strong, but acceptance will swing according to the experiences of installation, orchestration, quality of communication and whether there is a clear value proposition for participants;
- Programs need ongoing sentiment, trust and acceptance monitoring;
- Value exchange is useful in relation to trust and acceptance and this is explored in the next section.

13.2 Exchange of value, effort and care in relation to scaling and business models

Section 11 described what participants valued, what their expectations were of the trial, and the impact that the trial actions (orchestration) had on participant's perception of value. It described a complicated landscape of value. Some were unrealised, such as battery back-up, some perceptions of value were hindered by orchestration, for example, bill and energy reductions, and some were realised. This section builds upon the discussion in section 11 by exploring in more detail what realising value means in the context of this trial. It aims to make explicit the link between (perceived) value, business models, and care.

When does value emerge?

It is useful to take a wider view of values when considering their use in planning and design of programs at scale. In this project, all household participants who were interviewed had existing solar PV systems, and many had existing air conditioners. Most people were new to home battery systems, VPPs, DER integration and the latest grid constraint solutions. Clearly participants had to perceive that the trial would be valuable for them to participate. The perceived value was influenced by early communications and information shared, as well as perceptions and ideas (for example with home battery storage) that remained latent until this opportunity arose. Further value has been identified after engagement with the pilot with reasons to join the pilot discussed in section 6.2.2, with further detail on values and motivations to join discussed in section 11.

It is clear in this project and through other VPP and network tests that:

- Perception of value is not simple, and aspects of its perception are not always anticipated by designers. For example, bill reduction value was influenced by orchestration. Similar themes have been revealed in other research (Temby & Ransan-Cooper, 2021; Watson et al., 2019);

- Value perceptions can change from the perceived value that is set up or expected early on when engaging in a pilot like this. For example, the absence of back-up capability, and the lack of visibility for participants of the overall value of the pilot, and
- In the end, value is not what is anticipated by participants, but what is contained in the phenomena once application has occurred in context.

These elements impact trial design. Take, for example, the incentives for existing assets that were applied to participants bills pro-rata. Clearly, it was designed to encourage people to participate (and remain participating). You could consider in this case that participants receive this value when bill credits are applied to their bill. But participants in this research clearly had impediments to perceiving that this value was real, or not cancelled out by other negative impacts. Factors such as difficulty altering practices to align with orchestration, high or troubled installation and maintenance workloads were key to this perception. The fact that participants with a battery did not receive the orchestration payments also added to a general cancelling of perceptions of value that were gained with the asset subsidies and incentives for existing assets.

This is relevant for VPP business models and some contemporary framings of value, from the point of view of marketing, such as service dominant logic describe this as a co-creation of value (Ballantyne et al., 2008; Vargo & Lusch, 2004). This co-creation of value proposes that value is not created until the participant perceives it and that the customer is the "arbiter of value-in-use derived from interaction with goods and other physical resources purchased" (Ballantyne et al., 2008, p. 43) In this case these factors mean that the 'moment' of value identification and/or creation for participants is not when bill credits are offered but is when the participant successfully integrates the VPP into their lives in a way that they feel creates value. This may and often does include valuing of the incentives and many other aspects of the system. In terms of a VPP operator, this means that the "work" participants expend integrating the VPP into their lives is critical to value creation therefore should become part of their overall business models.

Effort and value

An implication of the discussion above is that realising value requires effort from all parties. Effort here is used in a broad sense. It could mean physical effort, time spent, learning something, retrofitting assets into a house, or even the use of money.

The research showed that participants contributed significant amounts of effort and commitment to participate in this pilot. More broadly, a common and distinctive trait underpinning DER integration projects is that end users need to make effort to be involved (Dahlgren et al., 2020; Temby & Ransan-Cooper, 2021; Watson et al., 2019). This effort is only sometimes apparent (either to participants or proponents) prior to participation. Thomas et al. (2020, p. 6) describe this effort as "high engagement forms of flexibility provision." That this effort is needed, and will impact people's decisions to be involved (or capability to be involved) is often relatively poorly interrogated in the design of VPPs and network service solutions (Thomas et al., 2020). As proposed above, some effort on the part of proponents is likely necessary for value to be created and perceived by participants. But making this effort explicit enables better analysis of whether the level of effort required is reasonable when compared to the benefits offered for participation. Understanding the effort required, also assists in identifying where the level of engagement has the potential to create further injustice and exclusion of certain groups, without the means to access these options, or the ability to manage them (Thomas et al., 2020).

In this pilot, it appeared that the effort from participants was not fully known or considered at the outset by organisations involved. There was an expectation that participants would be involved in the pilot based on the information that was given, the contract participants signed (section 8.1) and the subsidies and incentives offered (figures 3 and 4). The project partners perceived this exchange

as fair value. However, there is little evidence from our research that anyone fully appreciated the level of engagement that would be required of participants as discussed in this report, through reading through complex information, time and effort for the installations and follow up visits, combined with an experience of orchestration that was confusing for participants. It is only through this social research that we can understand all of these aspects of participants experience of the pilot, to fully appreciate what was asked and expected of participants. From this, we argue that the amount of participation effort expected and required needs further interrogation (Lucas-Healey et al., 2022; Temby & Ransan-Cooper, 2021).

Without participants installing and maintaining the technologies in their house, the provision of grid services could not occur. The new effort that comes with these new electricity system solutions occurs throughout the life of end-user involvement, for example (from our data) effort includes:

- Early detailed decision-making during a complex choice
- initial contracts and paperwork phases
- making time for the installations
- having physical changes occur in the home (including things like retrofitting of large boxes on walls and bollards in garages)
- checking hardware and functions (with often little knowledge in early days)
- making time for and attending quality assurance checks by organisations and revisits (for anything from a small latch to replacement of assets that weren't working),
- correcting defects created, for example, slipped ducts in the roof during installation, water marks from water ingress in holes in roof)
- ongoing monitoring of systems to ensure they are functioning correctly
- assessments of whether it has been worth it (the value of participating)
- establishing new routines and practices related to the new technology, and constrain to zero scenarios
- gaining understanding over time about the pilot and how assets interact with it (which included discussions with Synergy, interacting on the Facebook group and talking with neighbours), and
- wondering about the ongoing future of the technology in their houses.

In the values section we noted that this effort was viewed by some participants as more than the benefits of the pilot (PI03, March, 2023), and by others as worth it compared to the benefits involved. Alongside self-assessments of their effort compared to value, we also heard that participants were ready to help the network in part because they valued finding energy system solutions for their community, for the environment and perceived an overall benefit for the future (PI17, March, 2023; PI20, March, 2023; PI44, March, 2023; PI50, March, 2023).

An example of a participant who assessed effort to value and found the value was not reflective of effort stated:

I'm still being charged at market rate essentially and then reimbursed a subsidy for participating in a scheme, but that's not reflective of what it's cost me to install the battery. I guess the time and materials, from my end, to maintain the apps and connectivity with that and to have the techs come out – I think I've had three subsequent visits from [the installer]. As I've said, they've been good, but they haven't always been short visits. They've been a little bit disruptive and for the incentive that Synergy offers, I just don't feel like that's reflective of the investment that I've put in with my time as well (PI03, March, 2023).

It was also evident from the research that networks, aggregators and other organisations will need to expend significant effort to realise value from VPPs, network services and other DER integration activities. The extreme organisational effort needed to establish processes and learn in a pilot

environment was obvious in this pilot (seen in observations and partner staff interviews). The ARENA funding and the overall value of the project also provides an indication of how much effort is required to realise value for organisations involved. Organisational effort such as to reinforce and grow understanding of customers, take necessary knowledge, to conduct and evolve professional development, and to monitor changing customer values and needs will require organisational processes to be embedded in all organisations involved with the current pilot. Understanding of the customer and further prioritising customer values in organisational decision making will be necessary. Additionally, organisation evolution and learning will need to be shared with organisations establishing support and intermediary roles for VPPs and network management.

Clearly there was significant effort required of participants, but whether this is reasonable or not requires consideration against the value participants received for participation. For most participants this was not a direct economic calculation of time, bill impacts or payback periods of assets purchased vs costs. Rather, it was weighed up qualitatively based on their perceptions of benefits, that for participants with a battery included the longer-term benefits of storing solar generation during the day, for use in the evening (arbitrage), thus avoiding paying for electricity. Service dominant logic proposes that participants are actors in the creation of value, and that the scope of the required actions needs to be considered explicitly in creating and implementing business models and value propositions. Therefore, for participants with a battery, energy arbitrage and back-up functionality were a measure of value that needs to be considered. The next section uses concepts of care to expand on the definition of the effort that was required by participants and organisations in the trial.

Interchange of effort and value as care

As discussed throughout this report, participants expended effort to participate in the pilot. Similarly, service dominant logic framing proposes that some effort, and interaction with the assets is required in order for participants to perceive value from the pilot. This section uses the framework of care to discuss effort and relate it to broader concepts and literature.

The inclusion of care here responds to common criticisms of visions of distributed energy futures and VPPs that conceal the labour required to sustain participation (Kaviani et al., 2023; Lucas-Healey et al., 2022). The discussion on value interchange above demonstrates the importance of effort in realising value. This section uses sociological framings of care by Fisher et al. (1990) to explore what sorts of care were critical in the delivery of this project. Similarly, the inclusion of care expands the notion of “value interchange” proposed by service dominant logic as more than just a transactional relationship between participants and the project proponents.

Householder participants cared for themselves (am I better off?) and their community (are we better off?) by getting involved. For example, one participant talked about their involvement contributing to making a decentralised energy order work in practice, stating:

It could change the whole way we look at power because rather than one main generator somewhere, it could be decentralised to batteries storing up power for each of the different communities and people providing power during the day, and then drawing from it at night. If they're drawing from it at night or using their own batteries in their homes. So, the whole business model or the technology model may change, but I was just thinking out loud (PI30, March, 2023).

Similarly, organisations undertook various activities that could also be argued to be caring in this pilot. The whole pilot was framed around caring for an electricity system that society relies on for essential energy services (Alexander & Blaver, 2021). Similarly, there were examples where Synergy cared for participants through adapting based on feedback received through surveys and the social researchers, as well as the broader project partners.

Care was proposed by Fisher et al. (1990) as occurring in three phases:

- **Caring about** refers to an attentiveness to the continuity, maintenance, and repair required
- **Taking care** of refers to taking the responsibility for and accountability of caring for something, and
- **Care giving and receiving** refers to the giving and receiving of care between actors (Fisher et al., 1990).

13.3 Participants and care

Participant perspectives on why they participated in the pilot have been discussed in this report in sections 7.3 and 11.1. These motivations from participants help us to understand what participants cared about.

The concept of “value in exchange” in service dominant logic implies that value creation requires active work from both parties for value to be realised (for example. aggregators and participants in VPPs). This potentially can be related to the concept of “taking care” as described by Fisher and Tronto (1990). There were many examples of participants taking care as part of participation. A summary is shown in table 7 below.

Table 7: Taking care examples

Care element	Description
Technology	<p>Participants needed to expend effort and time to care for the technology that was installed. This included maintenance and monitoring of its performance. Some of these tasks were technically challenging and labour intensive:</p> <p>So, I've got the installation guide and I know enough to be dangerous. That's the positive thing about growing up with tech. But it's time-consuming with the things, so you have to go and scan a QR code on the inverter, then you've got to go through the registration process, then I've got to link it up with the battery. It's not integrated.” (PI03, March, 2023).</p> <p>The project team and installers were often part of this process, but determining who to ask and how was not always clear. Events where the project team engaged with participants were sometimes key to resolving issues:</p> <p>I contacted them and that's why I said, “What do I do? My battery switched off,” and they sent me three little sheets and, “Do this, this and this,” and it fixed it. [...] It was just pushing a few buttons in sequence, that's all. I think I wouldn't have known that if I didn't attend to the focus group (PI18, March, 2023).</p>

Integration with life	<p>Many participants were already using energy in their home during the day to maximise the use of solar PV. Orchestration made managing usage harder because it is less predictable:</p> <p>So, my behaviour before Symphony was that I run my washing machine and dishwasher when the sun is shining. It's still kind of the case, but I may have modified it due to battery charging times. But now with Symphony, you are probably second-guessing yourself a little bit. It's like, "Oh, well, when should I be turning on my dishwasher? When should my washing machine run? When do I have my pool pump on?" So there's been a lot of that second-guessing in that respect because you're not aware of when you're being orchestrated. What are those triggers? (PI01, April, 2023).</p>
Co-ordination and advocacy	<p>Participants were sometimes left to co-ordinate the impacts of the pilot and technology on other parts of their life. For example, insurance:</p> <p>I know they mentioned about insurance previously with us - I still haven't gone to my insurance and asked them yet. But I don't think they do anything different because it's part of the house, so I don't think – it's covered already, but I do need to double check. (PI41, March, 2023).</p> <p>Resolving issues sometimes took a concerted effort, persistence, and advocacy on the part of participants:</p> <p>Yeah, I'm not gonna give that up. It just frustrates other people – and it wasn't just be – it could be other people would ring up and that's what happens sometimes with trade, they do a job and they have to get caught up, they just don't wanna do it anymore 'cause it starts costing them money or whatever, that was the burden. (PI07, March, 2023).</p> <p>Also, sometimes participants had drivers that were not shared by the project. In these cases, they needed to advocate for them themselves. But this may not have been apparent upfront, as the participants may not have had information provided in the initial stages, for example with battery back-up:</p> <p>So we had a power surge and I was anticipating that I would have back-up power and I didn't, so I found out the hard way (PI03, March, 2023).</p>
Orchestration	<p>Orchestration is obviously key to achieving VPP benefits, however it impacts participants. It reduces predictability of asset behaviour. This impacts participants both at a daily practice level (how do I maximise</p>

	<p>the benefit of the equipment I have installed) and a “mental load” level as participants try to understand the behaviour:</p> <p>The problem then is I’m second-guessing when are they gonna start holding charge, or there was [were] occasions where they were like – they were holding the charge at 50 percent, and I was going, “Why? I’m exporting x kilowatts into the grid and I’m not –” and again, it’s back into customer value. So that was the second-guess piece as well. And the interesting bit is that I’ve had to really modify my behaviour, ‘cause I was a very early uptake. I took up solar when the WA government was still offering 47-cent net feed-in tariff, which actually incentivised me to do nothing during the day and run everything at night, because I was getting paid to export (PI01, April, 2023).</p>
Cost/the benefits	<p>Orchestration adds dimension to participant understanding of their energy bills. When bills change it is unclear if the orchestration was a contributor and whether the contribution was positive or negative:</p> <p>And I do feel like when the system first went in, admittedly, it was autumn, but I was actually getting credits on my bill at that point. So, over those bill cycles, I think the first billing cycle, my invoice came in at negative \$36 or something. So to go from that to a \$500 usage, where’s that coming from? (PI03, March, 2023)</p>

Participants were taking care of many things on behalf of themselves and the project. This unseen care work impacts their perceptions of participation in the project. Any future incentives for participation need to be considered in the context of the amount participants must take care to enable their participation. This could impact the level of support provided to participants, or the amount of incentive they require to participate.

There were also many examples of **caring relationships** in the pilot between participants. For example, participants formed support networks between themselves as noted in section 13.1. Privacy issues means they may have needed to stumble upon these networks. These networks help with sense making. They also helped each other with troubleshooting and bug fixing:

“So when we get out the driveway, our job is to make sure the light is on, ‘cause that neighbour was saying – he told me last week that he didn’t even know that it wasn’t switched on” (PI04, March, 2023).

As discussed throughout this report, one focus group mentioned how he had set up a private Facebook chat group where participants could share their experiences and “diagnose issues” (focus group 2 participant). While an example of care relationships between participants, this also reveals the role of the social researchers in providing and helping the provision of care. Some participants became aware of the Facebook group at the focus groups and several participants became aware of the Facebook page during the second interviews:

I: Did you hear about the [Facebook page] -

P:Oh no. [...] For Project Symphony?

I: Somebody started it who's a participant from the Project Symphony.

P: Oh, I'll Google it.

I: I think if you're part of it, they just check you're part of the program pilot.

P: I'll go in and join. (PI27, March, 2023).

13.4 Organisations and care

Energy retailers and intermediary agents have care and wellbeing functions. There are clear indications the organisations involved and related to this pilot have an intent for people to be protected and considered (cared for). Western Power and Synergy, as government owned entities, represent care coming from the Western Australian government to provide for their community and constituents.

Government is in essence caring for their communities – ensuring reliable flows of affordable electricity that also include renewables and checking this through supporting social research (that includes considerations of fairness and equity). They are essentially, in certain ways, trying to build infrastructures of (or that) care (Binet et al., 2022). With those infrastructures of care also comes responsibility for avoiding the reproduction of inequalities and exclusion that may occur when the infrastructure requires additional invisible work (Binet et al., 2022; Sovacool, 2021; Star, 1999).

Energy retailers also have a role in caring for consumers. By managing and mitigating pricing risks they insulate consumers from excessive unpredictable market prices. Similarly, they have a role in de-complexifying energy for their customers, and where they feel that reforms make this role untenable may resist them (Jones et al., 2023). While this care process is not perfect, it has been important for protecting customers.

The pilot describes its links to government intentions for a smart energy future in the DER roadmap (Energy Policy WA, 2019) and the activity on the pilot. The vision document (Alexander & Blaver, 2021) produced by the Project Symphony partners can help contrast these with participant drivers. From this document we can see examples of **caring about**:

- **Integration:** "Project Symphony [...] is unique as the first end-to-end pilot of a new energy market, using new and existing assets, rather than an independent and/or incremental trial of specific elements of the technology solution."
- **Progress:** "it is actively incorporating the lessons that have been learned through previous DER related trials to incorporate the most up-to-date knowledge and test the best ideas that have been presented."
- **Business models:** "The rapid growth in distributed energy resources (DER), such as rooftop solar [...] is leading to a range of emerging issues for network operators such as Western Power and challenging the traditional electricity generation and retail business models."
- **The energy system:** "However, the high penetration of DER can pose a significant risk to power system stability, for example at times of low system demand. Based on advice from AEMO, the stability of the SWIS may be at material risk as early as 2022, if DER is not efficiently and effectively managed."
- **Cost, carbon, and equity:** "One of the project's working hypotheses is that DER can provide cheaper, lower carbon outcomes through network and market services [...] in a way that shares the most value with customers through their participation, than the alternative of significant network investment and transmission level responses" (Alexander & Blaver, 2021).

Further evidence of care is implied in the minimum intent that the participants involved would also not be worse off overall during the pilot. Synergy undertook analysis throughout the pilot to check that participants were not worse off through the pilot. Synergy's customer support staff's care relationship acted as an intermediary between the participants and the broader project team. This was also very important, as can be seen from earlier communication and appreciation from participants contact with Synergy's customer service staff (section 8.2).

Installers also had a major role in caring for participants. As well as installing the technology, installers provided advice to participants:

The techs have always been great. They do seem knowledgeable and approachable. They've never left me with a big mess or anything along those lines. (PI03, March, 2023).

The broader Synergy project team also had a care relationship with participants. Orchestration was relatively new for the broader project team and certainly new for participants. This meant that there were examples of mutual care between participants and the team. Synergy also had another less visible role to care for participants welfare by advocating to the rest of the project team when feedback was received from participants.

13.5 What sort of care from what perspective?

There is some alignment in meaning and care, and some diversity that programs likely need to deliberately understand moving forward at scale. Cost, environment, and community (or at least caring about the electricity system components of community) were all things that were in common. Sustainability of energy system business models is an example of a divergence because most participants did not consider this in any detail. Consumer and organisational/industry cost drivers can be opposing. Indeed, experience in other projects has shown energy industry drives to reduce the cost of VPPs (Jones et al., 2022; Kuiper, 2022), and for profit to be made (Bedggood et al., 2023; Singer & Ron, 2022). These industry drivers do not necessarily lead to favourable outcomes for participants as discussed in sections 11.4 and 12.3. We also know that participants were incentivised by subsidy and bill credits, which increased the cost of the VPP and DER integration processes. Other aspects participants cared about were not considered at all by the project. For example, some participants spoke of a form of resilience as a key driver for participation, but many of the installed systems were not capable of providing back-up in the event of an outage (see section 11.2.1).

A case of care both ways

Reciprocal or responsive care is useful to understand for scaling purposes. A good example of reciprocation was when participants were concerned and therefore attended (or expressed interest in attending), the focus groups during what we have already discussed as a time of anxiety for many participants. They were anxious about their own benefits from the pilot, and also the overall pilot outcomes – that they might not be beneficial (section 9). Participants recognised that the project is a pilot and that sharing their experiences were critical for its success.

Similarly, Synergy sent out a descriptive email after the challenging testing that occurred in the first orchestration phase, after the focus groups. The communication Synergy sent was detailed as discussed in this report (figure 16) and responded to many of the questions and concerns that participants had. Focus group feedback was checked and responded to during the drafting of the email sent by Synergy to ensure that what was said met the needs expressed. This we read as an important gesture of care for participants. Participants mentioned the email in the second interviews

and thought it contained helpful information. Participants noted they would have appreciated this detail earlier as stated by one participant.

Look, I think the March one is probably the example of where it should've been from beginning and should continue to be. (PI01, April, 2023).

Implications of value, effort and care for pilot objectives

Being aware of exchange of value, effort involved, and care all link back to VPP and DER integration planning at scale. To frame these learnings in useful terms it can be helpful to consider how care work could influence business models. As described above, the proponents of Project Symphony were concerned about how their business models needed to evolve to respond to the uptake of DER. Orchestration provides an opportunity for organisations to make DER more beneficial to them through increasing responsiveness of consumers (Chandrashekeran, 2020). Clearly, consumers still have a large role in this new responsive paradigm. Value propositions and being aware of how they interact is part of this. Consumers are key actors in the care and maintenance of the technologies that enable responsiveness. Their drivers correlate and oppose those of the energy system, which influences their likelihood of participating or continuing to do so. Their day-to-day lives are influenced by the actions of devices in their homes, and unpredictability makes these practices chaotic. Consumers can be responsive to the energy sector and have their value realised, while bypassing active consumer decision making (Chandrashekeran, 2020).

Insight on values, value exchange and care exchange can help define the question of what does a VPP business model need to look like? Synergy in this instance act as intermediaries in the pilot and likely in scaled efforts and new business models. On one side they have participants, with their diverse technology and needs. On the other side they have grid and market stewards who desire services abstracted from consumer technology, needs, and perspectives. There are clear examples in this pilot of Synergy intermediating and advocating for the needs of participants to be considered. For example, high frequency responses caused by the VPPs participation in the balancing market were undesirable for participants. One response by Synergy was to learn from the experience of participants from the first phase of testing, reducing the intensity of DER asset orchestration in the later stages of testing (as discussed in section 9.1). This reduced participant impact and Synergy have confirmed it is a challenge for aggregators to maximise value for themselves, while minimising customer impact (Synergy, July, 2023a personal communication).

13.6 Summary – overall interchange section

For future applications of VPPs, it would be beneficial to consider what participants care about in further detail and in relation to the interchange of effort and value. Particularly, in relation to the expressed interest of participants to have battery back-up, which indicates the importance of this for future VPPs. Even if battery back-up was not to be provided as part of the subsidy, the project proponents could have ensured that participants discussed back-up with their installers and were deliberate about including (or not) the capability in their installed systems. There also needs to be a clearer value proposition for participants in relation to energy arbitrage vs participation in VPPs. As discussed in section 11.2.2, the savings for customers to participate in a VPP service where an aggregator has unlimited control of a battery is less than the savings that can be accrued from energy arbitrage (Kuiper, 2022). This needs careful consideration, particularly from what we learnt through this research about what participants value.

Clearly care was important. Participants and the project team cared about many things, enacted care practices in many ways, and formed several care relationships. These factors were critical for the success of the pilot. But these relationships may be easier in the context of a pilot. On the

project side, participants have a closer commercial relationship than they might have outside of a pilot project. Similarly, participants give trials and pilots additional leeway for bad experiences than they might outside of this context. This means that it is important to extract insight that helps scaling and business as usual. From the discussion in this section, we can derive four key findings:

- Deeper consideration of the factors, which participants **care about** could lead to an improved value proposition for participation. For example, the project considered back-up capability out of scope, when participants clearly felt it should be in scope.
- There were many examples of participants **taking care**. These actions are critical to understand as they impact the viability of the responsiveness approach envisaged by the project proponents.
- Several formal and informal **care relationships** helped in the delivery of the project. Some of these networks (such as the role of researchers) may not exist outside of a pilot. Similarly, privacy provisions impede the creation of informal “participant to participant” care. Proponents of VPPs should consider these care needs when framing support for customers and upstream contracts to energy system organisations.
- These care actions impact business models. **Service dominant logic** is an example of a business model frame that can take this into account.

14 Implications for policy

This section aims to answer research question four (RQ4) (table 2) to understand some of the policy implications that have emerged as a result of this social research. We understand that Project Symphony is operating in the context of other relevant policy work in WA, such as the Distributed Energy Resources Roadmap (Energy Policy WA, 2019), and the DER Orchestration Roles and Responsibilities Information Paper (Energy Policy WA, 2022a). Policy can be the enabler of consumer wellbeing and can ensure an orderly energy transition. Without certain policies, it is more likely there will be problematic barriers to smart and useful innovations.

Project Symphony aims to "unlock greater economic and environmental benefits for customers and the wider community" (Alexander & Blaver, 2021, p. 4), and as discussed in section 12, there is broader context that Project Symphony is working towards testing market, commercial and customer solutions to solve technical issues on the electricity grid. Project Symphony has also undertaken significant amounts of social research as discussed in this report, and these social research findings should ideally be communicated as part of the overall final project findings. That is, reported outside of the social research report. This is because we know from prior energy sector trials and pilots that societal sentiment is key to success, and thereby to scaling up (Lovell, 2019). We also know from the literature review discussed in this report that findings relating to customers are not always integrated into broader learnings for VPPs and demand response projects, despite the fact they are identified as crucial to the success of projects.

Having acknowledged this context of Project Symphony, and the social research within it, in the remainder of this policy section we concentrate on two issues. First, what we see as the most significant social research finding with relevance for policy, namely the shift in household sentiment once orchestration started and the implications of that shift for broader scaling of VPPs. The social researchers note here that Project Symphony experienced significant delays at its inception, which led to a compressed timeframe for testing of the four scenarios. A known factor that also led to heavy orchestration is described in section 9.1 when the project attempted an intense form of orchestration prior to developing experience and capabilities with DER asset optimisation. Second, we consider the implications of how Project Symphony is embedded within wider WA and national policy.

Additional extrapolation of the data from the social research can be undertaken for further policy insights, and we recommend any interested party approach the authors to discuss this possibility.

14.1 Household VPP responses and greater customer visibility and protections

As discussed, in section 9 of this report, there was a notable shift in household sentiment about Project Symphony – from positive to negative, when orchestration commenced. This finding is relevant to all policies to do with the wider implementation of VPPs in Western Australia, and indeed in Australia, as it highlights the importance of considering the household perspective, and how quickly sentiment can shift if the household perspective is not taken into account in upstream technical and market decisions.

One of the issues discussed by participants of Project Symphony that led to anxiety, as reported to the social researchers in interviews and the focus groups, was the lack of lack of visibility about what was happening with their assets. This occurred due to limited compatibility between the solar PV inverter and battery inverter apps, and the initial decision to not provide the third-party dashboard, as discussed in section 10.4. But it was also due to limited information provided to participants in the early stages of the project, particularly about orchestration. As discussed in section 8, communication improved throughout the pilot as feedback emerged from participants,

which reflected the iterative and learning process that Synergy engaged in, mentioned across the pilot.

The issue of visibility is noted in the DER Orchestration Roles and Responsibilities Information Paper as a key theme and principle. The information paper notes that improving visibility is essential for all participants, the DSO, DMO, aggregator and the customer. On the issue of visibility for the customer, the paper states that "prosumers will require visibility of how their equipment is managed to ensure trust and social licence is maintained" (Energy Policy WA, 2022a, p. 7). The DER Orchestration Roles and Responsibilities Information Paper also refers to consumer protections and notes that the Alternative Electricity Services (AES) framework is under development, with "protections to be provided through industry and service specific codes of conduct, including for aggregators" (Energy Policy WA, 2022a, p. 14).

It is worth noting that although the WA draft code of practice for behind the meter services (Government of Western Australia, 2023b) does not apply to aggregators such as Synergy at this time, it nonetheless has some sensible provisions that would help guard against householders having the sort of unexpected interventions in their service that we saw through the social research. For example:

"2.2.2.1 (1) Before entering into a BTM ('behind the meter') service agreement, a BTM provider must provide the BTM customer with the following information:

l. how any electricity generated that is not consumed by the BTM customer is treated;

r. the percentage of output of the BTM system that may be externally controlled by the BTM provider or BTM provider's representative, where the BTM customer does not have full control over the BTM system output" (Government of Western Australia, 2020, p. 6).

We understand from conversations with project partners, that the AES frameworks are a work in progress, and a framework for aggregators "may be prescribed", but the process of developing and implementing these frameworks requires extensive consultation (Energy Policy WA, June, 2023 pers. comm.). Synergy customers are covered under the Code of Conduct for the Supply of Electricity to Small Use Customers 2022 (recently updated) (State of Western Australia, 2022). Part 2, section 10 of this code relates to non-standard contracts, which Project Symphony participants were subjected to, as discussed in section 8. Much like the draft BTM code, there appears to be some useful guidance for customer contracts, but it is likely that an AES framework, specific to aggregators may provide stronger and more targeted protections for customers.

Such an approach would fit with federal government initiatives such as the consumer risk assessment tool being developed by the Energy Security Board and Australian Energy Regulator. Discussions about the tool have identified issues that are highly relevant for the orchestration response in Project Symphony, for example consumer risks to do with control of assets, with questions being raised by the AER such as:

What are the implications for consumers if a product or service in their household is being remotely controlled by a provider? Are there checks and balances in place to ensure decisions about managing the product or service are to the consumer's benefit?" (Australian Energy Regulator, 2022).

Careful thought about the consumer benefit of a product or service in advance of it being offered is vital and an understanding of customer value and acceptance as discussed in sections 11 and 13 is needed in order for consumers to make informed decisions. Regular updates throughout the project as circumstances change as discussed in section 8 will also be important. As Project Symphony did not test any aggregation products for participants, it would be prudent for Synergy and the project partners to consider where financial value and other forms of value (as discussed in sections 11 and

13), can be shared with future customers. Considering customer aggregation products would also require careful consideration of customer acceptance and the levels of control required to meet a mutually beneficial outcome for both the aggregator, the network and the customer. It is also suggested that the level of control needed to obtain that mutually beneficial outcome is made explicit to customers, so they understand what they are participating in.

14.2 Project Symphony and policy mobility

Several electricity policy and regulatory amendments are currently underway in Western Australia (some of which are mentioned above), therefore, it is useful to situate Project Symphony within this policy landscape. We do not intend here to scrutinise the policy context in detail, as there are excellent summaries already available (see for example the December 2022 Project Eagle Information Paper (Government of Western Australia, 2022a). As part of the Energy Transformation Strategy and the DER roadmap, there are significant reforms occurring with the operation and the design of the Wholesale Electricity Market, and these reforms are concurrent with the Project Symphony pilot (Energy Policy WA, 2022b).

Academics studying policy often discuss the stages of policy, also referred to as the policy cycle. These are the different phases of policy development that take place over time, from initial agenda setting, to policy formulation, implementation and evaluation (figure 36 below). In practice, the policy process is not so rational and predictable. Many things happen that make the distinction between these stages much less clear cut and recognisable. This model though is instructive in thinking about the role of Project Symphony in WA energy policy development, as doing so highlights how policy is being formulated at the same time as the Project Symphony pilot is being implemented – as is illustrated in the schematic below and in the WA policy timeline (figure 37).

Figure 36: The policy stages (left) and the policy stages showing the Project Symphony pilot and WA Electricity development²¹

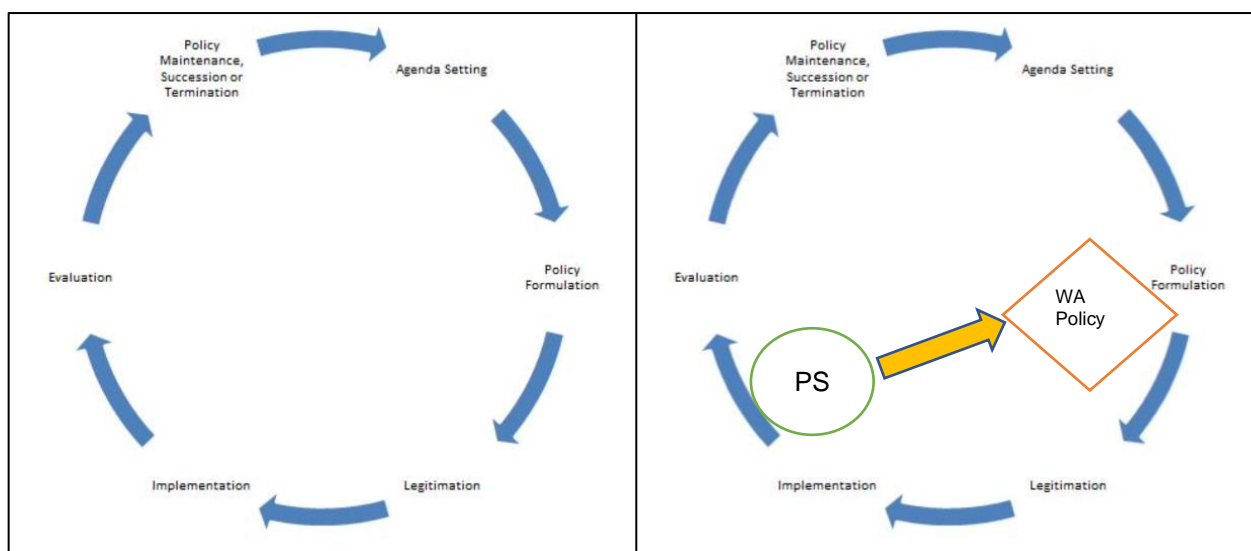
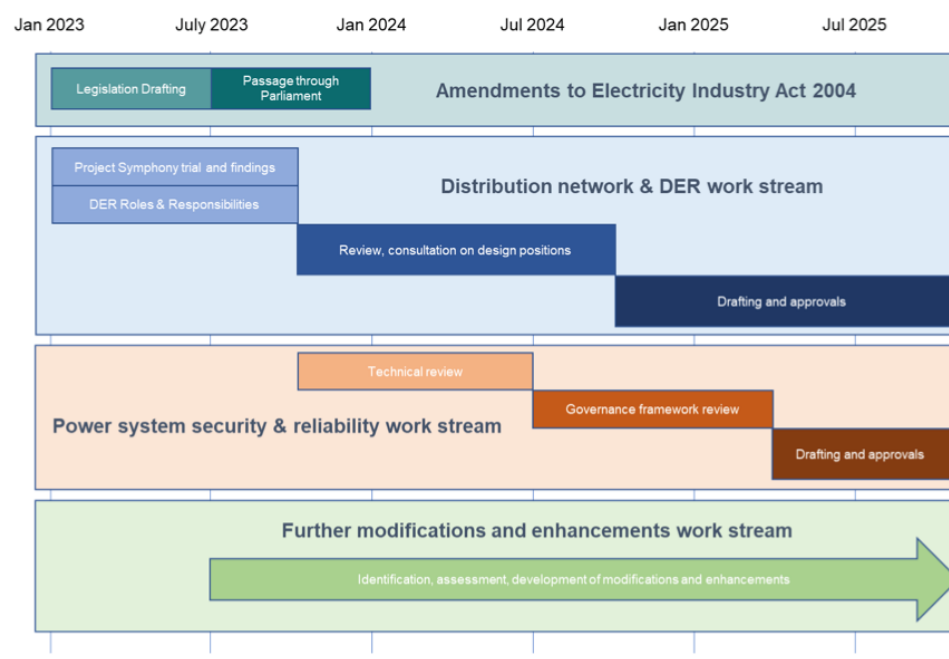


Figure 37: Policy stages showing Project Symphony and WA energy policy development



Project Symphony is described in the Project Eagle Paper, as follows:

²¹ Source: <https://paulcairney.wordpress.com/2013/11/11/policy-concepts-in-1000-words-the-policy-cycle-and-its-stages>

A review will identify all relevant provisions in existing instruments, consolidate policy positions (such as those developed through Project Symphony and DER Roles and Responsibilities work by EPWA) into a consistent view of requirements, and undertake a gap analysis to outline the areas for further drafting development (Government of Western Australia, 2022a, p. 23).

Thereby illustrating how it is seen as fitting in alongside other policy development activity, in an iterative way.

The point of drawing attention to this wider policy context is that any relevant findings emerging from Project Symphony will be considered in relation to an already existing body of work in WA to develop new DER and/or AES policies. In other words, a clear policy agenda is already in the process of being developed in WA – which is about the greater use of DER. This was expressed in our project partner interviews as providing some challenges for policy development, for example:

Normally a process for this sort of project would be... you do the testing and the project and then you do the policy development afterwards. The way the roadmap was developed and the time pressures ... [...] was such that the project and the policy development and implementation are running in parallel. So that's making it quite tricky and challenging. (Project partner interview, October, 2022).

It has been further clarified by this project partner that the work that is being undertaken with Project Symphony will directly feed into the DER roles and responsibilities work undertaken by Energy Policy WA and that Synergy and Western Power are a central part of that process. Other smart grid and energy sector trials have shown that negative findings (i.e., those that run counter to the prevalent policy agenda) are usually not taken into account into broader policy evaluations, unless they are really significant (Lovell, 2017). In the case of the Advanced Metering Infrastructure (AMI) Program in Victoria, Lovell (2017) discusses how the AMI program was considered a failure in Victoria and it was a big enough problem that states across the NEM decided to change their policy approach. In other words, other states decided the program would not be replicated and smart meter rollouts would be voluntary, and not mandatory as occurred in Victoria. However, such an outcome is relatively rare, more typically policy failures are not mobile across institutions, experts, models, technologies, etc. and are largely ignored, thus the lessons from failure are not transferred to other policy contexts (Lovell, 2017, p. 318).

For Project Symphony, there is still a potential risk that some of the learnings in this report that would assist in improvements for any scaling of VPP projects might be ignored, with the positive aspects of the pilot considered more fully than the more challenging learnings discussed in this report, particularly around orchestration. This risk increases due to the limited number of social researchers who have been deeply involved, in comparison to the technical and market focus of the project. However, the social researchers are aware since writing this report that learnings from the research are in fact being considered in recommendations for future WEM arrangements. One of the project partners also noted that the early results from this social research have reinforced that the current tariff is not compatible with some of the scenarios tested (table 1) and discussed in section 11.4. The risk of not considering the lessons of this research and social research in general also carries for other VPP projects.

Lovell (2017, p. 325) also discusses the use of storylines (Hajer, 1997) and the power of discourse to "effect (or hinder) policy change." We can again see evidence of this in Project Symphony and more broadly across the energy industry, with embedded storylines of techno-optimism (Quitow & Rohde, 2021). It is positive that Synergy have engaged in an iterative and a learning approach to the pilot. WA is in a unique position with Project Symphony and it is clear from this research that very few retailers or aggregators would be able to achieve the level and range of testing that Project

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Symphony has done. One reason for that is quite simply the cost, but also the risk of losing customers to other retailers, of which Synergy has not had to contend with.

It is therefore recommended that considerable effort is placed upon the key implications and recommendations of this social research discussed in sections 8.4 on communication, 9.4 on orchestration, 10.6 on technology and systems, 11.5 on value, 12.5 on social equity and finally, an overarching consideration of acceptance and mutual values.

15 Conclusion

This research report has stepped through key findings from the social research conducted for the Project Symphony pilot. The research used a before and after, longitudinal, multiple methods approach with data collection from participants over a period of time to capture useful dynamic, comparative and contextual findings. Responses from participants were collected from the recruitment and onboarding through to the beginning of the second orchestration phase. This provided a useful time period with changing circumstances for the Project Symphony pilot. The complexity and scale of Project Symphony as a pilot project has provided rich data for all project partners, and the social research conducted provides significant findings that will assist in understanding customer responses to VPPs and DER integration programs more broadly for future projects and programs.

The following section provides a summary of what the social researchers consider the key findings, with recommendations for Project Partners to consider for future projects, and for other similar VPP and DER integration projects. The themes and recommendations below are grouped according to key focus areas that were found through the social research and discussed in this report. These are areas of focus recommended for future programs.

Communication and visibility

Summary

Communication and visibility are critical areas that need focused attention in programs such as this one. Project Symphony as a technical, market and customer participation pilot was a difficult project to effectively describe to potential participants during recruitment. As noted in the introduction, the pilot area was chosen based on a high penetration of household solar PV (and associated technical issues on the network) in suburbs captured within the Southern River substation. It was also an opportunity to "unlock greater economic and environmental benefits for customers and the wider community" (Project Symphony, no date - milestone 2, p. 4). Project Symphony was described by one of the project partners as providing a nominal value to participants (in the form of asset subsidies and incentive payments), to determine the actual value of operating household DER (solar PV, home battery systems, air conditioning and hot water) on the WEM as described in the testing scenarios (table 1). This description speaks to the investigative nature of the pilot, which was highly ambitious and technically complex. It was a key point of communication needed at the outset for participants to effectively weigh up their involvement and determine if participation in the pilot was valuable for them. The findings from our research show that this was not well communicated, evidenced by the intangible value proposition that participants consistently told us about, and the limited recognition of the value of the asset and orchestration payments, which were credited to participants bills (figures 3 & 4).

Participants became involved in Project Symphony through information provided from Synergy to customers with expressions of interest (figure 6) and early communications provided to customers located in the target suburbs. At the time of installation and when the first interviews were conducted, participants informed the social researchers about the limited information provided on the actual assets to be installed, what to expect with installation (such as the time and space needed in garages), and the types of monitoring that would be helpful or useful. Overall, while participants reported a positive installation experience, and the installers were seen as being highly professional and helpful, they were interested in specific information about the technology and the pilot at installations. The installers (through no fault of their own) were unable to provide the specific and often detailed information that participants were trying to understand about the pilot. The

installers also had conventional understandings about home battery systems and did not provide information about what participants could expect with orchestration.

The issue of air conditioners and how these were going to be controlled and whether they were actually connected was frequently raised by participants who signed up to have their air conditioner connected. The fact that this point was frequently raised in interviews (with no prompting) was an indication of participants seeking further information about this.

As the pilot progressed and when the first phase of orchestration began in November 2022, a significant proportion of participants from the interviews and focus groups wanted more information and communication about the broader context of the project and what it was achieving. Most participants felt that orchestration was poorly communicated and was therefore not well understood. This sentiment was heightened at the focus groups, held in February 2023, near the end of the first orchestration phase when heavy orchestration of participant assets occurred as discussed in section 9.1. Synergy stated there were challenges in providing detailed information about orchestration to participants early in the pilot due to the iterative nature of the pilot and the test and learn approach employed.

Focus group participants provided suggestions for communication to be presented clearly, using less words, and with more graphic representations. Based on observations at the focus groups, participants appreciated a forum where they could gather and discuss their shared experiences. Participants were also seeking additional information throughout the pilot, and they were spending time trying to find this information themselves, through online technical forums, manufacturers information, a Facebook chat group set up by one participant, and by reaching out to Synergy and the installers. Participants noted an improvement in the frequency, relevance and detail of the communication from Synergy later in the pilot. There were challenges in the initial phases of the pilot with getting support when issues arose, which improved later in the pilot when participants knew who to contact.

There was also a barrier to effective communication with the technical terms and concepts that were used in Project Symphony as discussed in section 8.3 and this is an industry wide issue. As orchestration was such a significant experience and an unknown for participants in the first phase of testing, this term did not convey meaning. As discussed in sections 8 and 9, there was no understanding of the effects of orchestration on participants DER assets, or on their household energy use, particularly with the constrain to zero (gross) testing scenario. These findings, along with those discussed in section 8.3, suggest that the social licence to orchestrate participants assets was tenuous, as participants had no visibility of this, despite signing a contract to participate. As discussed in section 14, the WA Government, sets out key themes for consumer protection and states that visibility of how consumer assets are to be managed are needed "to ensure trust and social license is maintained" (Energy Policy WA, 2022a, p. 7). Thus, even as participants signed a contract saying that Synergy will use their assets for the purpose of Project Symphony (figure 14), the lack of visibility indicates that social licence to operate participants assets was tenuous.

Visibility of what was occurring with participants DER assets that were connected to the pilot and what this meant for the broader pilot was also a key theme emerging from the research. Participants frequently told us through the research of their desire to have an online interface, platform or one app where they could easily monitor and see what was occurring with their solar PV, home battery systems and other asset connected. There was frustration with having to move between the battery and solar inverters apps that did not align or provide an accurate holistic picture for participants.

Added to this confusion and stress was when participants solar output was being constrained in the middle of a sunny day to zero output, so participants could not utilise solar generation at these times and were forced to import from the grid. This was completely unexpected and not logical for participants as discussed in this report. For new solar installations (post February 2022), the ESM will direct household solar PV to be turned down or switched off in emergency situations. This may

at times, require that households import grid electricity in the middle of the day when there is low load conditions (Government of Western Australia, 2023a; Synergy, 2023b). Project Symphony was testing if there is value that can be provided to the customer with the constrain to zero testing. Participants also reported having their battery charged at unexpected times (mentioning 2am), which conflicted with their expectations for their battery to be charged during the day from their solar generation. Visibility about what was occurring would have assisted to help participants understand these activities.

Recommendations for communication and visibility

For communication and visibility, the following recommendations are made:

1. Clear and explicit information needs to be provided by the aggregator or retailer (and other project partners as needed) at the outset of any VPP or DER integration program. This information should go to participants and installers, clearly describe what the purpose is, and who the expected beneficiaries of the project are. In the case of Project Symphony, a clearer description of the nominal values that were provided was needed, to effectively describe what the project was trying to achieve (determine the actual value of operating household DER on the energy market). This would also assist with setting expectations for customers at the outset.
2. Customers need clear information about the technology installed in their homes and how it will interact with the pilot before, and at the time of installation. This information needs to include what to expect from all assets while they are connected to the pilot or wider program (for example, batteries connected to the pilot act differently to a battery installed for a household outside of this pilot.).
3. This social research provides further information for the project partners to determine a realistic proposition of customer benefits (and risks). This needs to be understood to enable customer decision making on participation. Aggregator product offerings that will be developed from this pilot should assist in this regard, to provide various options for different levels of participation. When offering VPP products or recruiting customers, effective explanation of what is being asked of customers who participate, and why this is being asked, is needed. An example of how orchestration activities may impact on future customers bills, alongside any financial benefits or compensation would assist in providing transparency.
4. All participants need to be provided with (or have access to) an interface, platform or integrated app for visibility of their DER assets. Without visibility and understanding for customers of what is happening to their household solar PV, home battery systems and other DER assets, we consider that the social licence to operate is limited. Having this visibility ensures transparency and is consistent with learnings from other VPP or DER integration pilots. Notifications should also be provided where possible, depending on the scenario and the ability of the aggregator to provide forecasted or real time updates.
5. Language that conveys meaning is needed across the entire energy industry to effectively explain the issues that are occurring with the energy transition (i.e., too much solar on the network, a need for energy storage and/or infrastructure upgrades). This need not be complicated and attempt to explain every nuance; it just needs to accurately convey meaning. Avoid using blanket terms such as orchestration or DER if possible and use more descriptive terms. Participants of Project Symphony sought and requested more meaningful communication through visual representations or examples of what may occur with orchestration. Consider also providing visual information on what is occurring behind the scenes (on the energy market) to provide a broader, contextual understanding. AEMO has

some useful and easy to understand information from their Energy 101 series (including podcasts) that could potentially be expanded and adapted to explain many of the terms, concepts and behind the scenes operations with Project Symphony.

6. Communication with participants needs to be continuously monitored, adapted and considered throughout pilot and broader VPP projects. Synergy effectively responded to survey, interview and focus group feedback and our findings showed that participants felt heard in the second interview stage. The value of social research in this regard was important, as it was only through the social research and calls to the Synergy team from participants, that the issues experienced by participants was known and fully explored. A dedicated customer service team that monitors sentiment and has sufficient capacity to provide regular updates and respond to queries is needed for future VPP projects, particularly for those at scale.
7. Clarity is needed to determine responsibility for the ongoing monitoring, operation and maintenance of physical assets in homes that are part of a VPP or DER integration project. As discussed in this research, participants were unclear who to contact for assistance with the installed assets, whether this was the installer or Synergy. Clarity and communication will be needed around the end of pilot and what happens with the additional hardware installed (such as gateway devices and high-speed data recorders). Where assets are provided as part of a pilot or broader project, it is recommended that installers and retailers/aggregators define their roles and responsibilities upfront and communicate this to customers.

Motives, value and acceptance

Summary

This summary provides information about motives, values and acceptance of the pilot – in particular acceptance of orchestration as discussed across sections 9, 10, 11 and 13. These are discussed together here because of the strong links between motives, values and ultimate acceptance of programs overall. The value of the project for participants includes their expectations and motivations. It is noted here that the majority of participants through this research, across the interviews, focus groups and surveys were participants with a battery (table 3). With high levels of battery participants from the first interviews (81%) and the focus groups (75%), the recurring expectation that the social researchers found was an ability to utilise battery storage in the evening (energy arbitrage), battery back-up in the event of a power outage (or for perceptions of self-sufficiency) and reduced bills. Participants with a battery expressed an expectation in the initial interview that they would benefit by having energy stored in their battery to utilise at night and reductions in their bill. Battery back-up was also frequently brought up by participants and disappointment was expressed when they realised that their battery did not offer protection in the event of an outage.

The subsidies provided for home battery systems was highly motivating for participation in Project Symphony, but possibly not available in future programs. Section 13 outlines the value that participants perceived when deciding to join the pilot, which was influenced by early communication and expressions of interest, as well as beliefs about battery storage. Many participants who were interviewed informed us that they wanted to purchase a battery before the pilot, but due to the cost and long payback periods decided not to do this. Figure 32 shows that most participants from the onboarding survey, indicated that it was either unlikely or very unlikely they would have purchased a new battery within the next 2 years. The expected value proposition for participants with a battery included reduced bills, battery storage (arbitrage) and back-up.

Orchestration payments applied to participants with solar PV connected, and those without an asset subsidy, thus excluding battery participants. Participants with a battery were a crucial part of understanding the "actual value" of participation with orchestration, and they were the largest percentage of participants that formed this research but were excluded from orchestration payments. The social researchers did not get a strong sense of the value of the orchestration payments for participants without a battery, despite asking specifically about these in the second interviews. Most participants clearly told us, in various ways that the value for participating in the pilot was difficult to determine, particularly in the first orchestration phase. Few participants could understand what the value proposition of the project was as discussed in section 11.3 and 11.4 and this correlates to what is described by Bedggood et al. (2023), as a service that is high in credence qualities and thus, inherently intangible.

Most participants interviewed aimed to maximise their solar use during the day. With the constrain to zero scenarios of the pilot, a shift in how participants maximised their solar was needed, but it was not clear to participants how to optimise their energy use with orchestration. Maximising solar was a strong enough motive that participants were processing how to adjust to regain this benefit. Some participants noted that they needed to shut all the appliances they had running off, when solar was being constrained to zero output (gross), rather than limited to zero export (net) where participants could still meet their household demand with solar. Orchestration changed the way participants used energy at home, to avoid using energy when solar was being constrained.

Various aspects of value were motivating, or showed they could be motivating for future programs. Participants were highly satisfied with the asset subsidies and reasonably satisfied or indifferent to the financial incentives offered for signing up existing assets. However, participants did not have a clear picture of the overall value of the project. When participants reflected on the overall benefits of the pilot – cost savings and asset subsidies were the strongest themes. This was followed by their ability to contribute to the community. Orchestration was where participants expressed the most dissatisfaction, as it negated their personal benefits and expectations. This is particularly the case for participants with a battery, as they had expectations at the outset that they would be storing electricity generated from their solar during the day, to their battery for use in the evening. This expectation did not materialise for participants in the first phase of orchestration as discussed throughout this report.

Synergy perceived the value of the asset subsidies, incentives for existing assets and the orchestration payments (for non-battery participants) as fair nominal value to achieve the goal of testing participants assets on the market to determine the actual value – for Synergy as the aggregator, for the DSO, and for the participants. However, the actual value for participants did not necessarily materialise with the incentives applied to bills and some of the value or benefits of participation were cancelled out from their experience of orchestration and the time and maintenance (work) that was needed to participate.

The other aspect of value from Project Symphony is that of tariffs as discussed in section 11.4. Given that most participants were on a flat tariff of approximately 30c kWh, there were times throughout the pilot when participants were being charged this tariff to import electricity from the grid. This often occurred when participants would normally utilise their solar generation, during the day for example, or at times when they would not be using much electricity at all, around 2am to charge their battery from the grid. This is discussed at length throughout this report, in relation to several of the testing scenarios described in table 1. Participants were quite clearly agitated at having to import grid electricity on a bright sunny day due to their solar PV being completely constrained, and they were perplexed with grid importation to the battery at odd times. For participants motivated to participate for environmental reasons, orchestration activities did not match their understanding or expectations. Some participants who were knowledgeable about energy, also felt that orchestration was not being optimised to their benefit and questioned the value to them as participants.

Sentiment on orchestration shifted throughout the pilot and was noticeably negative at the focus group, which was conducted near the end of the first orchestration phase. This sentiment had improved when the social researchers conducted the second interviews in late March/early April 2023. However, participants still discussed orchestration and at times the disruption that occurred with orchestration, particularly around changes to their energy use, with noticeable increased usage due to having to import grid electricity. Non-battery participants were compensated for this increased usage through the orchestration payments.

Recommendations for motives, value and acceptance

8. The response from participants of this research to the constrain to zero (gross) testing scenario was wholly negative. This negated a significant amount of value for participants, particularly those who were participating for environmental reasons. We saw an easing of sentiment with the constrain to zero (net) testing when participants could still maintain their household electricity needs. It is understood that testing of constrain to zero, was implemented to determine value from what will be implemented "as a last resort" in times of low load under the ESM (Synergy, 2023b). Any future aggregator products that attribute a value to constrain to zero (gross) should also consider the motivations of customers, particularly environmental motivations.
9. Back-up battery functionality and battery arbitrage were a significant measure of perceived and actual value for participants that needs to be considered in future projects. Any clashes in relation to arbitrage should not be ignored, and its value should be properly assessed for future customers of similar programs.
10. Aggregator products are needed for any future VPP project or pilot. This should include a clear value proposition to be communicated to customers, to enable decision making about participation. Participant experiences in the pilot has demonstrated that intense orchestration practices will be challenging for customers to accept, and difficult for the industry to communicate to customers. Parameters around all offerings are needed, with clear communication and visibility of what is occurring in relation to participation.
11. For any future projects, mapping the potential financial and non-financial benefits and costs of participation should be undertaken. This would include measures of value discussed in this research, for example, time and effort versus financial reward, forgoing full control of customer assets versus contributing to helping the grid, and access to new technology versus risks of technical issues. It is recommended that Synergy consider these broader measures of value and potentially set up an advisory group or panel to interrogate these questions of value further with customers. Given the experience of Project Symphony participants and their motivations for participating – an invitation extended to these participants post pilot is likely useful.
12. Layering with the above recommendations about understanding the value proposition for customers, and understanding the time and effort required from organisations and customers; it is important that the value to customers in any broader program is also mapped against the value to organisations involved, and to the wider WA community. During the commercialisation phase of technology, overall value in the entire ecology of a product or process is assessed using well established assessment processes. The assessment of value for all actors involved appears to be a valuable next step as the lessons from Project Symphony need to be assessed for at scale application. A cost benefit analysis for this pilot is underway, which would support this next step.

13. A broader definition of value is suggested that includes consideration of expectations (such as battery back-up, bill reductions), motivations for participation (such as environmental, costs savings, community benefits) and effort required of participants (section 13).

Social equity

Summary

Most Project Symphony participants were in higher income brackets and did not have significant concerns about their bills. Families tended to use more electricity with heating and cooling and were conscious of their electricity consumption; however, these families prioritised comfort for their family over costs. These participants recognised their ability to cover that cost due to higher incomes. The fact that participants used enough energy to keep warm or cool, and prioritised comfort over cost indicates that Project Symphony participants were not facing an energy equity gap (Cong et al., 2022). Participants of Project Symphony were also homeowners, who had existing household solar PV, and many were able to purchase a subsidised battery through the pilot.

As stated in section 12, the secondary observations from Project Symphony on social equity are useful in considerations for scaling of future projects. Our findings showed that there was a power imbalance between Synergy and Project Symphony and this power imbalance is important to address for any future scaling to avoid exacerbating these issues for the broader community, some of whom may be experiencing disadvantage. The ways in which the power imbalance played out is discussed throughout this report and listed in section 12.3. When thinking of further scaling a few points need to be considered.

Fundamentally for WA, the majority of customers are non-contestable customers, meaning they have no choice of retailer, other than Synergy and Horizon Power. This is not necessarily negative in and of itself as there are many benefits for electricity customers in WA, having a level of protection, particularly around pricing with publicly owned entities and the way in which the WEM operates, with a level of reserve capacity (unlike the NEM). Most participants when asked about their views of Synergy, Western Power and the WA government expressed their trust and gratitude to be part of the project. There is limited awareness of AEMO among residential customers and this social research did not ask participants about their understanding or perspectives of AEMO.

Participants were also grateful they were not experiencing the high prices and issues occurring for customers on the NEM. The fact that Synergy is trusted is likely to explain participants trust at the initial stages of Project Symphony with contracts, and their generosity in sentiment towards Synergy in the second interviews when reflecting on their experience of the first phase of orchestration. The point about contestability is noted here to ensure the preservation of that trust for any future projects.

Some recommendations noted in the above sections will also assist with the power imbalance identified through this research (section 12). Further recommendations are provided below to ensure social equity is considered at the outset to improve transparency, decision making for customers, distributional impacts, and inclusion for any future VPP or DER integration projects.

Recommendations

14. The operation of DER in market scenarios needs to be optimised for the benefit of consumers. Starting with a clear value proposition will assist with transparency and allow customers to effectively assess risk before participation. Having parameters (or limits) placed around orchestration is also needed to ensure optimisation of customers assets and consideration of household energy practices in VPP or DER integration projects.

15. Functionality for customers in the form of visibility and notifications of orchestration events is recommended (where feasible) to enable customers to opt out of orchestration events and have an awareness of what is occurring with their DER assets.
16. Underrepresentation of people at risk of, or experiencing disadvantage is a challenge for the government to address with industry involvement. It is likely to be of benefit for the Synergy and the WA government talk with Energy Locals (as the VPP retailer for public and community housing tenants) to understand their business model, processes, challenges, and success of the SA VPP in public housing. A similar project in WA could provide many benefits for reducing electricity costs for residents in public and community housing and assist with addressing needs on the electricity network.
17. Housing quality, type, tenure and the space needed to accommodate the technology in homes is a critical factor and a social equity consideration for future projects. As with solar PV, many members of the community are excluded from the benefits that can be gained with home battery systems and VPP projects due to living in apartments, renting or other housing precarity. These issues are known and are inherently challenging to address. Solutions to increase the range of housing and tenure types in future VPP and DER integration projects needs further investment and research to understand the business case for such projects in WA as a first step.
18. Future projects should consider gender differences and explore gaps in appealing to female participants. These considerations could include, gender dynamics and decision making in the household as well as interests, needs and the specific experience of females in these types of projects. At a minimum, collecting data and reporting on gender breakdown (and household decision making) of future projects is valuable to enable further research on gender equity.
19. Further work is needed to understand the distributional impacts of future VPP and DER integration projects on a broader scale. This is particularly the case if any of the solutions (or learnings) that were found in Project Symphony are considered for adoption on a mandatory basis (for example time of use tariffs). The distributional impacts of such decisions are required before being adopted across the community.

Organisational learning

Summary

Synthesising the findings of this report will require organisations and key personnel to act and evolve processes to accommodate learnings from this social research. To do this, findings from this pilot and insights from previous VPP and DER trials need to be integrated into decision making processes and incremental learning processes in all pilot partner organisations. The findings and recommendations in this report could be interpreted as they are to indicate possible actions for organisations. To make organisational next steps clearer, this conclusion and recommendation section considers the findings in relation to overall processes undertaken in the project, the context, including the social research, and activities excluded due to scope (not prioritised in this research). The intent is to provide more direct recommendations for next steps in project partner organisations.

Interrogating organisational processes and how they will allow insights from the social research to be absorbed and utilised for future program design and scaling is seen as critical to success of future VPPs and DER integration projects. As noted in section 3, organisational learning and

memory was originally in the scope of this research and was discarded in part due to budget, scope management and available capacity to do such a complex piece of research. Currently only a handful of staff in the organisations involved have the relevant knowledge and skills to support consumer insights being integrated; and current cultures in most organisations involved have proven previously resistant to the integration of consumer and customer insights in an in-depth way. The recommendations below suggest ways organisational processes could change, such as through skills development and process change.

Recommendations

20. Organisations involved need to ensure that insights from this and previous research are synthesised into organisational decision making and processes related to future scaled VPP and DER integration projects. There are new findings in this research and existing relevant research cited in this report, which need to be embedded in organisational processes. The communication recommendations above provide examples of particular ways processes related to customers could evolve in organisations.
21. Organisations need to maintain and expand successful customer related processes. Customer research in organisations, dedicated customer service contacts (for specialist programs) and quality assurance processes were all highly successful and can be further applied moving forward at scale. Customer service and quality assurance staff roles in Synergy were received positively by participating customers and Synergy's consumer research processes were critical to monitoring and capturing insights. These roles and process can therefore all inform expansion of VPP and DER customer processes - both within Synergy and in other organisations involved.
22. There were insights from customer service engagement and quality assurance checks (mentioned in the recommendation above) that are not yet absorbed into organisational processes and can be shared to enhance customer processes in all organisations involved moving forward. For example, quality assurance checks revealed information provision and technical issues, but these did not get absorbed into consumer processes well. This insight is precious and needs to be woven into organisational understanding. This information acts as risk mitigation for organisations. Sharing these insights across organisations will ensure all organisations understand what they are dealing with.
23. Consumer facing roles, such as those mentioned immediately above, enable regular customer monitoring, which will be important moving forward with scaled initiatives. This regular monitoring can be embedded in various ways in different organisations involved and/or, be generated in one organisation that then shares insights with all organisations involved. Processes will need to be designed to share findings successfully and regularly. One-off insight sessions, or one way insight sessions are not useful. Understanding will be developed over time through repeat, safe information sharing and issue exploration, across organisations. Organisational assumptions and culture may need to be examined and perhaps then challenged to embed new customer focused processes.
24. Capacity to undertake customer and consumer monitoring, reporting and integration of consumer insights into organisational processes will be required. There is currently only a small group of consumer-focused specialists in all the organisations involved in this pilot. Further (likely much more) consumer focused capacity will be required to successfully integrate insights and monitor consumers as activities are scaled.
25. To achieve the embedding of consumer awareness, specialist processes, growing of consumer facing skills, active professional development programs (related to consumers and

VPP/ DER) will be required. Understanding pedagogy and how learning at work occurs will be essential to shifting to more consumer awareness and skills. Professional development needs to be conducted in a way where genuine learning can occur. Again, this cannot be one off or one-way communications. Repeat sharing of insights and discussion over time is needed and likely learning through application. Additionally, insights from all WA VPP and DER programs, pilots and trials need to be part of the professional development processes. Some of this information is likely hidden in organisations, thus further dissemination of important insights likely needs to be organised, with materials developed for long term use and made publicly available. This recommendation is about working toward knowledge immersion, with repeat exposure for staff. Ensuring access to consumer related insights could include a repository or wiki page to support repeat visits.

26. The inter-organisational pilot structures limited social and consumer specialist engagement with other organisations during the pilot. More casual repeat interactions that enhance learning were very limited. Structural considerations for safe and repeated incidental learning should be embedded moving forward. The larger organisational structures of Project Symphony were part of the impediment but need to be overcome if cross institutional insights are to be shared and absorbed. Previous ARENA projects have used more effective cross disciplinary structures for cross learning and could be interrogated for ways to structure programs moving forward.
27. Recruitment choices based on availability of solar, a locational focus, and then specific housing types indicated that there are locational, infrastructural and housing conditions that can affect VPP and DER integration scaling. Understanding the wider occurrence of certain infrastructure and housing features will be critical moving forward. The features to be assessed include housing lot sizes, occurrence of apartments versus stand-alone, proportion of houses with viable undercover spaces for technology, viability of existing meter boards and more. Shifts of technology needed over time will affect this. These will all need to be assessed by the organisations and installers involved.
28. Organisations need to ensure cultures of visibility and transparency towards customers. Participants appreciated information and utilised it in positive ways and we have related this throughout this report. Participants also became stressed without necessary information, Therefore, organisationally, a culture of regular communication and transparency needs to be established. If information cannot be simplified or does not match exactly with other information, we recommend it is still shared with participants.

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Appendix 1 – Thematic codes first interviews

Name	Description	Files	References
Energy use & efficiency	Responses to question about energy use and any efficiency or behaviour modifications (i.e., timing of daily activities)	32	176
Community interest & fairness	Responses to question about neighbourhood involvement, community, and fairness	32	145
Bills, electricity & gas costs	Discussions about bills, affordability of electricity and gas, usage & cost changes with solar	32	142
Motivations	Motivations for taking part in pilot	31	113
Sustainability, environment & climate change	Responses to question about sustainability and whether energy supply is green, or other mentions of climate change and broad views on environmental issues	32	113
Installation	Any discussions on installations	31	103
Synergy communication	Discussions about communication from Synergy & process	30	103
Perspective of context or network	Responses to question asking about understanding of Project Symphony	32	98
Battery storage & back-up	Use of battery storage, self-sufficiency, monitoring of battery storage, expectations & understanding.	23	90
Perception of WA state actors	Responses to questions relating to Synergy, Western Power and WA government	31	90
Decision making	Decisions around taking part in pilot, prior interest & purchasing a battery	27	81
Use of Apps	Discussions about the apps being used	30	81
Incentives	Responses to question on incentives	31	76
New asset details	New assets being connected as part of pilot	25	76
Existing asset details	Existing assets mentioned, solar, hot water, etc.	30	75
Location of assets	Where assets are located in house, issues of space	25	62
Reliability & power outages	Responses to question about reliability and mentions of power outages	31	61
Understanding of tech (or lack of)	Discussions and understanding of the technology	26	58
Comfort & health	Where comfort and health were mentioned in relation to energy use	24	55
Household details	Broader household details, type of house, family households	20	52
Hopes & expectations	Hopes of being involved in pilot & expectations of bills savings or broader benefits	24	50

Working out this new stuff	Discussions where people are discovering new things with the technology	21	48
Compatibility of systems	Issues with compatibility of systems (i.e., inverters, air conditioners)	19	46
Cost of assets	Mentions of costs of subsidised assets	21	40
Timing of process	Mentions of timing of process	22	40
Synergy MyAccount	Responses to question about Synergy MyAccount	23	38
Installer communication	Communication from installer	13	35
Unforeseen issues	Mentions of things that were unexpected or unforeseen	16	32
Brand	Mentions of brands (Fronius, etc.)	20	31
Gateway device	Discussion of gateway device	19	30
Next interviews	Response to question about follow up interviews	28	29
Site visit	Discussions of site visit by contractors	20	27
Project set-up & EOI	Discussion of initial project set up & EOI	21	27
Insurance	Response to question about insurance	22	26
Renewable Energy Buyback	Where REBS is mentioned or discussed	15	25
Internet-Wifi	Mentions of internet connection, wifi, etc.	10	22
Issues in the 'eastern states'	Where people compared the energy situation in WA to the "eastern states"	12	22
Resourcefulness	Response to question on resourcefulness	12	20
Things that went well	Where interviewees expressed satisfaction about how things went	11	19
Trust	Discussion of trust in state actors, or others	10	16
Heat & safety	Mentions of heat and safety issues or concerns	7	16
Synergy decisions on eligibility	Where interviewees mention Synergy's decision making on eligibility	8	14
International comparisons	International comparisons to Project Symphony	6	12
Orchestration	Mentions of orchestration	6	9
Commissioning	Commissioning of battery system	4	7
EVs	Where people have noted EVs as something they are considering	5	7
Underground power	Where underground power in suburb is discussed	5	7
Future thinking	Evidence of future thinking in relation to environmental issues	4	4
Social research	Where social research is mentioned	2	2

Appendix 2 – Thematic codes second interviews

Name	Files	References
Communication	26	98
Bills and electricity usage	27	87
Apps and monitoring	26	84
Energy use & energy efficiency	27	82
Orchestration	25	75
Gateway device & data recorder	27	66
Community & other participants	26	50
Air conditioning	23	49
Incentives	24	48
Follow up visits	22	43
Expectations	22	35
Further projects	20	32
Battery charge, discharge & storage	14	30
Fairness	22	30
Householder role in managing the network	23	28
Understanding of project & tech	13	25
Motivations	14	23
Value for customer	8	21
Installation	10	20
Assets	8	16
Hot water	7	16
Location of assets	8	16
EVs	6	14
Battery backup	4	12
Solar generation	5	12
General views	4	10
Maintenance & troubleshooting	5	7
Tariffs	4	7
Community batteries	5	6
Gas prices	4	5
Contract	2	4
HEMS	2	4
Wifi	3	4
Withdrawal from project	3	4
Battery life	3	3
DEBS	1	2
Emergency solar management	2	2
Power lines & outages	1	2

Resolution of issues	1	2
Social research	1	2
Heat & safety	1	1
Other appliances	1	1
Questions	1	1
Safety	1	1
Size of blocks	1	1

Appendix 3 – Thematic codes focus groups

Name	Files	References
Information from Synergy	4	51
Reason for joining PS	4	40
Apps & monitoring	4	39
Battery charge, discharge & shut down	3	31
Cost & bills	4	30
Testing - orchestration	4	25
Air conditioner	3	23
Expectations	4	22
Installer & additions to installation	4	22
Understanding	4	22
Bill credits	4	16
Community discussions	4	14
Assets connected	3	13
Questions	3	11
Logic & consistency	3	10
Disconnect from pilot	2	9
Compatibility	2	7
Concept of orchestration	3	7
Community battery	2	5
Battery subsidy	2	5
Positive experience	2	5
REBS & DEBS	2	5
Trade-offs & sacrifice	3	5
Heat pump hot water	1	4
Pros	2	4
Safety & security concerns	2	4
Suggestions	3	4
What's the catch	2	4
Before orchestration	2	3
Internet & Wifi	1	3
Power outage	1	3
Control	2	2
Noise	2	2
Energy use and HEMS	1	1

Reliability	1	1
Teething issues	1	1
Wasted solar	1	1

Appendix 4 - Summary of research incentives offered

Research activity	Incentive format	Incentive provided
Online surveys (Mar-22 to Sep-22)	Entry into prize draw upon survey completion	5 x \$100 bill credits
Online surveys (Oct-22 to May-23)	Entry into prize draw upon survey completion	10 x \$50 gift cards
Interviews Part 1	Provided upon participation	\$50 bill credit
Interviews Part 2	Provided upon participation	\$50 bill credit
Focus group	Provided upon participation	\$75 gift card

Appendix 5 – Further information on methods and analysis

This appendix includes the timing of research data collection and the methods of data collection for the surveys, participant and staff interviews and focus groups. It also includes information not provided in the report about the thematic analysis for the interviews, focus groups and staff interviews.

Timing of research

All customers participating in Project Symphony were invited to fill out several surveys online. Four surveys were sent, the onboarding survey, installation survey, orchestration phase 1 survey (sentiment check) and orchestration phase 2 survey. In-depth interviews were conducted with Project Symphony participants and the social researchers from UTAS at the installation stage and again near the end of the first orchestration phase. Focus groups were also held with participants and the UTAS researchers in February 2023.

The timing of the social research data collection occurred as follows:

- The onboarding survey was sent upon signing of the contract with Synergy to capture initial and before understanding and also checked openness to undertaking interviews.
- The first interviews occurred after the survey to capture early in-depth insights, partially based on answers were in the initial survey, and answers from the survey were referenced in these interviews (Appendix 8). Most of these interviews were able to capture some installation data.
- The installation survey was a brief survey to understand installation experiences and was sent after assets and devices were installed at a participant's house.
- Orchestration phase 1 surveys were sent one month after orchestration tests began. This survey was sent to all participants who had relevant assets active in the tests.
- Focus groups were undertaken after the orchestration phase 1 surveys because of the negative sentiment shift observed in that survey.
- The second round of interviews occurred with people involved in the first round of interviews and were conducted just as the second orchestration phase began.
- Orchestration phase two surveys was the final social research data collection activity for this research. The survey was sent to participants and included sentiment-style checks and orchestration phase 2 checks.

Surveys with participating customers

Synergy had a process in place for conducting surveys, so surveys were designed and added to the Toluna platform already in use. Synergy sent out invites as part of Project Symphony, and to people who were involved and had contracts to participate in the pilot.

Assistance was offered in the information sheet for anyone needing help filling the survey, but no one requested this assistance. This is likely due to the demographic of participants were highly educated and capable with digital technology, and due to scope challenges, the offer of assistance was written in text in the information sheet, which people who needed assistance may have trouble reading.

Consent was listed at the beginning of the surveys and by taking the survey they consented to be involved in the research.

Survey questions are provided in appendix 7.

Information sheets

Customer information sheets were provided with each invitation sent to participate in an interview with the UTAS social researchers.

Interview methods

- Participating customers were invited to participate in an interview, after they indicated a willingness to be contacted by the UTAS social researchers in the first survey.
- Participants received a \$50 credit on their bill as an incentive to participate in an interview (Appendix 4).
- 33 online interviews were conducted in the first round.
- 27 interviews were conducted in the second round. The majority of the interviews in the second round were in person at participants homes in the pilot area.
- This was an appropriate number to provide qualitative insights for the research.
- An aim of the interviews was to capture an understanding of the diversity of experiences for customers.
- Exploratory (abductive and inductive) questions were used (Appendix 8).
- Purposive sampling was anticipated at initial stages of the research; however, deliberative invites were the only available means for recruiting research participants. Thus, an even mix of demographic features (such as income, size and types of households) was not purposively sought.
- Participants indicated their willingness to engage in the social research in the surveys, agreed to the interview when contacted by the social researchers and consent was sought at the start of each interview. This was important for ethical research.
- The characteristics of participating customers were not known at the recruitment stage, beyond being homeowners.
- Project Symphony customers were recruited to the pilot over time. The first interviews were therefore conducted over a longer period from April to November 2022. The second interviews occurred over a two-week period, from late March to early April 2023.
- The first interviews took 30 to 60 mins online. At end of the first interviews, the UTAS researchers asked for permission to contact the participant again for a second interview.
- The second interviews took 30 to 45 mins at participants homes in the pilot area.
- Many participants sent photos of installations at or near the first interview and permission was sought for the researcher to take some photos of technologies and appliances that are involved in the Project Symphony pilot at the second interviews. The researchers also sought verbal permission in the interviews before taking any photos.

Staff interviews – methods and questions

- Project Symphony staff from Synergy and another partner organisation were invited to an interview if, the staff member was able to develop insights about customer responses.

- Interviews were the preferred means of collecting insights from Project Symphony staff. The majority of the interviews occurred online, with one interview conducted in person.
- Five online interviews were conducted for 30-60 minutes, and one in person interview occurred. Interviews were conducted from July to November 2022.
- Staff were asked to discuss key insights they have developed about customers after working on the Project Symphony pilot.
- Interviews were held by/with UTAS researchers (listed in information sheet) as facilitators or interviewers.
- The interviews were recorded, and transcripts were generated from the recordings.
- Thematic analysis was conducted on interviews as noted below.
- Participants could request copies of transcripts they took part in. No requests were received for this.
- Participation was voluntary – staff invited to take part could agree or decline to take part. No incentives were offered for staff interviews.

Focus group selection method

On 25 January 2023, Synergy sent an Expression of Interest (EOI) to customers who had experienced orchestration of their assets. The EOI asked customers to indicate their interest in attending a focus group with the social researchers from the University of Tasmania (UTAS) to gain a deeper understanding of their experience with Project Symphony, particularly since orchestration began in November 2022. The survey was sent to 246 customers of which 87 customers registered their interest in attending a focus group. Synergy provided six dates and times for focus group sessions in their survey. However, places were limited to only four sessions with each session limited to 14 people maximum. Synergy did not communicate the additional times to the social researchers prior to sending out the survey.

Due to the high level of interest in the focus groups, interested participants were chosen using random selection functions in Excel. Names were first listed according to availability in an Excel spreadsheet and assigned a random number using the function =RAND(). The Index Rank Formula was then used in Excel to capture the names and random number to provide a random list of names for selection for each session. It was decided that one session would include non-battery customers only to capture experiences from this group of customers. The full list of each session was checked in Excel for duplicates as some customers indicated they could attend more than one session. Any duplicates were removed manually, and additional people were included from the random selection to provide places for duplicates and where people indicated they could not attend. This resulted in a list of 47 people who were sent invitations to attend a focus group. The total number of participants who attended the focus groups was 33, which was 83% of the targeted quota (Appendix 6).

Focus groups February 2023

- Four focus groups were held with Project Symphony participants from 8 to 9 February 2023, with two social researchers from the University of Tasmania.
- All participants at the focus group signed a consent form to take part in the research. Written consent was provided for the social researchers to record the focus group sessions from all participants in attendance.

- Participants received a \$75 gift card incentive to attend the focus group that was provided at the end of each focus group (Appendix 4).
- These focus groups were held in a community centre in Southern River, close to where all the participants resided. Each focus group ran for 1.5 hours, and a list of broad questions (Appendix 8) were asked in each of the four focus groups.
- The first three focus groups on 8 February included participants who had a mix of assets installed including, batteries, solar PV, air conditioners and heat pump hot water systems.
- The final focus group on 9 February included only participants who did not have a battery installed. All of the participants in the final group had their own solar PV systems connected to the Project Symphony trial, and most were also connecting their air conditioner.

Analysis of interviews and focus groups

- The first and second interviews, staff interviews and focus groups were recorded, and all recordings were transcribed.
- All interview participants were deidentified using a Project Interviewee (PI) number.
- Participants could request to see copies of transcripts from the interviews they were part of. No participants requested to see the transcripts and no alterations were requested.
- The transcribed interviews were uploaded to NVivo and coded into initial themes (Appendices 1, 2 & 3).
- The staff interviews were also uploaded into NVivo and coded.
- Further analysis was undertaken using Excel and Word to determine recurring patterns and relevant themes from the initial coding. Other methods of analysis were also undertaken in NVivo using, word frequency, text search and charts. From the analysis, the data was written up into the main thematic analysis that formed the basis of the report and data was triangulated throughout the writing process from the first and second interviews, focus groups, staff interviews, surveys, and academic and industry literature.
- Significant narrative themes were apparent from the coding and analysis of the focus groups, such as communication and orchestration.
- The social researcher involved with coding the focus groups and interviews in NVivo has a background in energy research, was present in the focus groups and across most of the interviews and also attended the Synergy office regularly to work with Project Symphony staff. This enabled the researcher to discern through language, tone and the frequency of discussions from participants, the most relevant themes occurring from the data.

Appendix 6 - Summary of research participation rate

Research activity	Response volume	Response rate	Invitation volume
Onboarding survey	125	36%	347
Installation survey	31	9%	347
Orchestration Phase 1 survey	110	43%	256
Orchestration Phase 2 survey	128	37%	345
	Participant volume	Participation against quota	Quota (target volume)
Interviews Part 1	33	94%	35
Interviews Part 2	27	82%	33
Focus group	33	83%	40

Appendix 7 – survey questions

Onboarding survey

Section 1: Demographics

TEXT BOX.

Q1. Please enter the email address to which you received the invitation to this survey. This helps us ensure the survey is being filled out by the household it was sent to.

SINGLE CHOICE.

Q2. Is anyone else completing this survey with you?

- a. No
- b. Yes, another member of my household is completing with me and they are contributing responses.
- c. Yes, I have someone helping me read this survey and write in my responses.
- d. Other (please specify)

Please note for the rest of the survey, when we ask about 'you' we are referring to the primary survey respondent.

SINGLE CHOICE.

Q3. What age group do you fall in?

- a. Under 18 SCREEN OUT
- b. 18-19
- c. 20-29
- d. 30-39
- e. 40-49
- f. 50-59
- g. 60-69
- h. 70-79
- i. 80-89
- j. 90 or above
- k. Prefer not to say

SINGLE CHOICE.

Q4. Which gender do you identify with?

- a. Male
- b. Female
- c. Non-binary / gender fluid
- d. Other
- e. Prefer not to say

SINGLE CHOICE.

Q5. Do you identify as Aboriginal or Torres Strait Islander?

- a. No
- b. Aboriginal
- c. Torres Strait Islander
- d. Aboriginal and Torres Strait Islander
- e. Prefer not to say

SINGLE CHOICE.

Q6. What language is usually spoken at your house?

- a. English
- b. Other (please specify)

SINGLE CHOICE.

Q7. Which of the below best describes you?

- a. Working full time
- b. Working part time
- c. Work casual hours
- d. Self-employed
- e. Home duties and/or caring duties (part or full time)
- f. Not employed /not in paid employment
- g. Student
- h. Retired
- i. Other (please specify)

SINGLE CHOICE.

Q8. Are you (either solely or jointly) a primary income earner for your household?

- a. Yes SKIP TO Q10
- b. No, someone else is the primary income earner
- c. Not applicable (e.g. if you are financially independent housemates) SKIP TO Q10

ASK IF **Error! Reference source not found.**b = a | SINGLE CHOICE.

Q9. Which of the below best describes the primary income earner?

- a. Working full time
- b. Working part time
- c. Work casual hours
- d. Self-employed
- e. Home duties and/or caring duties (part or full time)
- f. Not employed /not in paid employment
- g. Student
- h. Retired
- i. Other (please specify)

SINGLE CHOICE.

Q10. It helps us to have a general indicator of income for each customer premises/household. If you are comfortable answering, which of the below household income brackets represents your household's **total** pre-tax income?

- a. \$25,000 or under
- b. \$25,001 – \$50,000
- c. \$50,001 – \$75,000
- d. \$75,001 – \$100,000
- e. \$100,001 – \$125,000
- f. \$125,001 – \$150,000
- g. \$150,001 – \$175,000
- h. \$175,001 – \$200,000
- i. \$200,001 – \$225,000
- j. \$225,001 – \$250,000
- k. \$250,001 or more
- l. Prefer not to say

SINGLE CHOICE.

Q11. What is the highest level of education a person in your household has completed?
This can be anyone in your household – please answer this for whoever has achieved the highest educational level.

- a. Primary school
- b. High school
- c. TAFE/Vocational Educational Training
- d. Bachelor's degree
- e. Post-graduate degree
- f. Other
- g. Prefer not to say

SINGLE CHOICE.

Q12. Which of the below best describes your household?

- a. Live alone
- b. A two person household, where you are a couple
- c. A family household with a single parent and a dependent child or children
- d. A family household with a couple and a dependent child or children
- e. A group / share house with two or more financially independent people
- f. A multi-generation family household with grandparents, parents and children
- g. Other (please specify)

SINGLE CHOICE.

Q13. Which of the below best describes your current living circumstances?

- a. I/we own the house that we live in, with a mortgage
- b. I/we own the house we live in, outright (with no mortgage)
- c. I/we rent the house we live in
- d. I/we rent the house we live in, but own other property
- e. Other (please specify)

SINGLE CHOICE.

Q14. What type of house do you live in?

- a. A standalone (separate or detached) suburban house
- b. A semi-detached, row or terrace house, or townhouse
- c. A flat or apartment (including granny flats and houses converted to flats)
- d. A flat attached to a shop or office
- e. Other (please specify)

OPEN TEXT

Q15. Including yourself, how many people live in your household?

SINGLE CHOICE.

Q16. How many bedrooms does your house have?

- a. 1
- b. 2
- c. 3
- d. 4
- e. 5 or more

OPEN TEXT.

Q17. Approximately how long ago was your house build (in years)?

ASK ALL. SINGLE CHOICE.

Q18. How long have you lived in your current house?

- a. Less than a year
- b. 1 – 3 years
- c. 3 – 5 years
- d. 5 – 10 years
- e. More than 10 years

SINGLE CHOICE.

Q19. How much longer do you intend on living in your current house?

- a. Less than a year
- b. 1 – 3 years
- c. 3 – 5 years
- d. 5 – 10 years
- e. More than 10 years

OPEN TEXT

Q20. Has your house had any renovations that included improvement or extension of the building (i.e. walls, floors, roof, or footings), or upgrading of the electrical system? If so, please briefly describe the renovations and approximately how long ago you had them done.

- a. Open
- b. No
- c. Not sure

MATRIX.

Q21. Generally, how would you rate the temperature of your home in summer and winter **without** the use of heating or cooling appliances?

COLUMNS

- a. Very cold
- b. Cold
- c. Neutral
- d. Hot
- e. Very hot

ROWS

- a. Summer
- b. Winter

Section 2: Energy and Your Home

ASK ALL. SINGLE CHOICE.

Q22. How would you rate the reliability of your home's electricity supply?

- a. Totally reliable
- b. Very reliable
- c. Reliable
- d. Somewhat reliable
- e. Not reliable at all

OPEN TEXT

Q23. Do you have any comments around the reliability of your home's electricity supply?

MATRIX.

Q24. Does your house **currently** have any of the appliances, devices, or features listed below?

COLUMNS

- a. Yes, the house already had this **before I/we moved** in
- b. Yes, this was installed **after I/we moved** in
- c. No
- d. Not sure

ROWS

- a. Solar system
- b. Household battery
- c. Solar thermal pool heating
- d. Solar hot water
- e. Gas hot water system
- f. Heat pump (air conditioning based) hot water system
- g. Air conditioning (for heating or cooling)
- h. Gas heating (indoor)
- i. Smart home management system (e.g. Amazon Alexa or Google Home)
- j. Eco-switches (devices that can turn off multiple appliances all at once)
- k. Roof insulation
- l. Wall insulation
- m. Double glazed windows
- n. Gas oven

TEXT BOX.

Q25. Do you have any other appliances/devices/features in your house that **help to manage energy or reduce energy use** that were not listed in the previous question?

MATRIX.

Q26. On the days you usually use the appliances below, **at what times do you typically use them?** Select 'N/A' if you do not have a particular appliance listed.

ROWS

- a. Air conditioner
- b. Electric heater
- c. Dishwasher
- d. Washing machine
- e. Clothes dryer
- f. Pool pump
- g. Electric oven
- h. Electric hot water system

COLUMNS

- a. 9am-3pm
- b. 3pm-6pm
- c. 6pm-9pm
- d. 9pm-9am (overnight)
- e. N/A

TEXT BOX.

Q27. Do you have any unusual or atypical things you use electricity for that may noticeably impact your usage? E.g. a large workshop, aquarium, waterbed, etc.

SINGLE CHOICE.

Q28. Thinking about yourself and others in the household, how well do you understand how your electricity use impacts your electricity costs (bills)?

- a. I/we understand it very well
- b. I/we understand it well

- c. I/we understand it a little bit
- d. I/we don't understand it at all

TEXT BOX.

Q29. When thinking about energy, there are generally three main factors that our customers consider: the size of your bill (Energy Cost), how reliable your electricity supply is (Energy Reliability), and how 'green' it is (Environmental Sustainability). Imagine you had 10 points to distribute between these three factors. The more points you allocate to a factor, the more important it is to you. Enter in the points you would allocate for each factor in the boxes below. Note that the total number of points across all three boxes must add to 10.

- a. Energy cost
- b. Energy reliability
- c. Environmental sustainability

MATRIX.

Q30. Which statement below best describes your approach to energy use?

- a. I/we use what we want to use and don't pay any attention to our energy use
- b. I/we use what we need or want to use but do try to pay attention or manage our energy use
- c. I/we use what we need but aim to be efficient with our energy use and manage it accordingly
- d. I/we always aim to reduce our energy use wherever we can

SINGLE CHOICE.

Q31. Generally, do you feel the rest of your household is more or less conscious about your household's energy use than yourself?

- a. More conscious
- b. Less conscious
- c. N/A (I live alone)

SINGLE CHOICE.

Q32. Which of the below best describes how you feel about reducing your energy use?

- a. I/we want to reduce our energy use, and feel able to
- b. I/we want to reduce our energy use, but don't feel able to
- c. I/we aren't trying to reduce our energy use

ASK IF Q32 = a, b. RANK.

Q33. What motivates you to want to reduce your energy use? Please select the top 3 things that motivate you, where 1 is your main motivator.

- a. To save on electricity costs / reduce my bill
- b. To be environmentally friendly, or more sustainable
- c. To be responsible and not wasteful with resources I use
- d. To improve the reliability of the electricity network on days of high electricity demand
- e. To be self-sufficient and less reliant on electricity from the network
- f. To limit the impact of any future electricity price rises

SINGLE CHOICE.

Q34. What statement below best describes how you have paid your electricity bill within the past 12 months?

- a. I have always paid on time
- b. I have been late with my payments once or twice
- c. I have been late with my payments regularly

- d. I rarely pay on time

SINGLE CHOICE.

- Q35.** Have you been on a payment extension or arrangement with Synergy in the last 12 months? A payment extension is where you receive an extension on your bill due date, and a payment arrangement is where you opt to pay your bill amount in instalments.
- a. Yes
 - b. No
 - c. Not sure

SINGLE CHOICE.

- Q36.** How concerned are you or other members of your household about being **able to pay your household electricity bills**?
- a. Extremely concerned
 - b. Very concerned
 - c. Concerned
 - d. Somewhat concerned
 - e. Not concerned at all

ASK IF Q36 = a-c | TEXT BOX.

- Q37.** What is particularly concerning to you about your electricity bills?
- a. Open
 - b. Nothing to add/prefer not to say

SINGLE CHOICE.

- Q38.** My Account is Synergy's free online management tool, available to all Synergy account holders. Customers can register and log in via the Synergy website. Within My Account, you can perform tasks such as viewing your billing and electricity usage history.

Are you currently registered for My Account?

- a. Yes
- b. No
- c. Not sure

ASK IF Q38 = a | SINGLE CHOICE.

- Q39.** How often do you log in to Synergy's My Account?
- a. At least once per week
 - b. At least once per fortnight
 - c. At least once per month
 - d. Less frequently than once per month
 - e. Only when I receive my bill
 - f. I've registered for My Account, but have never or hardly ever use it

ASK IF Q39 = a-e. MULTI CHOICE.

- Q40.** And what tasks do you typically do in My Account? Select all that apply.
- a. Check my electricity usage history
 - b. Check my billing amount history
 - c. Pay my bill
 - d. Manage my account (e.g. payment and billing options)
 - e. Other (please specify)

OPEN TEXT.

Q41. Do you use any other resources or tools (e.g. a website, an app, or device) to help keep track of your energy use? If so, what are they and what information do you typically get from them?

Section 3: Pilot experience

ASK ALL. MATRIX. RANDOMISE ROWS.

Q42. How important were the following factors in your decision to participate in the Project Symphony pilot?

COLUMNS

- a. Extremely important
- b. Very important
- c. Important
- d. Somewhat important
- e. Not important at all

ROWS

- a. Wanting to reduce my electricity use and costs
- b. Receiving the incentive payments
- c. Helping to make the most of my existing solar PV system
- d. Receiving a subsidised asset(s), i.e. battery or hot water system
- e. Having advanced technology installed through Project Symphony
- f. Being part of something new and innovative
- g. Being more sustainable and helping the environment
- h. Helping WA's electricity network to be more reliable
- i. Being part of a community of pilot participants
- j. Helping to future proof against possible future electricity price rises
- k. Increasing the resale value of my home

ASK ALL. TEXT BOX.

Q43. Do you have any other reasons for taking part in Project Symphony that weren't mentioned in the previous question?

ASK ALL. MATRIX. RANDOMISE ROWS.

Q44. Thinking about the process for expressing your interest in the pilot and signing the contract with Synergy, how satisfied were you with the following aspects of the process?

COLUMNS

- a. Very satisfied
- b. Satisfied
- c. Neither satisfied nor dissatisfied
- d. Dissatisfied
- e. Very dissatisfied

ROWS

- a. The ease of the process
- b. The length of the process
- c. Synergy's communication during the process
- d. The amount of information provided during the process
- e. The clarity of the information provided during the process

ASK ALL. MATRIX. RANDOMISE ROWS.

Q45. Thinking specifically about the initial site visit to your home, how satisfied were you with the following aspects of the visit?

COLUMNS

- a. Very satisfied
- b. Satisfied

- c. Neither satisfied nor dissatisfied
- d. Dissatisfied
- e. Very dissatisfied

ROWS

- a. The general timing of the site visit
- b. That the electrician arrived on time
- c. That your premises were left clean and tidy
- d. That the electrician provided sufficient information about the pilot
- e. That the electrician was friendly and polite

RATING SCALE

Q46. Participating in the Project Symphony pilot requires the installation of a small gateway device at your premises, as well as potentially the installation of new assets.

How do you feel about these installations?

[7 point slider: Negative – Neutral – Positive]

MULTI CHOICE.

Q47. What assets/appliances at your house have you agreed to be used for Project symphony? Select all that apply.

- a. Solar system
- b. Battery
- c. Air conditioner
- d. Hot water system

SINGLE CHOICE.

Q48. Are you having a subsidised battery and/or hot water system installed as part of your participation in Project Symphony?

- a. A battery only
- b. A hot water system only
- c. Both
- d. Neither

ASK IF Q48 = a | SINGLE CHOICE.

Q49. Without the subsidy through Project Symphony, how likely is it that you would have purchased a new battery within the next 2 years?

- a. Very likely
- b. Likely
- c. Neither likely nor unlikely
- d. Unlikely
- e. Very unlikely

ASK IF Q48 = c | SINGLE CHOICE.

Q50. Without the subsidy through Project Symphony, how likely is it that you would have purchased a new hot water system within the next 2 years?

- a. Very likely
- b. Likely
- c. Neither likely nor unlikely
- d. Unlikely
- e. Very unlikely

TEXT BOX.

Q51. Do you have any other comments about installations for the pilot or anything about your house you would like to note?

OPEN TEXT.

Q52. During Project Symphony, participants will receive various incentives depending on what existing assets they've elected be used for the pilot. As a reminder, these incentives are:

- Solar systems - \$150 per year
- Battery - \$200 per year
- Electric hot water systems - \$125 per year
- Air conditioners - \$150 per year

Do you have any thoughts about these incentive amounts?

- a. Open
- b. Nothing to add

SINGLE CHOICE.

Q53. Do you know any other person(s) or household(s) also participating in the Project Symphony pilot?

- a. Yes
- b. No

OPEN TEXT

Q54. Would you like to add any other comments about the pilot?

MULTI CHOICE.

Q55. Looking at the list below, please select which statements you think apply to Synergy.

Select all that apply.

- a. Trustworthy
- b. Recognises the issues facing households
- c. Has a strong customer service ethic
- d. Experts in energy
- e. Makes energy easy to understand & manage
- f. Is a responsible corporate citizen
- g. Actively supports the WA community
- h. Offers solutions that are right for me and my home
- i. Future focused and progressive
- j. Leading WA to an intelligent energy future
- k. None of the above

OPEN TEXT

Q56. Finally, as part of Project Symphony's social research, we are also conducting interviews with a small number of customers to better understand their experience in more depth. These interviews will be conducted online via video call and will take around 30-60 minutes to complete. Furthermore, everyone we interview will receive a \$50 Synergy account credit as a 'thank you'. as a token of appreciation for their time. Are you interested in having somebody from UTAS possibly contact you about participating in these interviews?

- a. Yes
- b. No

Installation survey questions

TEXT BOX

Q1. Please provide the email address which this survey was sent to. This helps ensure the survey is completed by the intended household and allows you to enter the prize draw.

RATING SCALE .

Q2. On a scale of 0 to 10, how easy has it been to interact with Synergy during Project Symphony so far? Where 0 is 'Extremely difficult', and 10 is 'Extremely easy'.
[0 – 10 rating scale]

SINGLE CHOICE

Q3. Which of the below statements best describes how you felt about Synergy choosing the contractor who would install your asset(s)?

- a. I was happy to use the installer that Synergy uses
- b. I would've preferred to choose my own installer

OPEN TEXT

Q4. Do you have any further suggestions or feedback on your experience with Synergy?
Please provide us with any details you think may be useful or that we could learn from.

RATING SCALE

Q5. On a scale of 0 to 10, how easy has it been to interact with [installer name] during the asset(s) installation process? Where 0 is 'Extremely difficult', and 10 is 'Extremely easy'.
[0 – 10 rating scale]

MATRIX.

Q6. Thinking specifically about your installation experience, how satisfied were you with the following aspects of the installation?

[5-point satisfaction scale: Very satisfied | Satisfied | Neither | Dissatisfied | Very dissatisfied]

- f. The overall quality of the installation
- g. The general timing of the installation
- h. That the installer arrived on time
- i. The time it took to carry out the installation
- j. The noise level during the installation
- k. That your premises were left clean and tidy
- l. That the installer provided sufficient information about your asset(s)
- m. That the installer was friendly and polite

OPEN TEXT

Q7. Do you have any further suggestions or feedback on your experience with Westsun Solar? Please provide us with any details you think may be useful or that we could learn from.

SINGLE CHOICE

Q8. And based on the information you have about Project Symphony so far, how confident are you about what happens next?

- a. Very confident, I'm clear about what happens next
- b. Fairly confident, I think I know what happens next
- c. Not very confident, I'm not sure what happens next
- d. Not at all confident, I have no idea what happens next

OPEN TEXT

Q9. Do you have any other comments, suggestions, or concerns about Project Symphony?

Q10. Finally, would you like someone to contact you about anything you've raised in this survey?

- a. Yes
- b. No

ASK IF Q10b = Yes | TEXT BOX.

Q11. To help us assign your query to the right person, could you briefly describe what you would like to speak to someone about?

Orchestration Phase 1 survey

Section 1: Sentiment

RATING SCALE

Q1. Firstly, how are you finding the Project Symphony pilot so far?

'0' is 'extremely poor' and '10' is 'excellent'.

[0 – 10 rating scale]

MULTI CHOICE

Q2. And how are you **feeling** about Project Symphony? *Select all that apply.*

a. Excited	f. Frustrated
b. Reassured	g. Irritated
c. Grateful	h. Confused
d. Interested	i. Anxious
e. Indifferent	j. None of the above (exclusive)

OPEN TEXT

Q3. Please tell us more about **why** you've rated the project [pipe answer from Q1] out of 10.

MATRIX RATING SCALE

Q4. To what extent do you agree with the following statements:

5 point agreement scale | N/A

- a. I'm **given sufficient information** about the project
- b. Information provided is **easy to understand**
- c. It's been an **easy experience** so far
- d. I'm **able to get help** (when I need it)

Section 2: Observations of appliances

MULTI CHOICE

Q5. Could you please confirm which appliance(s) you have signed up to Project Symphony.
Select all that apply.

- a. Battery
- b. Rooftop solar
- c. Hot water system
- d. Air conditioner
- e. Unsure (exclusive)

If Q5 ≠ (e)

Q6. And is everything working well with the appliance(s) that're signed up to the project?

i.e. your [pipe responses from Q5]

- a. Yes, all working as expected
- b. No
- c. Unsure

If Q6 = (b) (c)

OPEN TEXT

Q7. Please tell us in detail about **anything unexpected / any issues** you've noticed with your appliance(s).

If Q6 = (b) (c)

MULTI CHOICE

Q8. And are you concerned about what you've noticed with your appliance(s)?

- a. Yes, I'm concerned (exclusive)
- b. Not sure if it's an issue (exclusive)
- c. Not concerned (exclusive)
- d. Other (please specify)

Section 3: Demographics

Only asked if demographic questions not previously answered

Section 4: Further comments

OPEN TEXT

Q16. Do you have any other comments/ concerns about Project Symphony?

SINGLE CHOICE

Q17. Lastly, would you like someone to contact you about anything you've raised in this survey?

- a. Yes
- b. No, don't need to be contacted

Orchestration Phase 2 survey

Section 1: Pilot experience

RATING SCALE

Q1. How would you rate the Project Symphony pilot so far?

'0' is 'extremely poor' and '10' is 'excellent'.

[0 – 10 rating scale]

OPEN TEXT

Q2. Please tell us the **reason for your rating**.

MATRIX RATING SCALE

Q3. Based on your experience so far, to what extent do you agree that:

5 point agreement scale | N/A

- e. I'm **given sufficient information** about the project
- f. Participating in this project has been **worthwhile**
- g. It's been an **easy experience**
- h. I'm **able to get help** (when I need it)

MATRIX RATING SCALE

Q4. Please confirm the appliances you have, signed up to Project Symphony?

- a. Rooftop solar
- b. Home battery
- c. Air conditioner
- d. Hot water system

Section 2: Appeal factors & incentives

OPEN TEXT

Q5. Now that you've been involved in Project Symphony, what do you feel are the **biggest benefits / value of participating**, if any?

OPEN TEXT

Q6. What are the **downsides / disadvantages of participating**, if any?

MATRIX RATING SCALE

Q7. A range of payments and subsidies were offered to Symphony participants.

How **satisfied** are you with what was offered to you personally?

Extremely dissatisfied – Dissatisfied – Neutral – Satisfied – Extremely satisfied | Didn't receive this

- a. Payment (\$) for signing up each asset (in form of bill credits)
- b. Payment (\$) for 'orchestration' (in form of bill credits)
- c. Fully / partially subsidised asset

SINGLE CHOICE

Q8. Thinking about your electricity bill (\$) **after** you joined Project Symphony.. Which of the below best describes your bill and what you expected?

- a. My bill is **higher than expected** (since joining the project)
- b. About the **same** as expected
- c. **Less** than expected
- d. Unsure

SINGLE CHOICE | IF Q8 = a

Q9. Do you have **any concerns** about **changes in your electricity bill because of Symphony-related activities**?

- a. Not at all concerned
- b. A little concerned
- c. Moderately concerned
- d. Very concerned
- e. Extremely concerned

OPEN TEXT

Q10. Do you have any other comments about your bill amount and the payments / subsidies offered to you?

Section 3: Orchestration awareness & sentiment

SINGLE CHOICE

Q11. Have you noticed any of your appliances being remotely controlled (orchestrated) by Project Symphony?

- a. Yes, noticed it in the last month
- b. Yes, but most recent was more than 2 months ago
- c. No
- d. Unsure

If Q11 = (a) (b) | MULTI CHOICE | Carry forward answers from Q4

Q12. Based on what you noticed, which appliance was being remotely controlled by the pilot? *Select all that apply.*

- f. Battery
- g. Rooftop solar
- h. Hot water system
- i. Air conditioner

If Q11 = (a) (b) | 7-point Rating scale

Q13. And how do you feel about your appliances being controlled (or orchestrated) as part of the project?

Extremely negative – Negative – Slightly Negative – Neutral – Slightly positive – Positive – Extremely positive

If Q11 = (a) (b) | OPEN TEXT

Q14. Please tell us more about why you're feeling that way; and any other thoughts you have about orchestration.

SINGLE CHOICE | If noticed orchestration

Q15. Has orchestration made you change your routine / the way you use energy at home?

- a. Yes, changed a lot
- b. Yes, changed a little
- c. No
- d. Unsure

Section 4: Future participation & end-of-pilot preferences

SINGLE CHOICE

Q16. There are devices installed in participants' homes to allow assets to be remotely controlled (orchestrated). *These are gateway devices and some have additional data recorders.*

Let's imagine the pilot has ended and you're given options regarding these orchestration devices. Which of these would you prefer?

- a. Synergy removes the orchestration devices from your home
- b. Devices are left in your home, but the software is disconnected
- c. No preference either way
- d. Unsure

OPEN TEXT

Q17. Do you have any queries or expectations about options relating to the orchestration devices?

SINGLE CHOICE

Q18. Based on your experience with Project Symphony, how likely are you to participate in similar pilots in future?

- a. Not at all likely
- b. Unlikely
- c. Unsure
- d. Likely
- e. Extremely likely

Section 5: Energy attitudes and behaviours

SINGLE CHOICE

Q19. Which of the below best describes how your **household usually use energy**?

- a. Use what we **want** and **don't pay any attention** to our energy use
- b. Use what we **want** but **try to pay attention** to our energy use
- c. Use what we **need**, and **always try to manage** our energy use

SINGLE CHOICE

Q20. Since joining the pilot, have you changed **how often you monitor your energy**?

- a. Monitoring more than before
- b. About the same
- c. Less than before
- d. Unsure

MULTI CHOICE | If Q20 = a, b, c

Q21. And what do you **currently use to monitor** your energy?

- a. Synergy's online portal
- b. Battery app
- c. Solar app
- d. Synergy bill
- e. Other ways (please specify)
- f. None – don't monitor energy

MULTI CHOICE

Q22. Since joining the pilot, is there **anything that's made you use more or less energy at home?**

- a. More people living in the house
- b. Less people living in the house
- c. More time spent at home
- d. Less time spent at home
- e. Additional cooling / heating appliance
- f. Replaced energy appliances with more efficient ones
- g. Other changes that increase energy use
- h. Other changes that decrease energy use
- i. None, no changes

SINGLE CHOICE.

Q23. Since joining the pilot, how **reliable is your home's electricity supply?**

- a. Not at all reliable
- b. Somewhat reliable
- c. Reliable
- d. Very reliable
- e. Totally reliable

Q24. Part of Project Symphony's purpose is to improve WA's energy reliability, which needs involvement from individual households.

Now that you've been through the pilot, to what extent do you feel that:

Households with solar and batteries have a role to play in WA's energy reliability

- a. Strongly agree
- b. Agree
- c. Neutral
- d. Disagree
- e. Strongly disagree

OPEN TEXT

Q25. Do you have any other comments on individual household responsibility on improving WA's energy reliability?

Section 6: Demographics

Only asked if demographic questions not previously answered

Section 7: Further comments

OPEN TEXT

Q31. We'd like your final thoughts on the pilot. Share **any views you have** on the topics below.

- If the selection process for **who can take part** in the project is **inclusive / fair**.
- Your **interactions with other participants** and if that's changed your experience.
- Having **technicians / installers** visit your home
- The **organisations involved** in the pilot
- **Reliability** of your home's electricity supply
- Anything you wish was **done differently**

SINGLE CHOICE

Q32. Lastly, would you like someone to contact you about anything you've raised in this survey?

- c. Yes
- d. No, don't need to be contacted

Appendix 8 – First and second interview questions/template

First interview - installation/pre-commissioning of Project Symphony technology - template

[Interviewers note - Text included here in the introduction section of the interview is here to guide the interviewer. It can be slightly altered as needed. But please cover the points made below.]

Date:

Interviewee:

Interviewer:

Google map house check notes if can:

- Orientation (do the receive any northern light.
- Size, type
- Notable landscape features
- Neighbours close/far way
- One story, 2 storey

Other preparatory notes: (i.e., phoning directly on teams instead of zoom, or notes about install from Synergy)

Introduction – spoken by interviewer

Hello, I'm [name]. Thank you so much for taking part in this interview. We really appreciate your time and what we can learn from this interview.

Before we begin, I need to check a few things with you.

We sent through a consent document. Do you agree to the consent points we sent through?
[Discuss and relay the details of the consent as needed this as needed].

Consent points to check before begin

By agreeing in the first minutes of the interview (or signing the consent), I confirm that I understand that:

- My involvement in this interview assists the Project Symphony social researchers to understand customer experiences of the pilot and customer insights.

- I have been provided an information sheet or a link to the information sheet online. Any questions I have asked have been answered to my satisfaction.
- This is the first of two interviews and will be online. The other interview will take place around February 2023.
- This interview will take around 30-60 minutes and I will be asked about my insights and experiences of the Project Symphony pilot.
- I may also be asked to share some photos or video to help researchers understand the technologies installed as part of project Symphony. I can choose to provide these or not.
- This interview is to be recorded and transcribed.
- Providing responses in this interview is low risk and any publications will deidentify any answers I provide.
- I can contact researchers in the next two weeks following the interview if I want to withdraw or alter anything I have shared in the interview. After this time my contributions may have been analysed, deidentified or published.
- All identifiable data will be securely stored by Synergy, UTAS and ANU.
- Information I provide will be kept securely for a minimum of 5 years after the pilot ends and will likely be archived and kept.
- Deidentified findings will be used in the social research report for the pilot and may be used to support further projects and for teaching purposes.
- Synergy's contract with me also specifies they may use the data they collect for other purposes.
- I am involved in this interview because I am taking part in the Project Symphony pilot and agreed to an invitation to take part.
- I agree to participate in this interview.

Further introductory checks

[if needed after consent checks]

I note here that we are recording this interview. Recordings allow us to capture so much more from the interviews. I will note your consent on the recording when we begin.

I need to also confirm you are aware of the overall time needed. This will take 30-60 mins.

I have set questions to ask, but we are really interested in anything you think is important, so please feel free to note any points you think need to be raised or any information that will help us understand your experience of Project Symphony.

Do you have any other questions about how the interview will run?

TURN on the recorder

Interviewer states a date, name of interviewee, who is interviewing.

Relay that the participant/s have agreed to the terms of the consent and get them to respond on the recording to confirm this.

Questions

Project Symphony set up

The first questions are about your experiences with the Project Symphony pilot so far, and the technical and appliance set up for Project Symphony at your home.

Survey notes to support all interview – [Add survey answers from Q12 (type of household), Q13 (how many in house), Q14 (whether owners or renters) Q15 (type of house), Q16 (number of bedrooms), Q17 (how long ago house built), and Q20 [Q21 in toluna spreadsheet (TS)] (any renovations).]

1. To begin, can you please run me through the process you have gone through so far for Project Symphony and comment on how that all went?

Prompts. [Note relevant survey responses – list is below this prompt.] Ask about the EOI, site visit assessments, letters explaining what eligible for, installer visits if applicable Installations are asked about below. If renter - Is there any difference having to go through a landlord?

Survey notes to support Q1 - [Add survey answers from, Q44 [Q54 in TS] (EOI satisfaction), Q45 [Q55 in TS (site visit satisfaction), Q46 [Q56 in TS] (how feel re installations), Q51 [Q61 and 62 in TS] (any comments to add), Q54 [Q66 in TS] (any other comments about the pilot) as notes just under this question.] [can add a table of answers for satisfaction]

2. Following through on that previous question a little further, we were hoping to learn more about the assets (your appliances) you have (or are having) connected for use in the pilot. In the survey you mentioned that you are having [insert assets from Q47 [Q57 in TS] assets connected to the pilot with [insert assets from Q48 [Q58 in TS] subsidised and installed for the pilot.
 - a) Has your installation of the new assets been completed yet? If not when is the install?
 - b) Can you please describe more about these appliances, such as where they are located in your house, what size and brand they are?
3. Thinking about the assets that you are using for the pilot, can you describe how they will be utilised for the pilot?

Prompt – For example, can you run through how you think the gateway device and assets will interact with the electricity grid during the pilot?

4. We asked in the appointment email if you might be able to take a few photos for us of assets and where new assets are going. This is so we can get a visual idea of the assets you have involved in this Project Symphony pilot, their location and how they fit (or will fit into) into your house.

- a) Were you able to take photos for us? [yes/no] [If haven't received photos from this participant yet.] Do you think you might be able to take some photos for us? [yes/no] You can email those to us.

[Have a look at photos while in interview if they have already been sent]

- b) **[if they have already taken photos]** [Discuss the photos] Prompts: I see that you have them in the garage/outside....

- c) **[if they have already taken them]** Was there anything interesting that you noticed or thought of related to the assets as you took the photos?

- d) **[if they haven't yet taken any photos but have said that they will take some photos]** What do you think you will take photos of? And why?

5. **[If installation of assets occurring/has occurred]** As you are having new assets installed, I wanted to check if you had to notify your insurance at all about having these new assets, or whether they are covered under your insurance with no changes needed?

If required prompt – We ask this because it seems that different insurance companies might deal with things differently and assets like batteries related to this pilot are a fairly new additions to Australian houses.

6. Do you have any other thoughts or concerns about asset connections or installations?

Broad motives

Onto another section of the interview now. In this section we are interested in your broad motives and your perceptions of motives of key organisations involved.

7. We first ask about your perspectives about motivations of the organisations involved. What is your understanding about:

- a. why Project symphony is being run?
- b. why Synergy are involved?
- c. Why Western Power are involved? and

d. Why the State (WA) Government is involved?

8. In relation to motives to be involved in this pilot, in the survey you responded that you were motivated to be involved with Project Symphony because of [add survey answers from Q42 [Q51 in TS] as a table (how important following factors) and Q43 [Q51 in toluna spreadsheet] multiple motivations / a few key motives. Are there any other motives that weren't covered in the survey, or is there anything else to add to those answers? [Can run through the motives extracted from survey to prompt memory.]
9. You might remember from the survey that it mentioned there are generally three main factors that customers commonly consider with regard to energy and electricity: the size of your bill (Energy Cost), how reliable your electricity supply is (Energy Reliability), and how 'green' it is (Environmental Sustainability). In the survey you answered [add survey answers from Q28 [Q33, 34, 35 in TS]].
 - a) Is there anything further to add about this question or how you weighted these considerations?
 - b) Did these three groups work for you? And did giving them all a score work for you? Or not? Did this question cover things that actually motivate you or that you value?
10. When you were rating environmental sustainability in the survey, were you thinking about anything in particular, or just more generally?

Prompt - Energy use in WA has fairly high emissions because of certain fuel sources that are used, so when you weighted the Environmental Sustainability component, were you thinking about emissions reductions or climate change impacts at all?
11. And sometimes people see themselves as resourceful, rather than being environmentally sustainable – does the concept of resourcefulness feel useful to you in relation to your motivations? Does it work better for you than sustainable?

Energy use, issues for energy use and use motives

This next section is about energy use and related issues and motives.

12. Understanding the number of people and the type of household group at a premises can help us to contextualise the responses you provide about energy use. In the survey you shared that you are a [X] household group [add survey answer Q12 (living arrangement/household type)], have [X] occupants [add survey answer Q13 (number of occupants)]. Can you tell us a little more about your household group as it might relate to energy use in your house (and therefore to Project Symphony)?

Prompts if needed- How would you describe your household in relation to the way you use energy? For example, different people might be at home at different times due to shift work and lifestyle, young children or teenagers may or may not engage so much with energy efficiency strategies)

13. In the survey you noted that you [add survey answer from Q30 and Q32 [Qs37 and 39 in TS] (which indicated approach to energy use and how feel about reducing energy use)]. Could you share a little more about this approach?

Prompt if needed: Why, or why aren't you interested in reducing energy use? [If they are] How do you, or might you, go about reducing your energy?

14. On monitoring energy and/or bills, you mentioned in the survey that you [add answers from survey questions Q38[Q46 in TS], Q39[Q47 in TS], Q 40 [Q48 in TS] (My Account use), and Q41[Q49 in TS] (other resources to keep track of energy use)]. Can you expand on your reasons for tracking energy/not worrying about tracking energy use?

If installation complete can also ask – are you using the app that comes with the battery now?

Prompts if needed - Is there any particular information that you find helpful? Are you a person who prefers to set it up and forget about it? Do you use it to help assess energy daily or less often? Is it easy or hard to understand the information you have on energy? Do you find the information accurate? Do you find the information trustworthy/not trustworthy?

15. Alongside what we have already discussed in the interview, there are a number of motives/values that we do know drive energy use at a household level. For example, people often tell me that physical comfort and health are priorities and are present when they make decisions about how to use energy. Are these or other concerns/factors important to you? And have they affected your decision to take part in this pilot?
16. Do you think that being involved in the pilot will raise any issues for you in terms of how you use or manage energy in your house?

Prompt - Are there any times you foresee you might want to use an appliance that is being affected by the pilot and its asset orchestration?

Energy supply

Next I ask energy supply related questions.

17. This question is about electricity and reliability. In the survey you answered that [add survey answer from Q22 [Q24 in TS] (how reliable) and Q23 [Q25 in TS] (anything to add re reliability)] . What factors were you thinking about that led you to say your supply is very reliable/Reliable?

18. Would you say your electricity is generally affordable? And, if you have other forms of energy in the home, such as gas, is your overall energy supply affordable?

Prompt – Recognising there are multiple aspects to affordability, such as electricity prices, and what you can afford. So please just answer what you think about in terms of affordability.

19. Would you say your electricity supply is generally ‘green’, or sustainable? For example, would you say it is low emission energy?

Remuneration, benefits

We are also keen to ask about incentives and potential benefits of Project Symphony for householders.

As a reminder, the incentives for existing and new assets are:

Existing assets	Bill Credit
Air conditioner	\$150 / year
Solar	\$150 / year
New assets	Subsidy (approx.)
Battery	Large battery 10kWh - 63% subsidy (\$8,500 subsidy) (Customer pays \$5k) Small battery 7.5kWh - 70% subsidy (\$8,000 subsidy) (Customer pays \$3.5k)
Hot Water System	50% subsidy (\$2,475 subsidy)

20. In the survey you mentioned [add survey Answer from Q 52 [TS Q62,63,64]] [(opinions about incentives)]. Do you have any further comments to make about these incentive amounts?

21. Did you work out overall costs and benefits of being involved for your household in particular?

Neighbourhood and community and inclusion

We would also like to ask about Project Symphony in your neighbourhood and community.

22. In the survey you note you know someone else/don't know of anyone else [see Q53[Q65 in TS]] involved in the pilot. Is this someone in your street or further afield? OR, Do you know if anyone else in your neighbourhood is involved with Project Symphony?

23. Have you, as yet had any discussions about Project Symphony with anyone in your community, including other people who might be involved?

Prompts – Did you talk about assets/technologies you have involved or how they will be used for Project Symphony? Was it with a neighbour, or a passer-by?

24. Participation in Project Symphony is by invite-only, based on location and the type of assets at your house. What do you think about some people being invited to take part and others not getting to be involved?

25. Related to the question I just asked – do you have any thoughts about fairness in relation to what you know so far about the Project Symphony pilot and how involvement and benefits are decided?

Impressions, feelings

This section is to check how you are feeling about the pilot at the moment.

26. Are you feeling ok about the whole process of the pilot so far? (Prompts. For example, did you find it all fairly straightforward or were there some confusing or stressful parts to the process?)

27. Are you generally feeling ok about the organisation involved? **[skip this one if short on time]**

Anything we have missed?

Just a couple more questions now.

28. Is there anything that you haven't been asked about yet that you think is important?

29. A final question here about next steps. We are running part 2 of these interviews around February next year. We would love to be able to speak to the same people we spoke to this time. Would you be ok for us to contact you again when they are coming up to ask if you can do that 2nd interview?

Thank you. That is the end of the interview. [turn off the recorder]

Can TURN off the recorder

Thank you and Further information

Before we hang up, I wanted to let you know about what happens next with your interview.

- we transcribe the interview and store securely, if you are interested let us know and we will send the transcription to you.
- we use this information to better understand and to learn, alongside data from surveys.
- Some small surveys will be sent out to you over this year around 5-10 mins each
- A larger survey will come out next year - anticipating it will be Feb 2023.
- There will be follow up interviews likely Feb next year. We will check with you at the appropriate time to see whether you are happy and able to take part.
- If photos are to be sent – check they know the email. SM-symphony.socialresearch@utas.edu.au.

Thank you again.

End call

Second interview – post orchestration (March and April 2023) of Project Symphony - template

Introduction – spoken by interviewer

[Greet; Provide name & thank participants for their time. Reiterate this is super helpful.]

Before we begin, I need to check the consent with you.

We sent through a consent document. Do you agree to the consent points we sent through? I will record consent if you are happy when I turn the recorder on.

[Discuss and relay the details of the consent as needed].

Consent points to check before begin

By agreeing in the first minutes of the interview (or signing the consent), you confirm that you understand the consent form and have asked all the questions you want to.

Check that interviewee/s are aware that:

- I record this so we can come back and better understand what was said.
- I will note your consent on the recording at the start of the recording.
- I would appreciate taking photos if can
- We do store your information.
- All publications are anonymous.
- You can retract comments you have made up to for two weeks after the interview.
- Info sheet we sent has our contact details for you in case you need them
- The interview is 30mins. So I will be stepping through questions relatively efficiently because it is a shorter time than the last interview.
- We have set questions to ask, but we are really interested in anything you think is important – please tell us what you need to.

Do you have any questions before we begin?

TURN on the recorder

[Interviewer states a date, name of interviewee, who is interviewing.]

Relay that the participant/s have agreed to the terms of the consent and get them to respond on the recording to confirm this.]

Questions

We are keen to capture any impressions or insights you have about Project Symphony since we last spoke to you [either the last interview or the focus groups in Feb this year].

1. Firstly, we would like to invite you to share any comments or insights about your experiences with Project Symphony that are on your mind.

[**Prompt:** Are there any benefits or challenges that you are finding with the project]?

2. Have you had any additional installations, inspections or home visits related to Project Symphony since your original installation? (We likely talked with you about your original installations at the last interview.) How did those additional visits go?

[**Prompt:** Check assets connected - listed above]

3. Project Symphony has been actively testing various grid management scenarios. This means that your assets would have most likely been involved (or orchestrated) under these scenarios. What this may have meant is that your assets including battery, solar, air conditioning and hot water – anything connected to Project Symphony - may have been remotely controlled. Where you aware of this? And if so, what has been your experience of this?

[**Prompt:** Which assets have you noticed have been involved? **Prompt:** Any opinions on orchestration?]

4. We asked you about energy use in the first interview. Would you say you and your household's energy use and practices has stayed the same since you became involved with Project

Symphony? Or do you think you have changed the way you use energy in your home since the project began? And have orchestration activities influenced your energy use and management?

[Prompt: For example, are you using more or less than your typical use at the same time of year if you look at your average use on your bill? Has there been any changes in your household that would increase or decrease your energy use?]

5. Following on from that question, do you think your bill has changed since the project began? If so, how?

Check approximate date of last bill.

[Prompt – [if their bill has increased] Do you have a new electric heat pump hot water system (replacing gas) and do you feel this has been part of the change in your bill?].

6. Do you monitor what is happening with your assets with the project? If so, how? What has changed?

[Prompts: For example, do you use apps? Or are there other ways you are getting information? bills, noise, your meter board or anything else?]

7. Next, we would like to ask about incentives, and finances – What do you think about the remuneration and incentives in Project Symphony at this stage of the project? We are interested in any points you want to make about this.

[Prompt: What about electricity costs, bill credits, assets subsidies and/or orchestration payments? Did you notice extra payments on your bill? [For non-battery customers] People without battery subsidies received orchestration payments. Have you noticed orchestration payments on your bill (listed as a rebate)?]

8. On communication from Project Symphony:

a) We were told there was a relatively detailed email that came out in early March from Synergy about Project Symphony. Did you see that? What did you think of it?

b) Do you have anything further you would like to suggest for communication and information shared throughout this pilot?

9. We asked you in the first interview and *in recent the focus groups (if applicable)* if you have talked with others in the community about Project Symphony? Following that earlier question in the first interview, are you talking more now with people in the community? Are you involved with any groups (online or otherwise) related to the project?

[**Prompt:** Have you helped each other to understand what is going on? If talking with other Project Symphony participants]

10. Last time we asked about your ideas around how some people were invited to take part in Project Symphony and others were not (involved), and we also asked about your thoughts on fairness. Now that you've been involved in Project Symphony, do you have any further thoughts on inclusion, exclusion and fairness in relation to this pilot?

Questions on the future of the project and/or similar projects

For the next couple of questions, we need to provide a little context about the pilot (just before we ask them). The pilot will be ending in September and Synergy is exploring possibilities after that.

You have extra devices installed to connect your house assets to the pilot. This includes the gateway device and other equipment. They were put in for the pilot and would not otherwise have been part of the technology installed in your house.

11. What do you expect will happen to this equipment when the pilot ends? How would you feel about having these assets remaining in your home?

[If unsure or expect devices to be removed]

Prompt: Is there anything that would change your mind about having the devices removed? How would you feel if the devices remained but were disconnected?

12. Are you interested in participating further in this or a similar project if elements of it continue? If yes, why? If no, why is that?

13. Thinking about all we have discussed with the project, for example, with orchestration, energy use, with the assets and subsidies, is the experience you have had with the project what you expected when you first signed up?

14. This is a broader scale question. We would like to get your perspective on Virtual Power Plants and these types of solutions in managing the electricity grid.

What do you think of householders using household assets, such as batteries and solar PV to help take care of the grid? Is there any responsibility for the householder?

15. Finally [for people who haven't sent recent photos, may we take some photos of the assets and their surroundings? This will provide us with further insights. We will look at these with the photos we collected at the first interview.

[If people have provided recent photos] Thank you for your photos. I was wanting to check a few things [ask relevant questions needed about the pictures.]

[Ask about position of the assets while taking photos. Leave the recorder on for related conversation keeping in mind it will need to be transcribed!]

Can TURN off the recorder

Thank you and Further information

I wanted to let you know about what happens next with your interview.

- we transcribe the interview and store securely, if you are interested let us know and we will send the transcription to you.
- we use this information to better understand and to learn, alongside data from surveys.
- one final survey will be sent out to you in the coming month or so

Thank you again.

Appendix 9 – Discussion guide for focus groups

Householders/customer focus group schedule - Project Symphony

Purpose

To explore issues that were raised in the recent customer sentiment survey on orchestration and to understand participants experience of Project Symphony so far, to gain insights about participants thinking on these issues.

Dates

Wednesday 8th February 9:30 to 11am; 11-12:30 and 6.30 – 8pm

Thursday 9th February, 6.30 – 8pm

Location

Amherst Village Community Centre

2 Holmes St, Southern River 6110

Meeting room 2

Who attending

Up to 13 participants per group – householders who are involved with the Project Symphony Pilot, are customers of Synergy and have had household assets involved with electrical orchestration on the grid as conducted by Project Symphony

Who facilitating

Maureen and Phillipa

Run sheet

Time mins	Instructions, questions and text to be read	Who	Any other instructions or notes
0-5 mins	Maureen and Pip introduce ourselves Check consents all signed. Introduce Jade – as a researcher, sharing feedback back to organisation - Video recording to help ensure we’ve captured everything. - Post it notes – write down your thoughts at any point in time	Maureen to read out main text, Pip to check consents are signed	Hand out post it notes
5	Intro information - This focus group is to explore experiences of householders involved with Project Symphony at this point in the pilot including your	Maureen	

	<p>impressions of how the assets and appliances orchestration is going. All people attending are household participants of the Project Symphony pilot.</p> <p>We are using a questions and answer format today. This is not an information session. We are here to learn from you and your insights on Project Symphony. There'll be an update from Project Symphony soon.</p> <p>We will be working through from broader topics to more specific, and we will ask about:</p> <ul style="list-style-type: none"> • Why you joined Project Symphony • Issues you would like to explore with other Project Symphony participants in your community. • Your personal experiences of orchestration so far • Your expectations of orchestration/testing 		
10 - 20	Get all to briefly introduce themselves, assets connected and why joined Project Symphony	Maureen to guide	30 sec per person
20 – 25 (5 mins)	<p>First discussion – group or community activity and expectations</p> <p>As a group of people involved in Project Symphony, some people have let us know they would like to get together and have a discussion as a group of participants.</p> <p>Q1 –If you are interested in talking with other participants more about the pilot, what issues would you like to explore and what benefits do you see from this approach?</p> <p>Prompts: have you talked with anyone else involved in this pilot? If so, what discussions have you had? Would these discussions with other participants be useful for you?</p>	Maureen to read out main text, Pip to support prompting and conversation and take notes	
25-40 (15 mins)	<p>Second discussion – orchestration</p> <p>Project symphony is piloting systems and tech that help orchestrate.</p> <p>Check understanding of terms (brief)</p> <ul style="list-style-type: none"> - Large scale coordination of assets - Remotely manage assets such as solar, battery, hot water system, air con 	Maureen to read out main text, Pip to support prompting and conversation and take notes	Explain what orchestration is.

	<ul style="list-style-type: none"> - It's like an orchestra – there are lots of different instruments playing and it comes together as a whole. <p>Q2. How is orchestration going for you so far? At your house, do you notice when your battery or other appliances (air con, solar PV, hot water) are being orchestrated? [add prompts]</p> <p>Q3. Did your experience of orchestration match your expectations? If not, why?</p>		
40 – 50 (10 mins)	<p>Third Discussion</p> <p>Q4. Do you have any comments to make about the idea of orchestration - that is the approach being used in the pilot? This is seeking your opinions in the broader idea of orchestration.</p> <ul style="list-style-type: none"> - - What are your thoughts/responses about orchestration? - Have you any comments to make about Synergy's testing approach? - Do you have any confusion or concerns related to this orchestration? - Frequency of orchestration (as per FAQs) 	Maureen to read out main text, Pip to support prompting and conversation and take notes	
50 – 55 (5 mins)	Short tea/coffee/toilet/stretch break		
55 – 65 (10 mins)	<p>Q5. Thinking about the pros and cons of being involved in Project Symphony to you personally.</p> <p>a) Has this been valuable to you? And how? b) What else would you like to see?</p> <p>Prompts:</p> <ul style="list-style-type: none"> - Incentives offered so far such as bill credits and battery subsidies. - Anything else you can suggest 	Maureen to read out main text, Pip to support prompting and conversation and take notes	Explore incentives subsidies, and bill credits or other ideas from participants.

65 – 75 (10 mins)	<p>Communications -</p> <p>Q6. Thinking about communications you’ve received from Project Symphony – there’s FAQs and the latest email.</p> <ul style="list-style-type: none"> - Are you happy with the level of information & communication? - Is it understandable? 		Provide FAQs & email print outs
75 – 80 (5 mins)	<p>Closing and thanking participants</p> <p>Thank you for attending this focus group and for your participation.</p> <p>This information will be summarised and provided to Synergy and will be used in the social research for the overall pilot.</p> <p>If you have particular concerns, please do call Synergy directly as we are observers and can’t directly solve any individual issues.</p> <p>The next steps of the social research include further surveys and interviews. The timing of these final pieces is currently being organised, and you will likely hear from us about those in the coming month.</p>		

Appendix 10 – Academic literature review search strategy

Author: Cameron Atkinson

Method section

1. Literature review

The collection and comprehension of prior, pertinent scholarly works is fundamental to all research fields and research activity (Snyder, 2019). In aid of this, there are a number of guidelines and approaches developed specifically for conducting literature reviews. Some approaches in use are: the traditional review; systematic reviews; rapid reviews; narrative reviews; research synthesis; and structured literature reviews (Massaro et al., 2016).

Independent of the methodology employed to conduct the literature review, steps must be made, and decisions taken, to ensure that the review produced will meet publication requirements (Snyder, 2019).

Out of the above methods mentioned, the structured literature review has been identified as complementary to the traditional review, and allows researchers to produce results which are defensible (Massaro et al., 2016). Systematic reviews also provide defensible, rigorous, and transparent results, however they require the development and publication of a protocol as a critical first stage (Fernández Del Amo et al., 2018). Protocols are also required for structured reviews; however, they are not required to be published before the review commences, and serve instead as a replicable plan that researchers follow (Massaro et al., 2016). Due to time constraints, a structured, rather than systematic, approach was adopted for the research project.

2. Search strategy

This structured literature review seeks to answer two specific and interrelated research questions,

‘Regarding Australian VPP trials, what are the key learnings Synergy, Australian industry, government and academia have identified about customer responses to relevant new energy technologies? What knowledge gaps remain?’

A structured search strategy was developed to uncover the academic portion of the research question, and formed the foundation of the literature review. A consultative period between the lead researcher and search strategy developer resulted in the identification of three themes to be employed in the search; 1., customers, 2., virtual power plants and distributed energy within the context of renewable energy, and 3., social aspects. These fields were then joined with the AND Boolean to ensure that the strategy returned results pertaining to studies connected to the phenomena being studied.

To ensure that the range of the search covered a wide enough area, so as to capture as many pertinent studies as possible, a strategy was developed which could be input into multiple databases. To ensure transparency and replicability, the search strategies for all included databases will be presented in a table below.

2.1 Databases

Web Of Science

1. TS=("Virtual Power Plant" OR VPP)
2. TS=(prosumer* OR consumer* OR customer* OR communit*)
3. TS=(social OR behavior OR behaviour OR practice* OR acceptance OR trust)
4. Combine 1 and 2 and 3 and refine by articles and reviews

Scopus

1. TITLE-ABS-KEY("Virtual Power Plant" OR VPP)
2. TITLE-ABS-KEY (prosumer* OR consumer* OR customer* OR communit*)
3. TITLE-ABS-KEY (social OR behavior OR behaviour OR practice* OR acceptance OR trust)

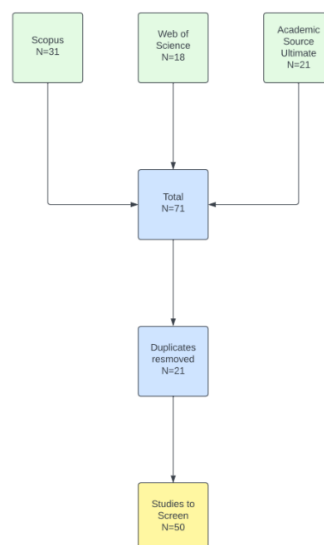
4. Combine 1 and 2 and 3 and refine by articles and

Academic Source Ultimate

1. ("Virtual Power Plant" OR VPP)
2. (prosumer* OR consumer* OR customer* OR communit*)
3. (social OR behavior OR behaviour OR practice* OR acceptance OR trust)
4. Combine 1 and 2 and 3 and refine by articles and reviews

The databases were searched on 29/3/22. The Scopus database returned 31 results, Web of Science, 18, and Academic Source Ultimate, 22 for a combined 71 studies. The search results were uploaded into EndNote before being uploaded into Covidence for duplicate removal. A total of 21 duplicates were identified. Once removed, there were a total of 50 studies to screen in the next stage of the review. In addition to these three databases. The following databases were also searched; Political Science Complete, Sociology Source Ultimate, and Humanities and Social Science Collection (Informit). The reason for not including them is that no studies were identified, possibly because the search strategy was too complex for these databases. Figure 1 provides a flowchart of this process.

Figure 1. Flowchart of searched databases



2.2 Screening

Once identified, the studies were uploaded into Covidence for the next stages of the review.

Covidence is a web based review software typically utilised in systematic reviews. It supports citation screening, full text reviews, as well as bias assessments and data extraction.

Importantly, it allows for more than one researcher to screen articles titles and abstracts for inclusion. This increases the rigor of the screening process as any differences in screening have to be resolved before the review can progress to the full-text reading stage. Both screeners independently screened each article and once the process was completed the screeners discussed conflicts in a zoom conference. Before the commencement of screening a list of inclusion criterion was developed to aid each screener. To be included, each study had to include; 1. Any research, research findings, discussions, or explorations that provide social insights about distributed energy resources (DER) systems, Virtual Power Plants (VPPs) and related electricity supply transitions, 2., studies need to take a social, customer, and/or community lens. They could include, but not limited to; prosumer insights, social welfare, energy justice, energy democracy, poverty alleviation, customer insights., 3., if a technical or engineering or economics based paper is identified, they MUST have an indication that they have social or energy user data, 4., studies be in the context of VVP, renewable DER technologies, and demand management.

3. Resolving conflicts

All conflicts arising throughout the title-abstract screening process were resolved during a Zoom meeting between two researchers on 31/3/22.

3.1 Included studies

From this process, we identified 10 studies which matched our screening and inclusion criteria. The list is provided in table 1.

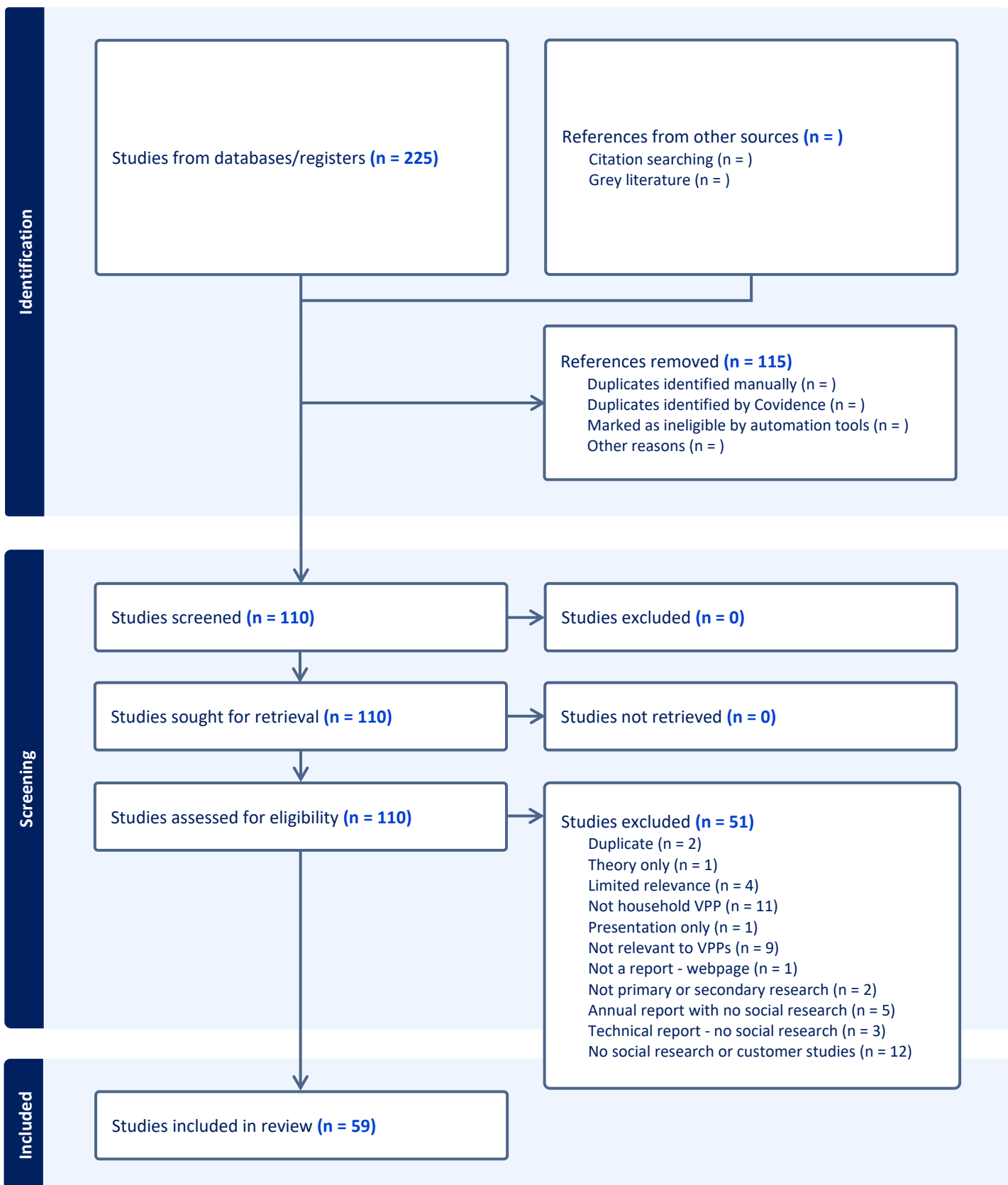
Table 1. Included articles for review

Author(s)	Title
Arslan, O.; Karasan, O. E.	Cost and emission impacts of virtual power plant formation in plug-in hybrid electric vehicle penetrated networks
Büscher, C.; Sumpf, P.	“Trust” and “confidence” as socio-technical problems in the transformation of energy systems
Gong, H.; Rooney, T.; Akeyo, O. M.; Branecky, B. T.; Ionel, D. M.	Equivalent Electric and Heat-Pump Water Heater Models for Aggregated Community-Level Demand Response Virtual Power Plant Controls
Gui, E. M.; MacGill, I.	Typology of future clean energy communities: An exploratory structure, opportunities, and challenges
Kahlen, M. T.; Ketter, W.; van Dalen, J.	Electric Vehicle Virtual Power Plant Dilemma: Grid Balancing Versus Customer Mobility
Morstyn, T.; Farrell, N.; Darby, S. J.; McCulloch, M. D.	Using peer-to-peer energy-trading platforms to incentivize prosumers to form federated power plants
Schlund, J.; German, R.	A distributed ledger based platform for community-driven flexibility provision

Stringer, N.; Bruce, A.; MacGill, I.; Haghdadi, N.; Kilby, P.; Mills, J.; Veijalainen, T.; Armitage, M.; Wilmot, N.	Consumer-led transition
Wang, H.; Riaz, S.; Mancarella, P.	Integrated techno-economic modeling, flexibility analysis, and business case assessment of an urban virtual power plant with multi-market co-optimization

3.2 Grouping included studies

The second research question pertains to the identification of knowledge gaps. The field of energy research is a multidisciplinary field. Given this, instead of discarding the screened out studies they were grouped into different themes in order to identify additional knowledge which could aid in identifying knowledge gaps.



Appendix 12 - Grey literature full list

Report title	Authors	Published
AEMO NEM Virtual Power Plant Demonstrations: Knowledge Sharing Report #4	Australian Energy Market Operator (AEMO)	2021
Demand Response ARENA Knowledge Sharing Report September 2018	AGL, Australian Renewable Energy Agency (ARENA)	2018
NSW Demand Response. ARENA Knowledge Sharing Report October 2019	AGL	2019
AGL NSW Demand Response. Final ARENA Knowledge Sharing Report May 2021	AGL	2021
Demand Response Short Notice RERT Trial Year 2 Report	ARENA	2020
Flexible Exports for Solar PV Lessons Learnt Report 3	Aurecon	2021
Flexible Exports for Solar PV Lessons Learnt Report 2	Aurecon	2021
Flexible Exports for Solar PV Lessons Learnt Report 1	Aurecon	2021
Ausgrid's Battery Virtual Power Plant Progress Report 2021	Ausgrid	2021
Ausgrid's Community Battery Concept - Customer Survey Report	Ausgrid	2021
Demand Response Project Performance Report. ARENA Knowledge Share Report	Energy Australia & ARENA	2019
ARENA Demand Response Trial: ARENA Test 4 Knowledge Share	Energy Australia	2019
ARENA Demand Response Trial: Activation Test 5 Knowledge Share	Energy Australia	2020
ARENA Demand Response Trial: Activation Test 6 Knowledge Share	Energy Australia	2020
Simply Energy VPPx Stage 1 Knowledge Sharing Report	Marchment Hill Consulting	2019
Simply Energy VPPx Stage 2 Knowledge Sharing Report	Marchment Hill Consulting	2020
Simply Energy VPPx Stage 3 Knowledge Sharing Report	Marchment Hill Consulting	2021
DEIP Access and Pricing Package: Reform Package Outcomes Report	DEIP Access and Pricing Working Group	2019
ARENA/AEMO DR Trial. Project Performance and Knowledge Sharing Report	Zen Ecosystems	2019
Virtual Power Plant in South Australia: Stage 1 Milestone Report	AGL Energy	2017
Virtual Power Plant in South Australia: Final Milestone Report	AGL Energy	2020
Pooled Energy ARENA Report	Pooled Energy	2021
Simply Energy VPPx Lessons Learnt Report	Simply Energy	2020
Consumer perspectives on demand response and community energy: A national survey of Australian residential energy consumers	Elisha Frederiks & Lygia Romanach	2021
Demand Response RERT Trial Year 1 Report	Oakley Greenwood & ARENA	2019
Implications of network ownership of grid-side battery assets on competition in the Wholesale Electricity Market	Rohan Harris & Lance Hoch	2021
Charging Ahead. New energy technology and the future of energy complaints in Victoria	Energy and Water Ombudsman Victoria	2020
Powershop Demand Response Program: Project Report (1 of 7)	Powershop	2018

Powershop Demand Response Program: Project Report (Year 2)	Powershop	2019
Opportunity Assessment Report: Rewarding flexible demand: Customer friendly cost reflective tariffs and incentives	Roberts, M., Passey, R., Adams, S., Whittaker, L., Russell-Bennett, R., McAndrew, R., Caton, S., Ben-David, R.	2021
Salisbury Residential Energy Storage Trial Summary Report	SA Power Networks	2021
Project Symphony: Lessons Learnt Report (Milestone 01: Scoping & Planning)	Project Symphony	no date
Applying Behavioural Insights to Powershop's Curb Your Power program	The Behavioural Insights Team	2019
We want it to work: understanding household experiences with new energy technologies in Australia: Final report of the VOICES project (Victorian Energy and Water Ombudsman's Investigation of Consumer Experiences)	Temby, H. & Ransan-Cooper, H.	2021
South Australia Virtual Power Plant Phase 3A: Knowledge Sharing Report	Tesla	2021
Customer Segmentation Research and Design for Orchestration Programs. Phase 1 knowledge sharing report	Upowr	2021
Origin EV Smart Charging Trial. Interim Report	Origin Energy	2021
Interim Social Report: From the Realising Electric Vehicle-to-grid Services (REVS) trial	Kathryn Lucas-Healey; Laura Jones; Bjorn Sturmberg, & Hedda Ransan-Cooper.	2021
Electric Vehicles and The Grid: Analysis, gaps, and recommendations	Kathryn Lucas-Healey; Laura Jones; Md Mejbaul Haque; Bjorn Sturmberg;	2022
Distribution Annual Planning Report 2021	Ergon Energy	2021
Consumer engagement report	Energy Networks Australia	2022
Engaging households towards the Future Grid: experiences, expectations and emerging trends	Nicholls L; Arcari P; Glover A; Martin R; Strengers Y.	2019
Digital energy futures: Review of industry trends, visions and scenarios for the home	Dahlgren, K., Strengers, Y., Pink, S., Nicholls, L., Sadowski, J.	2020
Digital Energy Futures: Future Home Life	Strengers Y; Dahlgren K; Nicholls L; Pink S; Martin R;	2021
Digital Energy Futures: Demand management opportunities	Nicholls L; Strengers Y; Dahlgren K; Pink S; Martin R.,	2021
Enabling Distributed Energy in Electricity Networks. Final Report (Phase 1)	Renew	2021
DER Customer Insights: The Customer Journey	Institute for Sustainable Futures, ARENA	2020
DER Customer Insights: Values & Motivations	ARENA	2020
Virtual Power Plant Demonstrations Consumer Insights Report	Paul van Veenendaal	2021
Virtual Power Plant Consumer Insights Interim Report	Customer Service Benchmarking Australia	2021

Small-scale solar and battery projections 2021	Graham, P.W. (CSIRO)	2021
Exploring regulatory approaches to consumer vulnerability: A report for the Australian Energy Regulator	Emma O'Neill	2020
AEMO Virtual Power Plant Demonstrations: Knowledge Sharing Report #3	Australian Energy Market Operator	2021
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