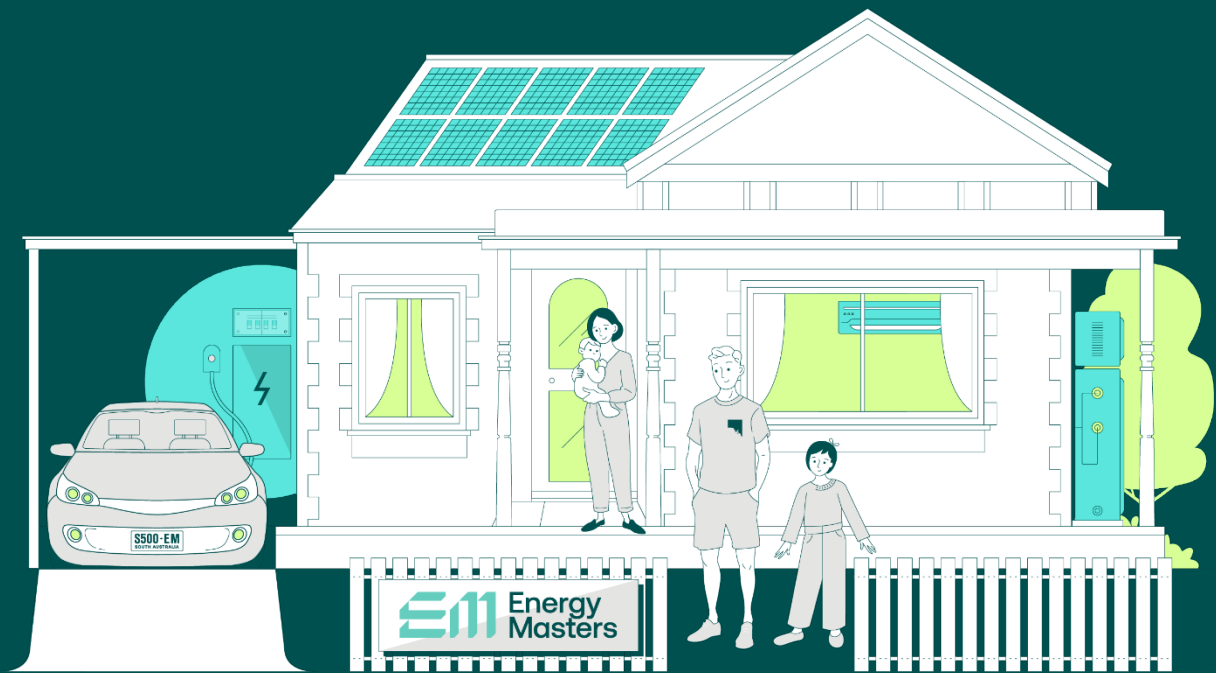


Energy Masters RACE Annual Report Year 1

August 2025



Progress report

RACE for Networks

Energy Masters

Project Code: 23.NT6.R.0534

October 2025

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What is RACE for 2030?

Reliable, Affordable Clean Energy for 2030 (RACE for 2030) is an innovative cooperative research centre for energy and carbon transition. We were funded with \$68.5 million of Commonwealth funds and commitments of \$280 million of cash and in-kind contributions from our partners. Our aim is to deliver \$3.8 billion of cumulative energy productivity benefits and 20 megatons of cumulative carbon emission savings by 2030. racefor2030.com.au

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Summary

Research for Energy Masters has made substantial progress across all six research streams, laying strong foundations for meaningful insights into the opportunities presented by household demand flexibility and home energy management technologies. Since the last update in March 2025, data collection has expanded, early findings have evolved, and lessons have been drawn from technical, behavioural, and policy challenges.

The research component of the project remains on solid footing, with continued financial and in-kind commitment from all project partners. While delays to the HEMS installation schedule have impacted the research timeline, these are being actively managed in coordination with SA Power Networks, and mitigation strategies are in place to minimise further disruption.



1 Introduction

While updates have been provided in a prior progress report, this is the first Annual RACE Report for the Energy Masters project, which commenced on 29 July 2024. SA Power Networks, with support from the South Australian Department for Energy and Mining (DEM) and several industry partners, are embarking on a 3-year pilot project called Energy Masters. The project has also received funding from the Australian Renewable Energy Agency (ARENA) as part of ARENA's Advancing Renewables Program.

Energy Masters is equipping 500 South Australian households with Home Energy Management Systems (HEMS), smart appliances, and access to special retail electricity offers and tariff structures to encourage and facilitate demand flexibility. The HEMS will control appliances including solar PV, batteries, smart electric vehicle (EV) chargers, heat pump hot water systems, and split system air conditioning, subject to consent by the household. Households always have the ability to choose which items their HEMS is connected to and how automatically or manually it operates.

The project aims to make it easier for participating households to reduce their electricity costs through demand flexibility, and to research the benefits that flexible household energy use can have for the homeowner, for electricity distribution networks, and for the environment.

RACE for 2030 has been engaged as the research partner for the project. The questions to be answered include:

- What will be the impacts of demand flexibility and HEMS on the SA Power Networks distribution network? What network investment will be required? Will the deployment of HEMS to optimise demand on the network be cheaper and easier than increasing the capacity of the network?
- What are the financial costs and benefits to households of demand flexibility? Can demand flexibility be used to manage increasing household energy flexibility and avoid the need for connection upgrades? How much do the benefits depend on the level of optimisation? What factors influence the effectiveness of a HEMS? What are householder attitudes to demand flexibility and HEMS?
- What changes to policies, regulations and standards are required for demand flexibility and HEMS to be effective?
- How must industry prepare for wide-spread deployment of demand flexibility and HEMS?

In addition to answering these research questions, the RACE for 2030 research team will engage in extensive knowledge sharing with industry to support the widespread adoption of demand flexibility and HEMS, so that households are empowered to shift their energy use to times when energy is cheaper and cleaner, in ways that work for them and benefit many.

The research for the project is divided into 6 streams:

- Electrical data analysis
- Social research with households
- Impacts on grids and households
- Policy and standards
- Industry readiness
- Knowledge sharing.

Progress on each of these streams is described in the following sections.

2 Electrical data analysis

In addition to monitoring and advising on participant selection, we have collected 2 years of historical energy use data from 517 households who were offered a place in the project. Most of this data is available in 5-minute intervals, though some is recorded in 30-minute intervals. We will eventually collect historical energy use data from all households offered a place in the project, as well as from at least 275 non-participating households.

The data collected is from *before* any intervention has been undertaken at the household as a result of Energy Masters. That is, this data reviews the existing household energy usage behaviours prior to investing in new technology, joining new energy retail plans, or receiving information and education on changing or controlling their energy usage habits.

We have divided the participants into 6 groups:

- Simple (without solar, batteries or EVs)
- Simple+EV
- Solar
- Solar+EV
- Battery (and solar)
- Battery+EV

We have started investigating ways to visualise and analyse the data. For example, Figure 1 shows the daily demand of the Battery+EV households during the winter of 2024. Positive demand is power drawn from the grid; negative demand is power exported to the grid. Each dot represents the power use of a household at a given time of day. The black lines are the mean daily demand curves across all Battery+EV households.

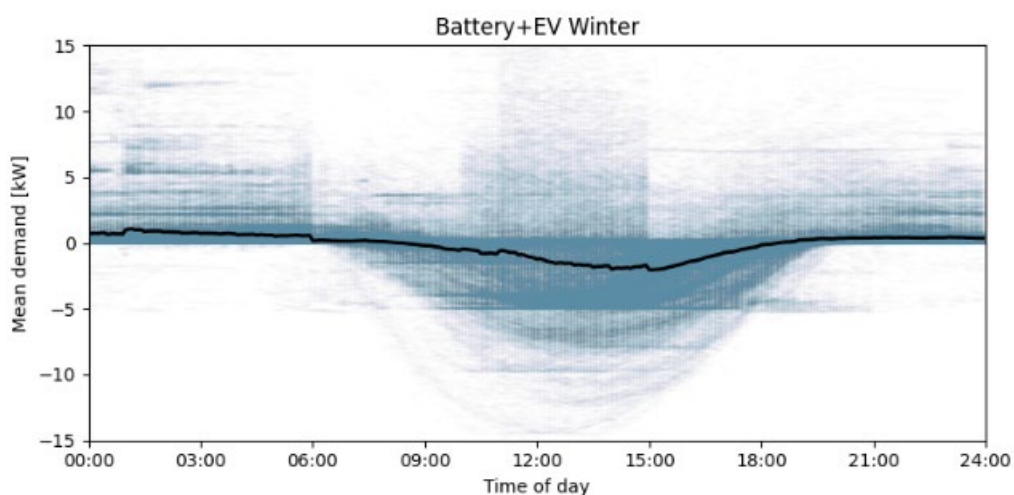


Figure 1: Historical daily demand (blue dots) and mean demand by time of day (black line) for participants with batteries and EVs

The interesting features include:

- the mean demand across all days and all households is small compared to the variation in demand
- there is a clear increase in demand during the solar sponge period (10:00–15:00) and during the overnight off-peak period (01:00–06:00)
- the distinct horizontal bands correspond to large loads such as EV charging or water heating
- the export limit of 5 kW for many households gives a distinct band, shown by the stratification of many data points during daytime hours at -5 kW; some older installations do not have a 5 kW export limit.

Figure 2 shows a different view of household demand, this time for Battery+EV households in December 2024. This view highlights the 30%, 60% and 90% quantiles of demand, as well as the mean and median demand.

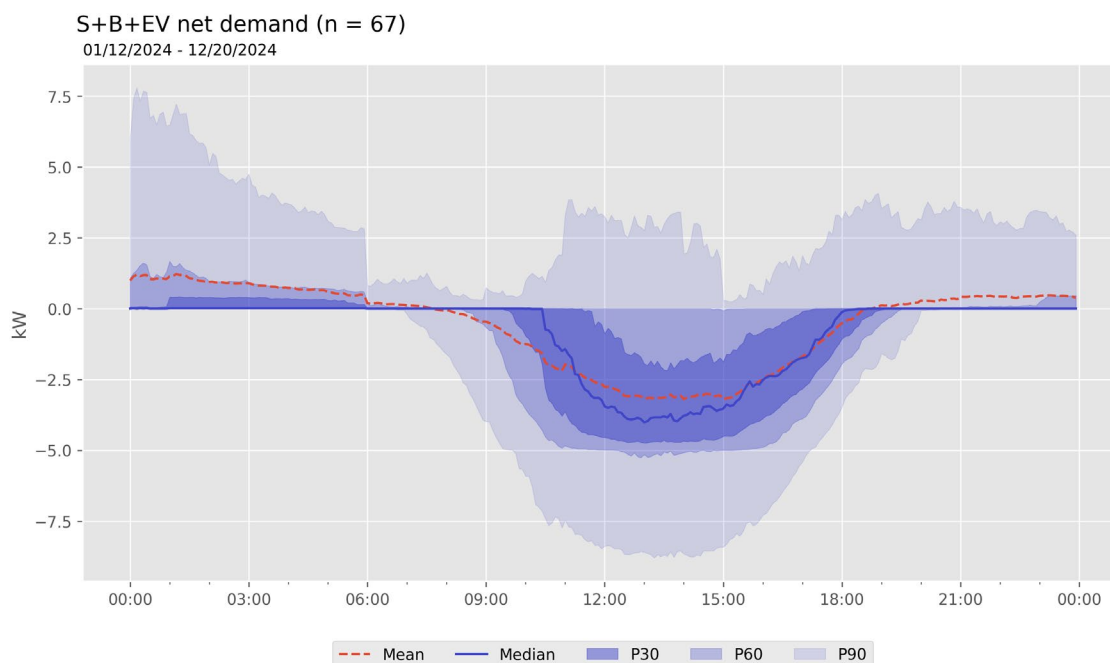


Figure 2: Quantiles of demand for Battery+EV households, December 2024

We have matched historical energy use data to data collected in the Expression of Interest process and in the first household survey (see Section 3.1). This gives us information about each household including:

- whether the household has solar or battery systems
- whether the household has electric vehicles
- the type of water heating
- the types of space heating and cooling
- electricity tariff type
- whether people are home during the day
- demographic information.

A common concern is that EV charging will cause a significant increase in evening demand, between 17:00 and 21:00. Preliminary results from the historical participant data (that is, behaviour measured before the effect of any intervention or new information to the household) show that this is not the case. Households with EVs have a slightly wider distribution of evening demand (see Figure 3), with a mean evening demand of 437 W compared to 428 W for households without EVs. Households with EVs have 2% greater evening demand than those without. Note that households that purchase EVs may have already had higher evening demand prior to purchase.

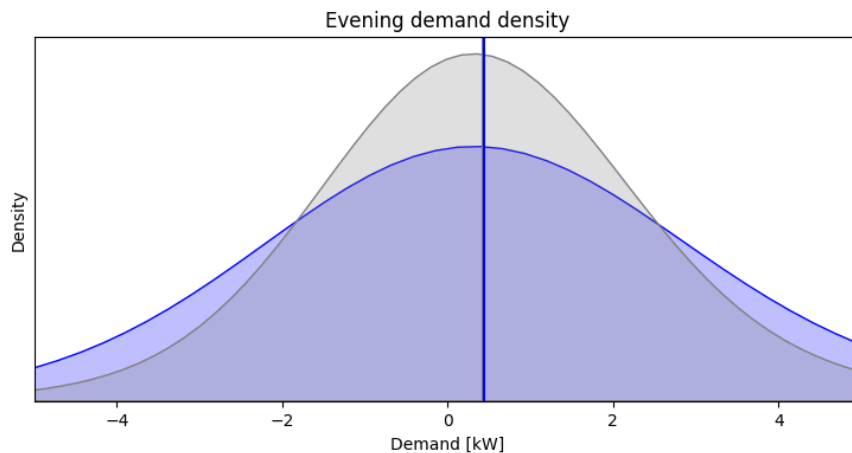


Figure 3: Distribution of evening demand for households without (grey) and with (blue) EVs

Over the remainder of 2025 we will collect data from additional participants, from the control group and from the general population. We will check the data for consistency and develop models that help us characterise the energy use of different types of household. As participating households start using their HEMS, we will collect more energy use data to compare to the baseline of historical energy usage.

3 Social research with households

The social research component is currently presented in 2 streams: qualitative and quantitative. Both are still in the early stages of analysis. These will be integrated in future reporting as the findings mature.

3.1 Quantitative research with households

We are conducting household surveys with three groups:

- participants in Energy Masters
- a control group matched to the participants, but who will not be receiving HEMS devices
- the general population.

The household survey findings offer compelling evidence that participants are significantly more engaged, equipped, and ready for the transition to flexible, low-carbon energy systems. Their higher income, education levels, technology adoption rates, and willingness

to engage with smart energy solutions differentiate them from the general population and even the control group. Further information regarding this is shown in Sections 3.1.4 to 3.1.9.

At the same time, the general population data highlights barriers to broader participation and underscores the importance of inclusive program design.

Together, these insights form a strong foundation for tailoring demand flexibility programs, policy interventions, and consumer engagement strategies that maximise both participation and impact across diverse household types.

It is important to note, however, that these findings are based on partial data and may be subject to change as additional responses are collected from both the pilot and control groups. Continued survey completion and monitoring will be essential to validate and refine these early insights.

3.1.1 Survey completion

As of early July 2025, the social research component of the Energy Masters project has made substantial progress in survey data collection across the key household groups. The pilot participant survey, targeting households enrolled in Energy Masters, has reached a sample size of 265 participants, representing just over 53% of the targeted 500 households.

Within the control group, 224 participants have completed the survey, combining 191 respondents from the structured sampling frame with an additional 33 verified EV owners from the open survey. This represents approximately 81.5% of the target sample of 275 for the control group.

In parallel, the general population survey has yielded 278 responses, exceeding the target of 275. The rate at which surveys are completed is constrained by recruitment and selection for the overall project. These combined efforts ensure a robust and diverse dataset to inform the evaluation of household energy behaviours, preferences, and readiness for HEMS deployment.

We are aiming to recruit the remaining 51 control group participants through continued collaboration with SA Power Networks and the South Australian Department for Energy and Mining, with a focus on reaching additional EV owners via the open survey.

Furthermore, we have a robust process and will actively encourage any new pilot participants to complete the initial household survey as they join the project to strengthen our data foundation moving forward.

Table 1: Survey completion summary (as of July 2025)

Participant group	Target sample size	Completed surveys	Completion rate (%)
Pilot participants	500	265	53%
Control group (total)	275	224	82%
Structured sample	—	191	—
EV owners (open survey)	—	33	—
General population	275	278	101%

3.1.2 Cohort design and rationale for sample structuring

To support a robust and policy-relevant analysis of household energy behaviours, the survey sample has been structured into three distinct cohorts: the control group, the general population, and the pilot group. This cohort structure enables both controlled comparisons and real-world insights, which are critical to informing the design, implementation, and future scaling of Energy Masters.

The control group has been designed to facilitate structured comparisons across six defined household energy profiles, derived from combinations of solar PV, battery storage, and electric vehicle (EV) ownership. Each subgroup is targeted to include approximately 46 participants, allowing for balanced sampling across configurations and enabling rigorous analysis of behavioural and attitudinal differences under varying technology ownership scenarios.

The general population sample, by contrast, reflects a naturalistic and unforced distribution of the same six energy profiles, as they occur naturally across the broader South Australian community. This cohort allows the research team to observe how these energy behaviours manifest in real-world conditions without imposed quotas, providing a valuable benchmark for assessing representativeness and extrapolating broader project implications.

The pilot group comprises individuals who are currently participating in, or were offered the opportunity to participate in, Energy Masters. While some participants will disengage from the project over time, their survey responses continue to offer critical insight into the motivations, expectations, and experiences of early adopters of home energy management technologies.

While data from these three cohorts can be aggregated into a simplified binary comparison of Energy Masters participants versus non-participants for reporting purposes, preserving the distinction between the control and general population cohorts adds important analytical depth. This layered structure allows the project team to differentiate between experimentally balanced samples and organically occurring consumer profiles, which is essential for evaluating both the targeted effectiveness of the project and its broader applicability to the general population.



3.1.3 Distribution of participants by quota group

The distinction between the control group and the general population is clearly reflected in the distribution of participants across the six household energy profiles.

In the pilot group, participation is fairly balanced, with the highest representation in Group 6 (households with none of the three technologies), followed by Groups 1 (solar only) and 4 (solar + battery + EV).

The control group aligns with its intended design, showing relatively even representation across Groups 1 through 4, as well as Group 6, each nearing the 46-participant target, with fewer respondents in Group 5.

In contrast, the general population group demonstrates natural variability, with notable concentrations in Group 1 (solar only, n=133) and Group 6 (none of the three technologies, n=111), and sparse representation in technology-intensive groups. This distribution confirms the value of maintaining separate cohort structures: the control group supports controlled comparison, while the general population illustrates broader behavioural trends in a real-world context.

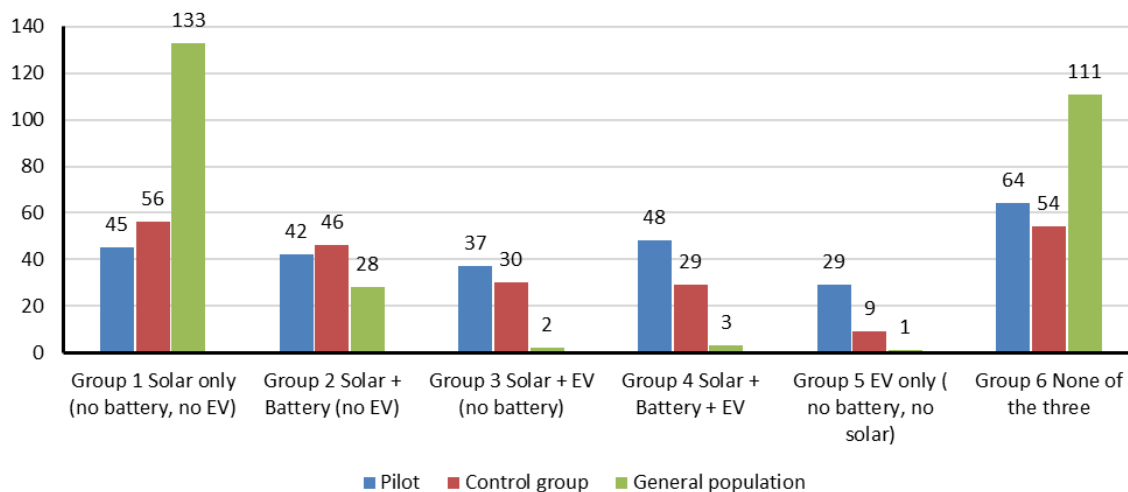


Figure 4: Distribution of participants by quota group

3.1.4 Demographic profile comparison across cohorts

A comparative analysis of key demographic characteristics reveals meaningful differences between the pilot group, control group, and general population samples. This comparison is intended to detect self-selection effects and assess representativeness of the pilot cohort. Identifying systematic skews upfront helps interpret behavioural differences, apply appropriate weighting/controls, and plan subgroup analyses, so results can be generalised beyond the trial.

3.1.4.1 Age, gender, and household structure

The average age of participants is relatively consistent across cohorts, ranging from 49.7 years in the control group to 53.2 years in the general population. The pilot group includes a notably higher proportion of male respondents (66.8%) compared to the control group (45%) and general population (46%). Household sizes are similar across the board, with an average of 2.9 occupants per household in the pilot and control groups, and 2.7 occupants per household in the general population.

These variables matter because they predict systematic differences in both demand and uptake: older households are, on average, less comfortable with new digital controls and

place a higher premium on thermal comfort; women in mixed-gender households often report lower visibility into tariffs/bill management; and larger households create more diversified, shiftable loads (e.g., laundry, EV charging). Flagging these skews helps separate composition effects from project effects and informs targeting (e.g., simpler HEMS user experience for older users, shared bill-transparency tools).

3.1.4.2 Education and employment status

Education and employment status are key predictors of both the resources and skills available to adopt and manage new technologies. Higher educational attainment is often associated with greater awareness of energy issues and comfort navigating complex systems, while full-time employment can affect daily occupancy patterns and the ability to shift loads, as well as the upfront capital available for energy upgrades.

Pilot participants are significantly more likely to hold tertiary or postgraduate qualifications compared to the other groups, reflecting a higher degree of formal education.

The control group also demonstrates relatively high educational attainment, while the general population shows more diversity in education levels.

Full-time employment is more prevalent in the pilot group, with the general population showing higher levels of part-time work, unemployment, and retirement.

3.1.4.3 Household income

The pilot group has the highest average household income at \$122,130, followed by \$95,940 in the control group, and \$91,520 in the general population. These income differences likely contribute to varying levels of technology adoption and readiness for home energy upgrades.

Table 2: Key demographics

Group	Average age (years)	Gender		Average household size	Average household income	Average number of cars
		Male	Female			
Pilot group	51.0	67%	33%	2.9	\$122,130	1.88
Control group	49.7	45%	55%	2.9	\$95,940	1.71
General population	53.2	46%	54%	2.7	\$91,520	1.58

These demographic differences suggest that the pilot group is better positioned—both financially and structurally—to adopt and benefit from emerging home energy technologies. It also reinforces the need for targeted strategies when designing interventions that seek to reach lower-income, renting, or apartment-dwelling households, who may face greater barriers to the adoption of HEMS and controllable appliances. The project will include at least 10% priority group members, including low income households.

3.1.4.4 Appliance ownership and electrification

Pilot participants in Energy Masters exhibit a markedly higher degree of energy “savviness” and readiness to transition away from gas, compared to both the control group and the general population. Survey data across various behavioural and technological indicators, from appliance choices to attitudes, consistently show the pilot group to be more engaged and prepared for an all-electric future.

Pilot participants were far more likely to own advanced clean-energy appliances (such as solar panels, home batteries, and electric vehicles) and had fewer dependencies on gas appliances than the other groups.

The control group tends to fall in between, often more engaged than the general public but generally slightly behind the pilot cohort.

The pilot group's uptake of home batteries is also higher (roughly one-third have battery storage, versus only ~11% of general population homes), and 40% of pilot participants own an electric vehicle, a stark contrast to just ~2% EV ownership in the broader population. This points to significantly greater electrification of transport among pilot families.

The control group also has higher-than-average EV uptake (~20% owning an EV), though still below the pilot rate.

In terms of household appliances, pilot families are further along in replacing gas with electric alternatives. Many have upgraded from gas water heaters to efficient electric heat pump systems or from gas stoves to induction cooktops. A higher share of pilot households are fully electric (no gas connection at all) compared to the general population. These patterns show that pilot participants not only already own more clean-energy technologies, but they are actively phasing out gas usage – clear evidence of readiness to transition away from gas.

The control group, while broadly similar to the pilot in solar uptake, has been somewhat less ambitious on vehicle electrification and may still rely on gas in more cases than pilot households, but nonetheless outpaces the general population on most electrification measures.

3.1.5 Energy pricing plan knowledge and control

Pilot households demonstrate greater knowledge of energy pricing plans and a stronger sense of control over their energy use. According to survey results, a large majority of pilot participants could identify or describe their electricity tariff structure and had actively sought the best pricing options (many pilot homes are on time-of-use or wholesale pricing plans).

In fact, through the Energy Masters initiative, pilot families expressed a willingness to trial innovative retail tariffs and network services. Some are already enrolled with Amber, who offer real-time pricing and appliance control. This indicates a higher engagement with complex energy pricing, whereas a much smaller fraction of ordinary households engage with such plans.

Many general population consumers remain on single-rate tariffs and are not aware of or comfortable with alternative plans. The control group falls in between: some have shopped around or know their plan details, but overall, they report lower tariff awareness than the pilot group.

Correspondingly, pilot participants feel more in control of their energy consumption. The survey found significantly more pilot households agreeing that they have high control over their energy use and bills, likely thanks to better understanding of their plans and usage patterns. By contrast, the general population often feels limited in controlling energy costs.

In summary, the pilot group's greater tariff-savviness and use of smart pricing mechanisms gives them a sense of empowerment in managing energy, which the control and general groups do not yet fully share.

3.1.6 Familiarity with and openness to HEMS

Survey responses show pilot members are very open to using HEMS and similar smart home energy tools to monitor and optimise their usage. In contrast, only a small minority of the general population even know what a HEMS is or does.

Outside the pilot, HEMS adoption is nascent—typical households lack such devices and may only be vaguely aware of them as a concept. Even in the control group, familiarity with

HEMS is low; some control households knew of the technology or had considered it, but nothing like the universal experience in the pilot group.

This demonstrates how the Energy Masters pilot has created a cohort of tech-engaged, energy-savvy users: participants quickly embraced the HEMS technology provided, whereas the average consumer has yet to encounter it. The pilot group's openness to new energy tech is clearly higher, reflecting a readiness to adopt innovative solutions that manage energy use at home.

3.1.7 Interest in reducing energy bills and emissions

All groups express strong interest in reducing their energy bills, but the intensity of that interest (and the coupling of cost-savings with emissions reduction) is highest in the pilot group. Being part of the project, pilot participants tend to be highly motivated to cut both costs and carbon footprint. Nearly all pilot households indicated saving on energy bills is a key priority, and many explicitly tied this to lowering their household emissions.

The general population is also very concerned about bills and the basic desire to reduce bills is widespread. However, pilot families have taken concrete steps beyond concern: they have invested in solar, batteries, efficient appliances, etc., to actively drive bills down. They are also keenly aware of the environmental benefits: pilot survey results show a higher proportion actively trying to reduce their greenhouse gas emissions at home, compared to the general public. That tangible opportunity for savings and sustainability resonates strongly with the pilot group.

The control group likewise shows considerable interest in bill reduction and some interest in emissions reduction, but generally with less commitment or know-how than the pilot participants. They mirror the public in being motivated by cost savings first and foremost, with environmental benefits as an added bonus.

Overall, the pilot cohort displays the greatest proactive intent to slash energy bills and contribute to emissions reductions, aligning with their role as early adopters of energy-smart home upgrades.

3.1.8 Willingness to accept smart controls

Energy Masters requires participants to allow a degree of smart control over household appliances, and indeed pilot members exhibit a far higher willingness to accept such controls (with appropriate safeguards) than others.

Most pilot households were comfortable with automated control signals from the network or retailer to optimize their energy use, so long as they retained the ability to manually override if needed. The survey results confirm that a majority of pilot members view this arrangement positively, seeing it as a fair trade-off to reduce peak demand and earn rewards.

By contrast, general population sentiment is far more cautious. Only a small segment of typical households say they would trust an external party to control their appliances, even with override options. Many people outside the pilot express discomfort at the idea of relinquishing direct control, reflecting low familiarity and trust in such projects. Even with incentives, uptake of direct load control in the general population has historically been limited.

The control group's attitudes fall in the middle: being somewhat more open to the concept than average citizens (since they were interested in Energy Masters), but still less ready than the pilot group to hand over control.

In short, pilot participants' willingness to accept smart, automated control of home energy devices—an essential aspect of modern flexible demand management—is significantly higher, demonstrating a greater readiness to cooperate with new grid-responsive schemes.

This openness is a key behavioural indicator of readiness for transition to a smarter, low-carbon grid.

3.1.9 Sentiment toward electrification and energy responsibility

The pilot cohort shows a stronger pro-electrification mindset and sense of responsibility for energy outcomes. They are, by and large, enthusiastic about shifting off gas and believe in households doing their part to support the clean energy transition.

In surveys, pilot participants overwhelmingly agreed that electrifying home energy (e.g. switching from gas to electric appliances and EVs) is important for the future, and many feel a personal responsibility to manage their energy wisely for the greater good. This is evidenced by their actions: a large portion of pilot households plan to fully disconnect from gas in the foreseeable future.

In contrast, while public opinion is gradually moving toward electrification, it is less aggressive. The pilot group far exceeds these figures in intent—a clear sign of greater readiness to transition away from gas. The control group is supportive of cleaner energy in principle, but their sentiment is closer to the general population's: many acknowledge the need to decarbonise eventually, yet fewer have firm plans or the same sense of urgency as the pilot participants.

Moreover, pilot households tend to feel more *empowered* in this transition, given the tools and knowledge they've gained (they feel that “energy is everyone's responsibility” and are confident in taking action), whereas the average household often expects government or industry to lead.

The pilot participants stand out in their positive attitude toward electrification and their willingness to take responsibility for managing energy use and emissions, underscoring that this group is psychologically and practically prepared to move beyond gas reliance.

3.1.10 Environmental framing drives stronger consumer engagement

Across all three cohorts, survey findings reveal that energy bill savings are by far the strongest motivator when it comes to household energy decision-making, followed by environmental motivations. Grid-related considerations are the weakest.

Respondents across the pilot group, control group, and general population placed greater importance on reducing carbon emissions than on reducing demand on the electricity grid. This suggests that while grid resilience and peak demand management are critical system-level outcomes, these messages may be less compelling to households than those that emphasise climate action and sustainability.

Therefore, framing Home Energy Management Systems (HEMS) and demand response initiatives in terms of their environmental and emissions-reduction benefits is likely to resonate more strongly with consumers than focusing solely on grid efficiency or reliability. This insight should inform project design and communication strategies, particularly when aiming to increase engagement and long-term behavioural change.

Table 3 summarises key metrics of energy savviness and electrification readiness across the three groups (pilot participants, control group, and general population) based on the survey data and research findings. It progressively builds a strong evidence base to demonstrate that pilot participants are:

- more technologically equipped
- more informed and confident in managing energy pricing
- more familiar with emerging technologies like HEMS

- more motivated by cost and emissions savings
- more accepting of external control over household appliances
- more aligned with electrification goals
- more responsive to environmentally framed project messaging.

Table 3: Key metrics of energy savviness and electrification readiness across the three groups

Metric	Pilot group	Control group	General population
Solar PV ownership (%)	61%	70%	60%
Home battery ownership (%)	27%	31%	11%
Electric vehicle ownership (%)	40%	18%	2%
No mains gas connection (fully electric home)	40%	38%	36%
On a time-of-use or flexible pricing plan (%)	62%	38%	28%
Preference for greater control over electricity usage (%)	91%	56%	57%
Familiar with HEMS technology (%)	46%	18%	7%

3.2 Qualitative research with households

3.2.1 Pre-installation interviews

The project plan includes longitudinal qualitative research with participants from the pilot cohort to explore in depth their experiences of the pilot and track how this affects their attitudes towards and understanding of electrification and allowing control of their appliances.

The core method of data collection is through a series of semi-structured interviews, carried out online. Researchers work with an interview guide that includes suggested questions, potential prompts and broader topics for discussion, but allow the conversation to be steered by participants to enable richer insights into aspects beyond those anticipated.

The first round of interviews was carried out with participants prior to installation of HEMS and other pilot appliances. These interviews focused on establishing a rapport with the participants and a broad understanding of their existing energy use and behaviours, their motivations for participation and expectations for the pilot.

The pre-installation interviews will contribute to addressing research questions H3, H5, H6, H7 and H8 (see 4 below), but answering these questions requires data collection throughout the pilot.

Table 4 : Research questions explored through pre-installation interviews

Household decisions and behaviour	
Identify and understand the factors that influence household decisions to adopt flexible demand technologies and their energy behaviours and interactions with these technologies.	
H3	How do social, cultural, economic, environmental, health, resilience and other considerations drive or deter household decisions to electrify, adopt flexible demand technologies, and purchase different appliances and related energy service offerings?
	How are these decisions affected by different financing models, subsidies, incentives and other interventions, and by the timing of the interventions?
	Are the potential financial benefits sufficient to provide a driver for customers to adopt flexible demand technologies and services?
H5	How do households' self-reported energy practices with flexible demand technologies vary over time and compare with their practices without these technologies?
	How do behaviours vary between households with basic, sophisticated, orchestrated and hybrid energy management?
	To what extent does the use of flexible demand technologies align with expected or desirable use?
Household understanding, sentiments and broader representativeness	
Understand household sentiments towards, and understandings of, flexible demand technologies and their impacts, across different cohorts within and without the Pilot.	
H6	How can the experiences of households in their customer journey through the Pilot inform the design of products and approaches to sales, installation and after-sales services for flexible demand technologies and energy service offerings?
	How does the form and content of communications about features, costs and benefits of technologies, and service offerings, used by different stakeholder groups across the customer journey impact customer understanding and sentiment?
H7	What are the levels of satisfaction and comfort with flexible demand technologies?
	To what extent do households feel that flexible demand technologies complement or conflict with lifestyle, comfort and convenience?
	How do households' experiences of flexible demand technologies compare to their expectations?
	What are households' experiences of the interoperability of

H8

flexible demand technologies?

How do households understand the impacts of electrification and flexible demand technologies on energy use, bills, the network, and decarbonisation?

How does this understanding develop over the course of the Pilot?

Where and how do households obtain information about electrification, DER, HEMS and flexibility and who do they trust to provide this information?

3.2.2 Interview cohort & recruitment

Pilot participants who have completed the application process and agreed to proceed with the pilot were emailed with an invitation to participate in an interview. Unlike the quantitative research, participation in the qualitative research is optional, and incentivised with a \$50 digital gift voucher for each interview.

The aim of participant selection is not to achieve a sample representative of the pilot cohort, or of the general population, but to achieve diversity across some key characteristics, including energy technology ownership as well as broader demographics including gender, household type, employment, urban/regional, etc. The size of the interview cohort is not prescriptive but aims to achieve this diversity and to achieve ‘saturation’ in the data — i.e., to reach a point where successive interviews do not reveal new insights. To this end, invitations were sent to a pre-selected list of participants, with further rounds of invitations aimed at filling ‘gaps’ in the demographic mix.

As described above, the pilot participant cohort is skewed towards higher income and tertiary educated men with higher ownership of energy technologies (including solar, batteries, EVs, etc.) and higher engagement with the energy transition than the general population. This over-representation of ‘resource men’ (common to many energy pilots and well established in the energy literature¹) was exacerbated by uneven response to interview invitations, with women, single-parent households and non-solar households particularly underrepresented in the early rounds. However, additional targeted recruitment, as well as an increase in sample size from 30 to 40, resulted in a more diverse cohort.

40 pre-installation interviews were completed by the end of June 2025.

¹ Strengers, Y. (2014), Smart Energy in Everyday Life Are You Designing for Resource Man?

Energy Masters - Pre-installation Interview Participants

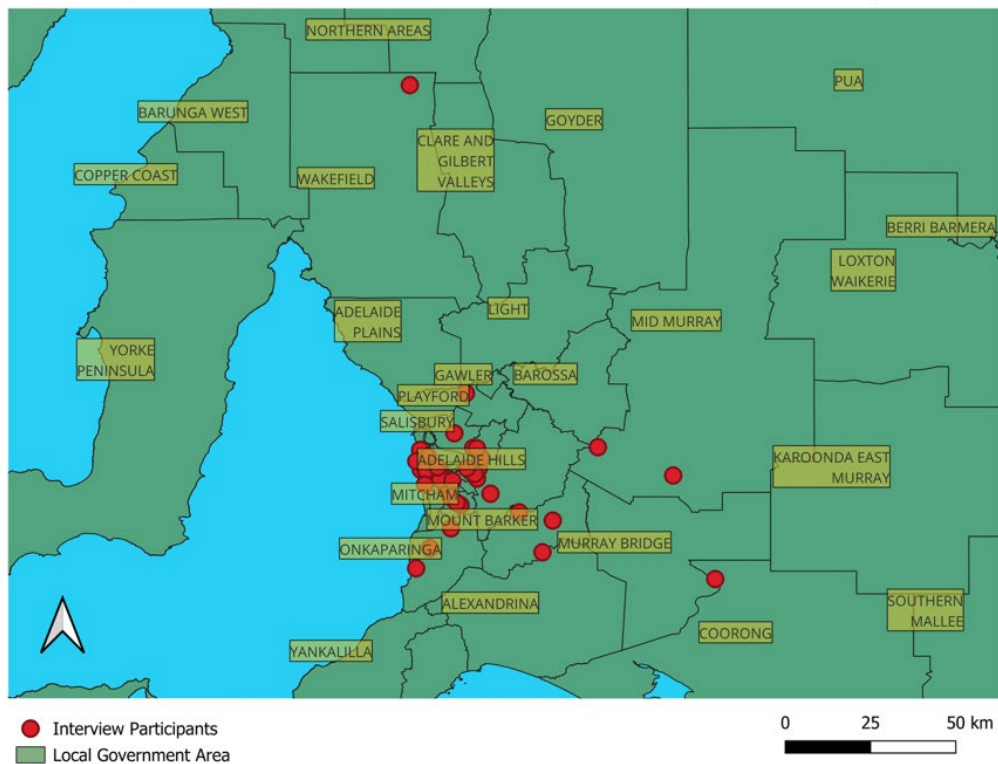
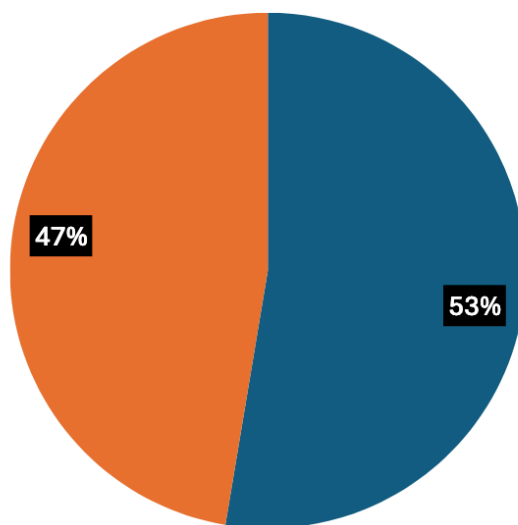


Figure 5: Geographic distribution of pre-install interviewees

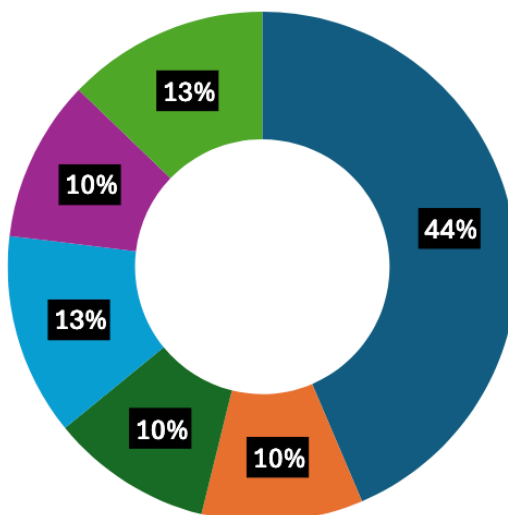
GENDER OF PARTICIPANTS

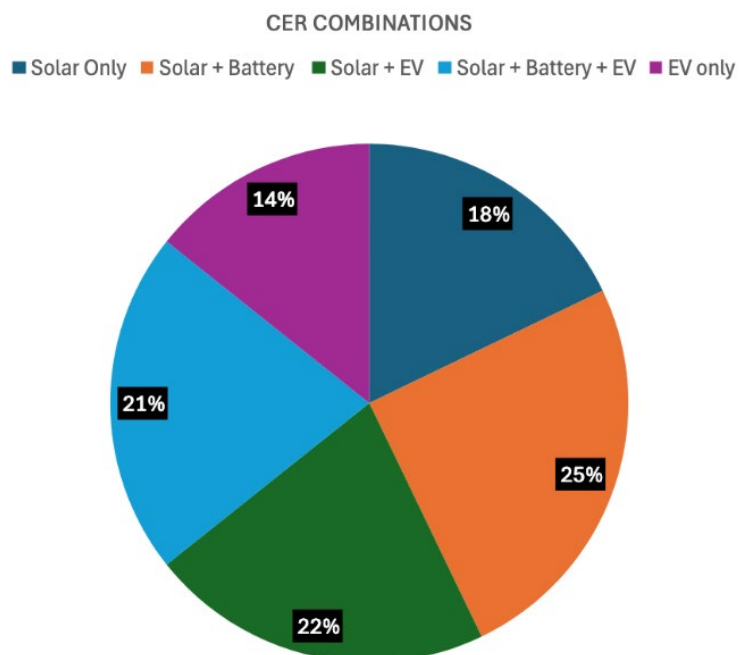
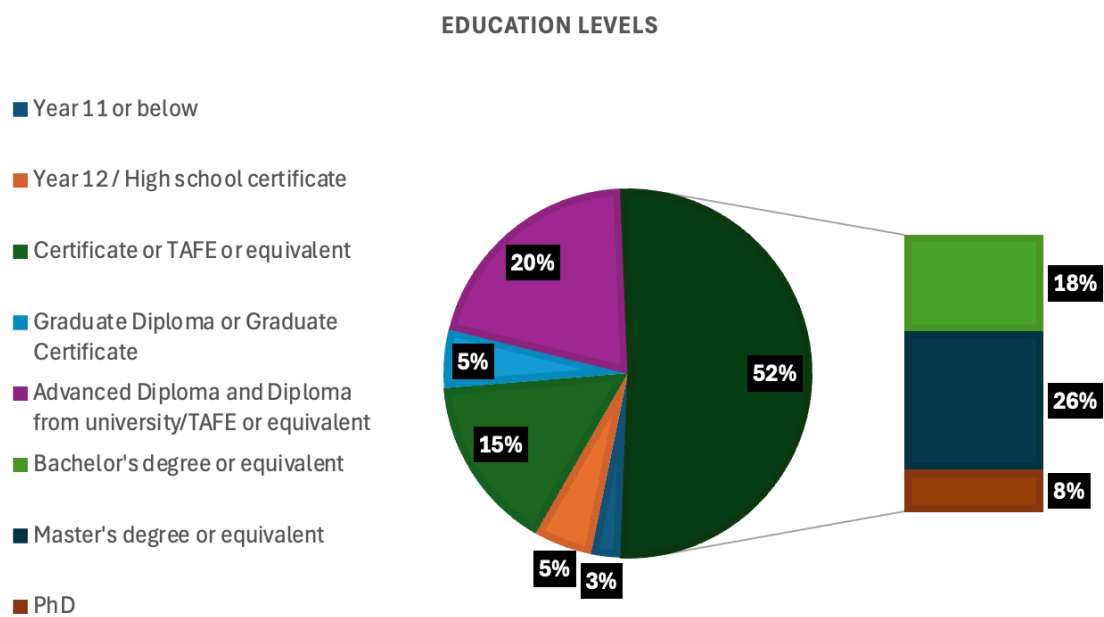
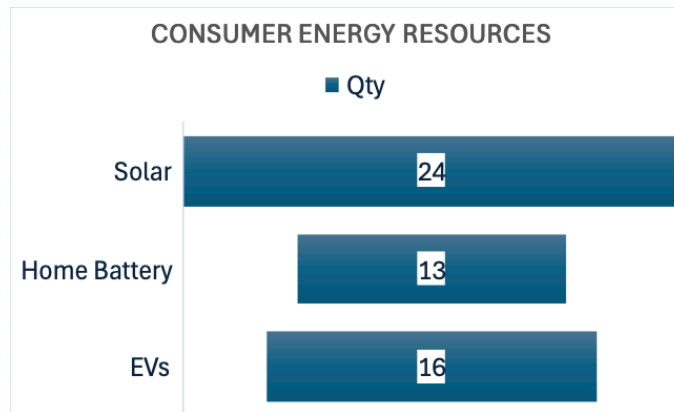
■ Male ■ Female



HOUSEHOLD STRUCTURE

■ Couple with children ■ Couple with no children
■ Single person household ■ Multi-generational household
■ Group/Shared household ■ Single parent family





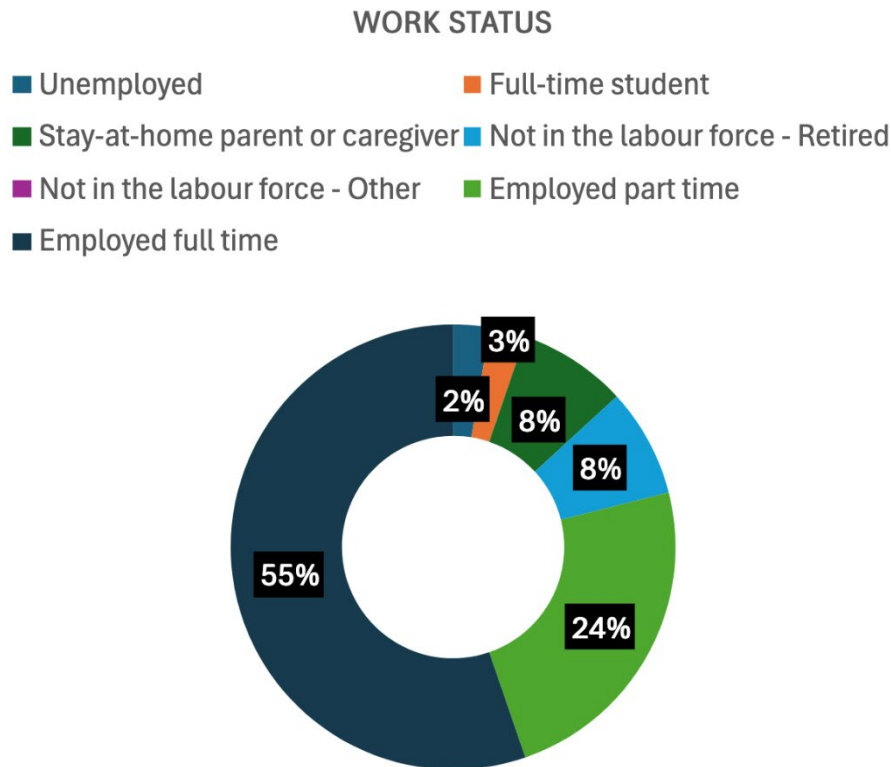


Figure 6: Various demographic profiles of pre-installation interview participants

3.2.3 Preliminary findings

Analysis of the data collected through the pre-installation interviews is ongoing. The initial insights below are, therefore, neither definitive nor comprehensive; detailed analysis and integration of more data is expected to reveal more nuanced insights. Quotes have been included to illustrate these preliminary insights.

3.2.3.1 Awareness & understanding

Interviewees generally demonstrated good awareness of Energy Masters as a project, including recognising the partners and the broad aims of the project.

"I did [trust the project], it's just that some of the things, the lingo, I didn't really understand."

However, they showed lower certainty relating to understanding of the technologies (e.g. actual functioning of HEMS, trial technologies) and key project concepts (automation / third party control of appliances) in relation to real life.

"If my reading is correct, no, but my reading of all the information might be not correct. So, the only – not concern, the only thing that we didn't particularly want is to have, and forgive me because I can't remember the right terminology, was for the government, or not necessarily government, but the SA Power Networks to have the ability to switch off, like the larger energy consuming items at times of need, which it won't, as far as I'm aware."

High-level understanding of the *potential* of the HEMS device was generally good. However, for many interviewees, this understanding was based on the options described in the Discrete Choice Experiments found in the quantitative household survey, and so was not necessarily aligned with the actual pilot. More generally, interviewees were less clear about

how the HEMS will work in the context of their own homes and daily lives, and some expressed concerns about perceived lack of control.

"All I know is, like, in one of the surveys that we did, we had to rate all these different options and how likely we were to get them. And it was like certain restrictions that might have been like a certain time of day or a certain duration that they could restrict your energy usage and how much you'd be willing to pay for that and what potential benefits there were. So, I'm guessing it's to do with restricting power at certain times and for a certain amount of time without necessarily having your say in it... The only thing that came up was, I was like, what if it was really hot and like you just got home, and the house is hot and you want to put the aircon on? And then they're like, no, you're going to, we're going to restrict it now. I guess it's just that practicality that life can be unpredictable sometimes and wouldn't interfere in some way or make it inconvenient in some way. And I'm not sure if it would, but it was just that idea, like, could it do that?"

"My husband thought the HEMS sounded terrible. He's like, I don't want anyone taking control of my power usage or my appliances power usages... You know, so it's that sort of loss of control, I think, was what he was worried about."

3.2.3.2 Motivation & trust

Interviewees showed a high willingness to accept trial processes. For some, 'being on the project' and the involvement of government and research partners creates trust which may not exist outside a government trial.

"Well, I just didn't really have any expectations. So, I mean, it's a government thing, so I just thought oh, well, it'll happen when it happens."

Bill savings and subsidised appliances are a much stronger motivation for project participation than grid stability, environmental concerns, or desire for greater convenience by automating household appliances.

"Well, I guess, yeah, knowing that they would be subsidised is a real like selling point with the whole program, like that's really good. But just the whole concept, because I think that all of the electric homes are the way of the future and kind of being part of that and being able to be part of that program and share my experiences and perhaps that help get to go further and like encourage more people. So, yes, the getting things installed is great, but also a bigger picture of knowing it's part of something that's going to be really positive for our future."

Strong motivations for project participation include:

- subsidised appliances
- opportunities to continue home electrification and improvement
- vetted installers and products offered by trial
- potential for home energy monitoring and appliance control
- chance to participate in research (doing good for others).

"I guess, probably my motivation was the subsidised hot water service. That was the main [motivation for participating], so that's a good chance to get a heat pump solar system... Everything else is going up, and if I can keep the energy costs around the home, you know, in check, that means we can survive all the other stuff...the side benefit is the environment, but it was always, let's try and get our bill back to zero."

3.2.3.3 Communications

Interviewees described communications about the project as largely being clear and helpful, but they found some confusion about details of appliance control, etc.

"No, I think [communication has] been clear. I think it's been probably by design, fairly simple. I don't know if that's the right word, but obviously in your attempt to be clear and to be accessible by everybody, you have to keep it very to the point and simple... So I've been just going along with the flow, I guess. But, yeah, before I would like deeper detail about what actual automation would look like before I sign on to that bit."

"So, communication is great. I ring up and I talk to people, and they look up my record. They got an idea of what's going on. The only delay now is trying to – for them to try and integrate this battery thing into the package."

Frustrations and uncertainty are emerging around the communications relating to installation timeframes for individual households, particularly where there are protracted delays between communications. There is also some confusion caused through the involvement of a range of different people in participant-facing communications.

"...getting to the right people to find out [has been a problem] because you don't know where everybody merges. And it's like a gentleman who came out to do the site program, he told me, 'I'm here to do the site,' and he explained to me, he's just doing the site. That's what he's doing. He's an electrician. So, I couldn't ask any questions about, 'Oh, can I do the battery instead of the water pump?' 'Oh, you have to speak to the salesman, and he should get hold of you the next couple of days...' So, it's not like you're dealing with one person or one – that's probably the hardest thing about the communication."

3.2.3.4 Energy engagement

A high proportion of participants are males showing an interest in economically efficient management of the household's energy and finances, particularly through smart energy technologies, the archetypal 'resource man'. Some interviewees showed awareness that their attitudes to technology are not typical of the broader population.

"I'm a bit of a techno curious, so, you know, we're going back years, we've got WiFi-enabled plugs to switch things on and off. We've got Philips Hue lights to switch. So, all the air con or the washing machine's all Wi-Fi enabled. So, if we want, we can just remotely switch them all on. So, we've set the house up like that."

"I think I'm confident to manage [potential challenges in the trial technologies]. I am a technology man, so I'm very confident to use it, no problem."

"I think there will be some people out there who will probably absolutely grimace at the idea of having someone have the air conditioner... but I think it's being handled about as well as it can be. And anyone who's signing up for this is obviously sort of self-selecting."

Many participants with solar, batteries and EVs are already shifting energy consumption to periods of high solar production or off-peak evenings, showing in some households there is a good knowledge of, and some capacity to, shift the timing of specific practices (EV charging, dishwashing, clothes washing and drying, pool pumps).

"For example, our washing machine or dishwasher, they have timer... Yeah, almost the high function, consuming appliance work at noontime."

From these initial interviews, it is less clear how households that are lower-income, already low-energy consumers, or those with young children, will financially benefit from the project

as new technologies may increase consumption and/or cause unavoidable consumption in periods with higher time-of-use tariffs.

3.2.4 Next steps

3.2.4.1 Data analysis

Transcripts from the interviews have been imported into qualitative data analysis software for analysis. A high-level coding framework, based on the household research questions, has been drafted; this will be extended and refined as the analysis progresses.

3.2.4.2 Early exit interviews

Recruitment has commenced for interviews with households who completed the EOI but did not progress to participation in the pilot. These semi-structured interviews will be shorter in duration (around 30 mins) and aim to explore the reasons for non-participation in more depth than given in their initial response to the Energy Masters offer.

We anticipate recruitment may be challenging as these households are no longer engaged with the pilot.

3.2.4.3 Post-installation and future interviews

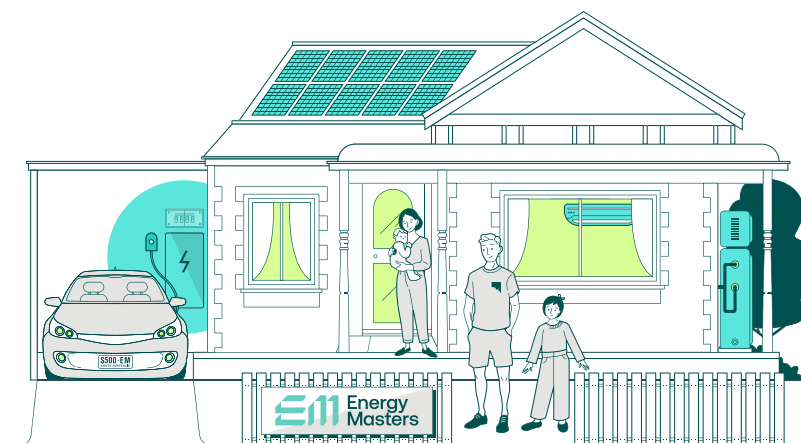
A second round of interviews will be carried out with households after installation has been completed. These will explore participants' experiences of the installation process and developing understanding of and sentiment towards the control technologies.

Recruitment will include a subset of the pre-install interviewees, once again aiming for diversity across demographics and technologies; if this is precluded by early exits, some new participants may be included to the cohort.

Future rounds of interviews will include visualizations of participants' energy use as prompts for discussion, and opportunities for participants to give virtual tours of their energy resources.

3.2.4.4 Communications analysis

A register of participant communications has been established to facilitate collation and analysis of communications across the pilot. This will be augmented with targeted participant interviews exploring attitudes and responses to different comms materials and media.



4 Impacts on networks and households

The Impacts stream will combine results from electrical data analysis and social research with households analysis to answer many of the key research questions. Research in this stream has not yet commenced.

5 Policy & standards

To understand what changes are required in the technical standards landscape to accelerate inter-operability in the HEMS ecosystem, it is important to first understand the standards and other technical mechanisms that currently exist.

To achieve this aim, a detailed review of existing standards and mechanisms was undertaken. This collected detailed information on 49 different standards that are applicable within the Australian context to the HEMS ecosystem.

These standards have been mapped against the four layers of inter-operability being used by SA Power Networks: DSO–TSO, organisation-to-organisation, organisation-to-site, and behind-the-meter.

The following diagram summarises the various pathways that could be used to establish standards.

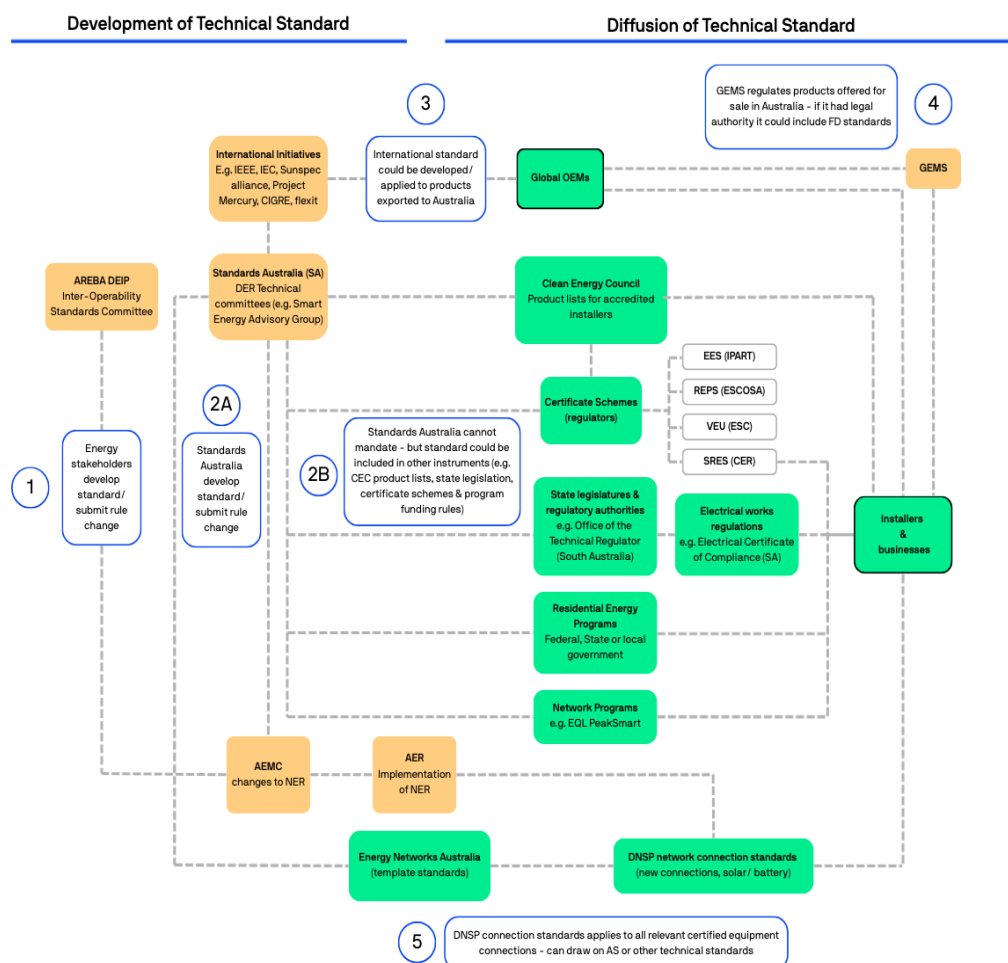


Figure 8: Draft potential standards pathways

The stakeholders, instruments and pathways for developing and implementing an inter-operability standard have also been mapped in a draft Energy Masters discussion paper, “Interoperability Standards: Mapping the Standards and Regulatory Ecosystem”. Six different pathways have been identified through which an inter-operability standard could be implemented, each of which have strengths and weaknesses and none of which appear on their own adequate for implementing an inter-operability standard that will have broad market coverage.

After the discussion paper has been reviewed by relevant project partners there will be stakeholder engagement to test the analysis and findings of the paper with energy market bodies, standards bodies and other energy industry stakeholders.

6 Industry readiness

Key activities within the industry readiness stream have focused on development of an installer survey, ongoing supply chain mapping, and monitoring of installation challenges and progress.

All activities have been impacted by project delays to, with timing of the survey pushed back to support installation delivery. Interactions with project partners such as MAC Trade Services regarding supply chain investigations have been temporarily minimised to allow focused delivery. Updates and emerging findings are described below.

6.1 Installer/contractor survey

An installer/contractor survey has been developed and received ethics approval for distribution. It has been reviewed by MAC Trade Services for accessibility and comprehensibility by participant contractors and approved via the wider project governance structure.

The purpose of this survey is to learn from contractor experience installing the various appliances and HEMS devices as part of Energy Masters. The survey covers topics including:

- installations and upgrades frequency, duration and challenges
- participant engagement
- indirect employees
- skills, knowledge and training required

The survey will be delivered once ~70% of installations have been completed. Piloting of the survey will be undertaken in August 2025 once the installation teams have appropriate capacity.

6.2 HEMS supply chain mapping

The HEMS supply chain for Energy Masters is more complex than ‘traditional’ supply chain structure maps, which run from device design to installation, as it needs to include the ‘value creation’ end of the chain.

That is, to be useful HEMS needs to include the device integrations and intermediary agents that unlock components of the value stack.

The supply chain mapping work aims to characterise the nature and scale of the interactions between the different parties (wholesale and retail suppliers, installers and service providers) from end to end across the supply chain. To date, the research team has developed a working HEMS supply chain map, highlighting the distribution pathways being used in Energy Masters, and identifying areas of uncertainty, or potential challenges for scaling up of HEMS installation.

Figure 7 shows a working version of the supply chain map that has been shared with relevant project partners. A feedback workshop was held to gather further insights into the current functioning of the supply chain, and emerging pain points. This has been supplemented with emerging findings from Lessons Learnt workshops.

The next steps will involve deeper exploration of the emerging challenges through interviews with the project partners, and wider industry.

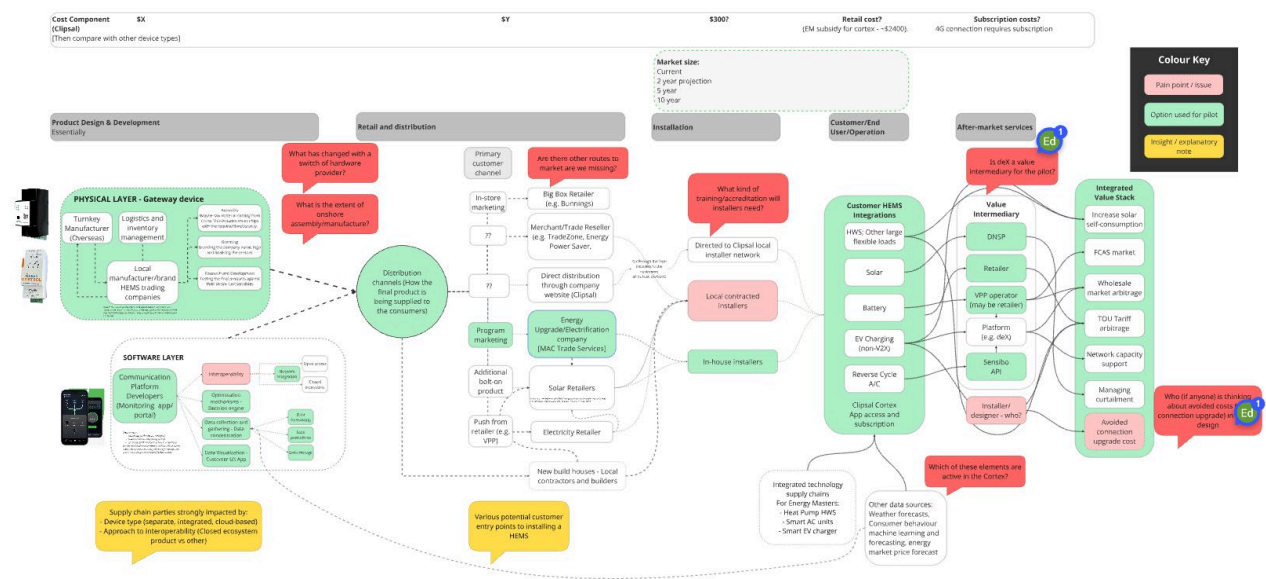


Figure 7: Draft supply chain map

7 Next steps

Installation of HEMS devices and new appliances in participant houses has been slower than anticipated. The reasons for delays include:

- rework required on older distribution boards
- long commissioning times when interfacing to various makes and models of solar and battery inverters, due to a lack of effective interoperability standards.

These issues are being documented and will be described in future “lessons learned” reports.

Delays to the project are being actively monitored and managed by SA Power Networks and the broader project teams. Research is progressing as planned, though we will need to adjust the research schedule to align with the delayed end of the 12-month data collection period when this is known.

During the next year the research team will:

- continue collecting and analysing participant survey data, pre-installation of HEMS
- continue collecting and analysing historical energy use data
- continue developing methods for evaluating the impacts of demand flexibility on networks and households
- conduct mid-way surveys of Energy Masters participants to understand their early experiences with HEMS and energy offers
- engage with industry stakeholders to discuss interoperability standards, regulations, barriers and opportunities
- continue to engage with HEMS manufacturers and installers.

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