Uptake of residential solar panels and battery storage systems

A mixed-method analysis of key drivers and barriers

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Section 1:
Introduction

Research overview

Key research questions

- What are the main drivers and barriers to the uptake of solar photovoltaic (PV) panels among Australian households?
- What are the main drivers for the uptake of home energy battery storage systems among Australian households?

Method

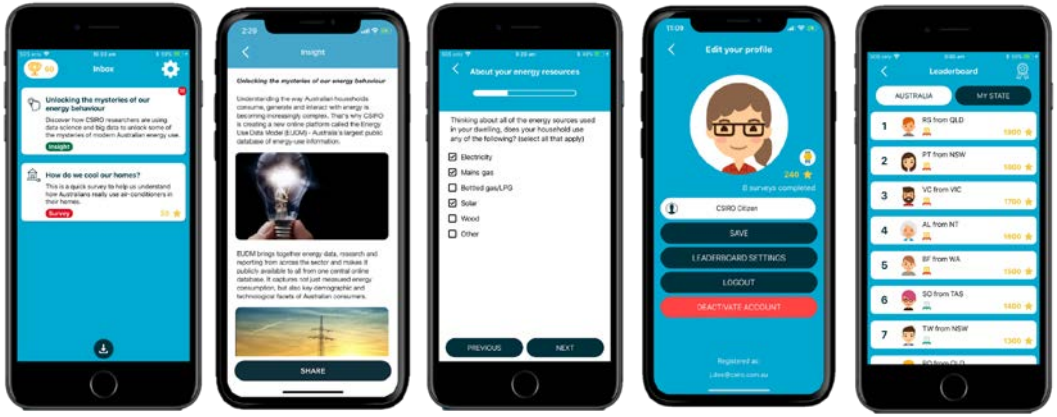
- Self-report survey (titled 'Solar power and batteries') was conducted using the CSIRO Energise app.
- Included a mix of multi-choice and open-ended questions (see Appendix)
- Survey data collected from ~1,800 app users across Australia between July and September 2018. Results herein are based on data as at mid-September 2018.

Data analyses

- Quantitative analyses involved computing standard descriptive statistics
- Qualitative analyses involved analysing open-ended responses (e.g. free text comments) using a multi-step procedure, as described in Section 4.

Data collection: CSIRO Energise

- CSIRO Energise is a smart device application that was launched in mid-2018. It allows Australians aged 18+ years to participate in short surveys over time.
- Compared to traditional methods (e.g. postal surveys), benefits include more rapid, longitudinal and on-demand (e.g. time/content-dependent) surveys.
- App is a two-way communication tool: users provide data by completing surveys, as well as receiving research findings and insights over time
- Strong focus on citizen science, with elements of gamification to increase user engagement.



CSIRO Energise is available to download for both Android and iOS devices. See: https://ws.energise.csiro.au/

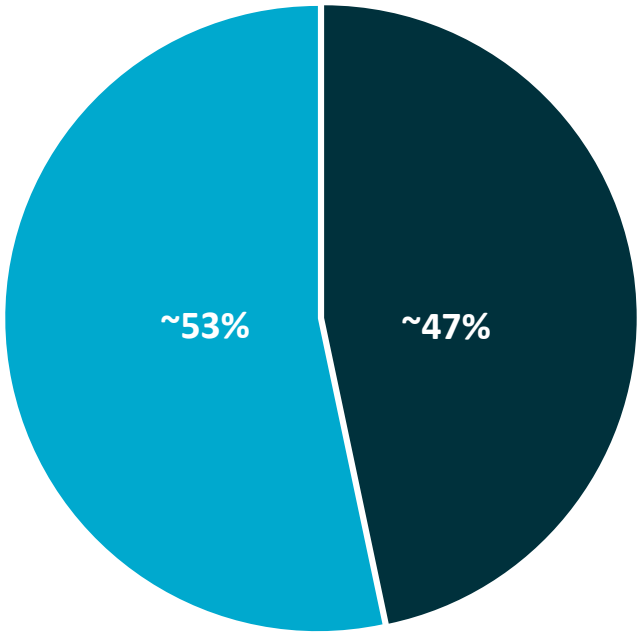
Available on the App Store

GET IT ON Google Play

Section 2:
Current uptake rates for solar panels and battery storage

Current uptake rates for solar PV

First, does your home have solar panels to generate electricity?

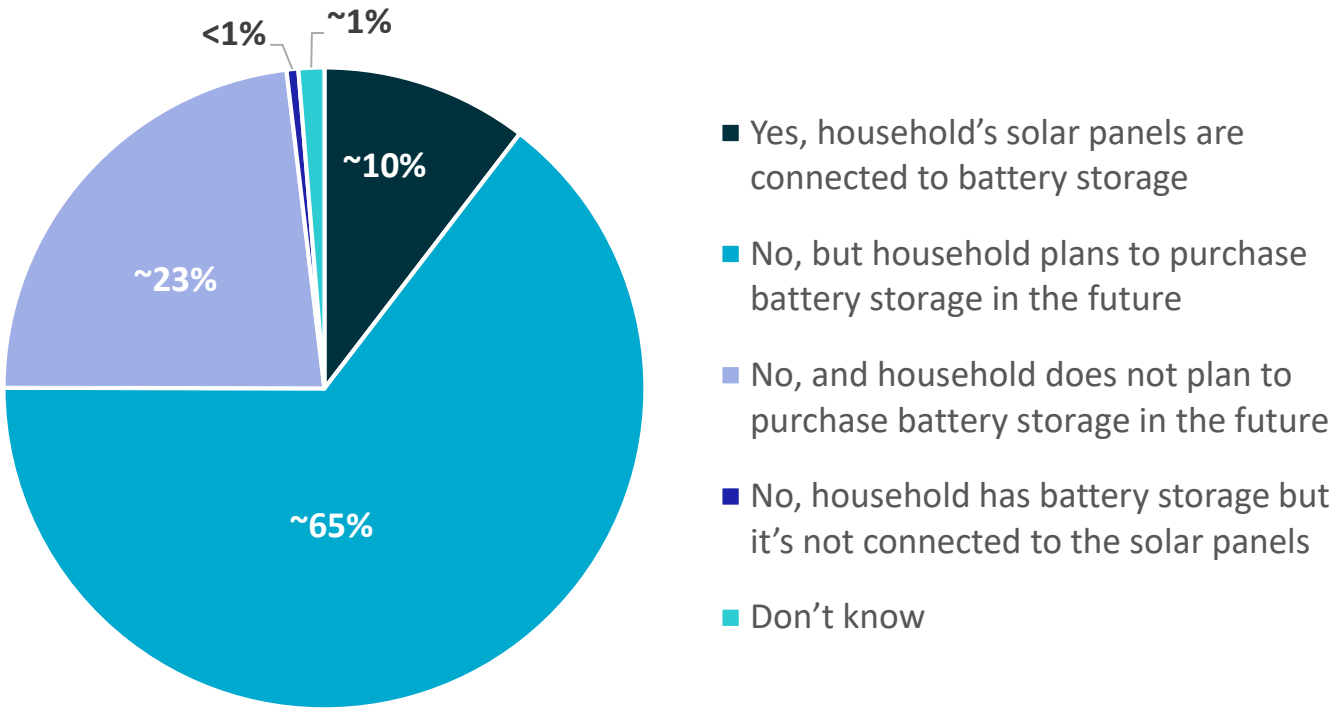


Nationwide, it's estimated that about one in five Australian households have solar panels. Thus, uptake of solar PV is much higher among the survey's sample than the broader population.

N ≈ 1,810

Current uptake rates for battery storage

Are your solar panels connected to a battery storage system?

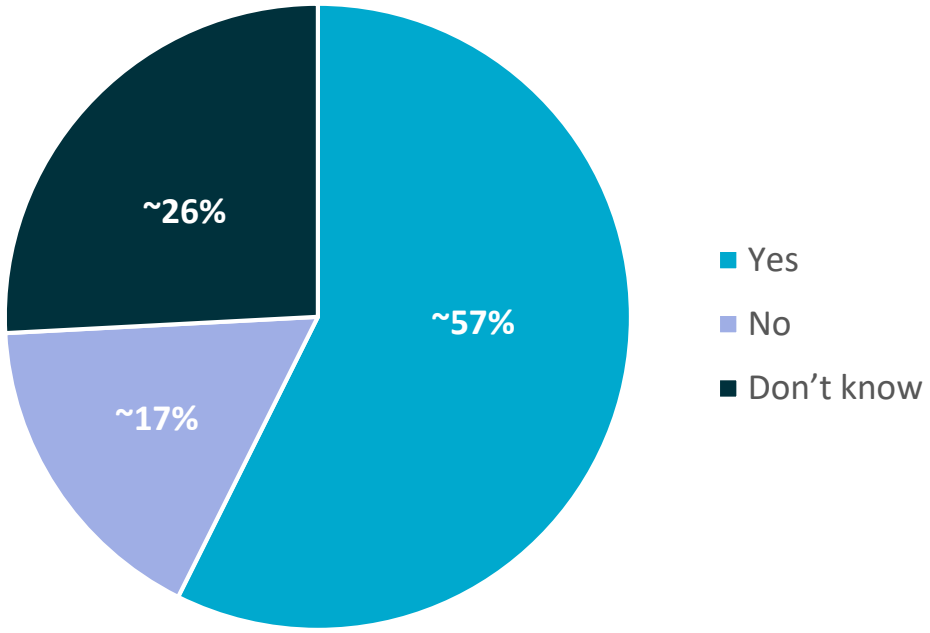


N ≈ 850

Section 3:
Intentions to purchase solar and battery storage in the future

Intentions to purchase solar PV in future

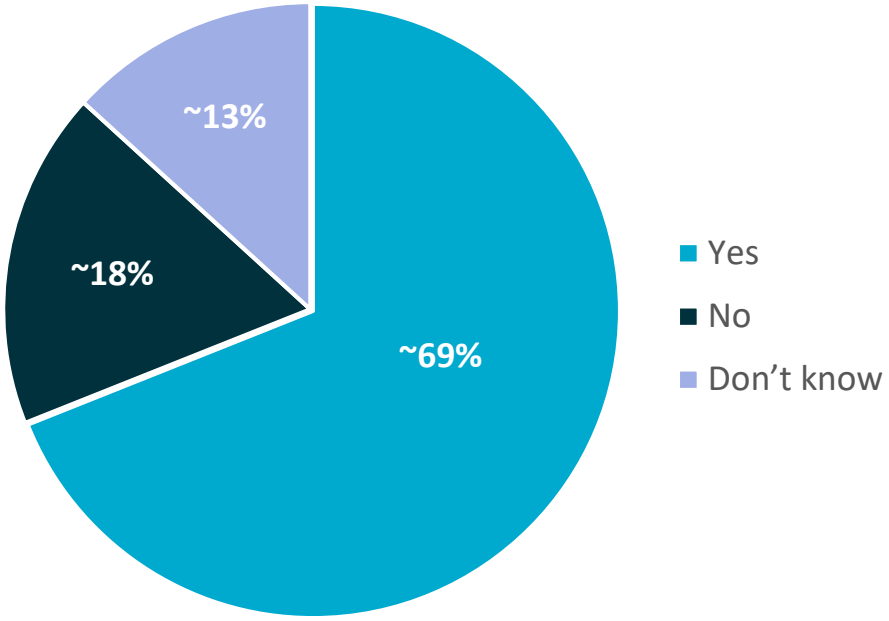
Does your household plan to purchase solar panels sometime in the future, either at your current home or at another future home?



N ≈ 960

Intentions to purchase battery storage in future

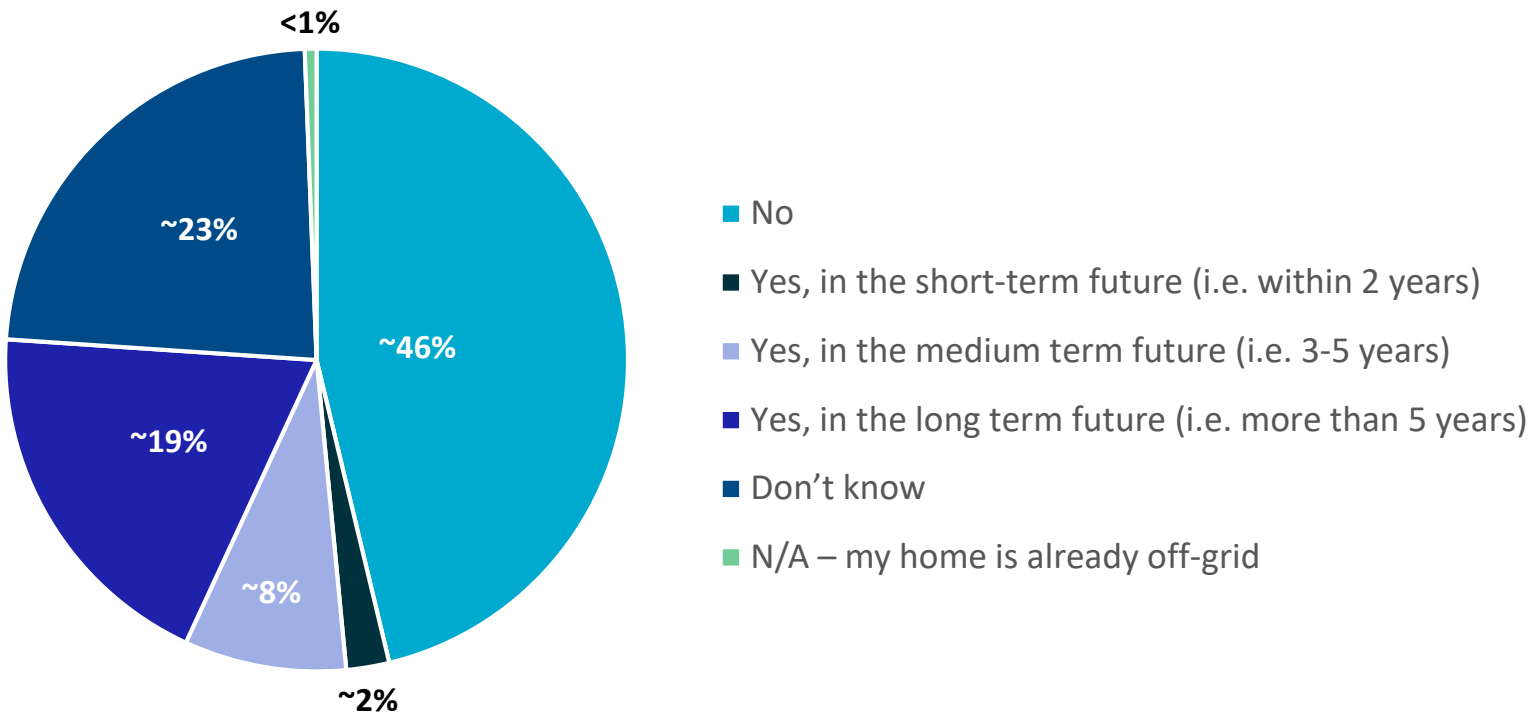
Does your household plan to purchase a battery storage system to connect to the solar panels?



Note: Chart includes a sub-sample of respondents (n ≈ 1290) who (a) currently have solar PV but no battery storage; and (b) do not have solar but plan to buy panels in the future. For the former group, battery storage intentions were assessed via a separate question asking about whether the household's solar panels were already connected to battery storage.

Intentions to go off-grid in future

Does your household plan to disconnect from the electricity grid (i.e. go 'off-grid') sometime in the future?



Note: Chart includes a sub-sample of survey respondents (n ≈ 990) who either (a) currently have a home energy battery storage system or (b) plan to purchase one in the future.

Section 4:
Key drivers and barriers to the uptake of solar panels

Assessing key drivers and barriers

- The survey included several open-ended questions designed to collect qualitative data (free-text comments) on the key drivers vs. barriers to the uptake of solar panels.
- Different questions were asked depending on whether or not the home already had solar panels, and whether there was an intention to purchase panels in the future.

Variable	Sample	Question	Response format
Drivers of solar PV uptake	Respondents who already have solar PV	*Why did your household purchase solar panels?*	Open-text field
	Respondents who plan to install solar PV sometime in future	*Why does your household plan to purchase solar panels?*	Open-text field
Barriers to solar PV uptake	Respondents who do not currently have solar PV installed	*There are a range of reasons why a home might not have solar panels to generate electricity. Thinking about your household, please tell us why your home doesn't have (or can't have) solar panels.*	Open-text field

Qualitative analyses: Multi-step process

For each open-ended question, a multi-step process was followed to analyse the responses:

1) Based on an initial review of data, a coding scheme was developed to capture the range of open-ended comments provided by respondents. Each category in the coding scheme reflected a conceptually-distinct theme or answer to the question.
2) Using the coding scheme, a social scientist then classified each open-ended comment. If a comment reflected more than one theme/category, multiple codes were assigned.
3) After the full dataset was coded, a second social scientist independently coded a randomly-selected subset of data (min 10% of responses or n=100, whichever was greater) using the same coding scheme.
4) To assess inter-rater reliability, Cohen's Kappa statistic was used to compare the coding of the two social scientists and ensure there was sufficient agreement (consistency).
5) For any categories where agreement was moderate or lower, open-ended comments were re-examined by both scientists. Any disagreement was resolved via discussion.
6) Standard descriptive statistics were then computed to determine the proportion of open-ended responses classified into each category of the coding scheme.

Results and data visualisation

- On the slides that follow, results for each survey question are presented in succession.
- Findings are presented in multiple ways: tables, figures (e.g. bar charts) and word clouds.
- The word clouds (also known as text clouds) have been created to help visualise the key themes in the respondents' open-ended comments.
  - To create the word clouds, stemming techniques were applied to the open-ended comments (e.g. free-form text), with the aim of grouping together text/words with the same stem. E.g. the words "electric" and "electricity" both have the same stem: "electric".
  - The size of individual words in the cloud reflects the frequency of each stem; that is, how often the text/words appear in the open-ended comments. In turn, the largest words in the cloud reflect the most commonly cited text/words in the open-ended comments, whereas the smaller words are less commonly cited.
  - To enhance interpretation of the visualisations, a threshold (e.g. word frequency ≥15) has been applied for the minimum number of times a stem must appear in the open-ended comments in order to be included in a question's word cloud.

Key drivers of uptake – current solar PV owners

Why did your household purchase solar panels?

Category	Description	Example comments		Percent
Economic reasons	Save/make money; reduce energy bills and costs; take advantage of subsidies, rebates and incentives; attractive feed-in tariffs *(Note: 5% of responses cited rebates or subsidies, while 4% cited generous FITs)*	• *Save money on power bills* • *Rebates and tariffs were too good to ignore* • *Take advantage of generous incentives* • *We had the funds, the government provided a rebate and power prices were going up*	• *To reduce power bills* • *Cheap energy* • *Cost savings* • *Good feed-in tariff* • *Clear financial benefit*	**~75%**
Environmental reasons	Help environment; sustainability; generate clean/renewable energy; reduce fossil fuels, greenhouse gases, carbon emissions; other environmental reasons	• *Environmental responsibility* • *To be sustainable* • *Generate and contribute to green energy* • *Environmental conscience* • *To minimise our environmental impact*	• *Reduce carbon footprint* • *Reduce emissions* • *Help the environment* • *Try to be greener* • *Mitigate climate change*	**~53%**
Grid independence	Reduce reliance on network; gain a sense of control and autonomy; self-sufficiency; ability to self-generate power; reduce grid-sourced power; decentralised power; going off grid	• *Work towards energy independence* • *Decrease our reliance on grid power* • *An attempt to run the house off the grid* • *To take control of our electricity generation* • *We aren't grid connected*	• *Sense of independence* • *Be more self sufficient* • *Become less reliant on a dirty grid* • *To generate our own electricity* • *Control over supply*	**~7%**
Save/reduce energy, offset usage, improve efficiency	To save energy, improve energy efficiency, reduce or offset consumption (including offsetting power use of specific appliances); generate enough energy to offset usage.	• *Reduce electricity consumption* • *To offset our household consumption* • *To supply the household during the day* • *To offset energy usage by the pool* • *To generate enough electricity to cover my use*	• *Energy efficiency* • *To save electricity* • *To displace our own load* • *To offset power usage* • *To counteract our energy usage*	**~5%**
Social responsibility	To be responsible, do the 'right' thing, make a contribution to society, set a good example to others, generate change for society, help future generations	• *Feel warm and fuzzy on the inside by doing my bit* • *Act as a good example to others* • *Do our bit to be responsible inhabitants of this planet!*	• *Contribute to society* • *To make a difference* • *Right thing to do* • *To be responsible* • *Generate social change*	**~2%**

N ≈ 770 responses

Key drivers of uptake – current solar PV owners (cont.)

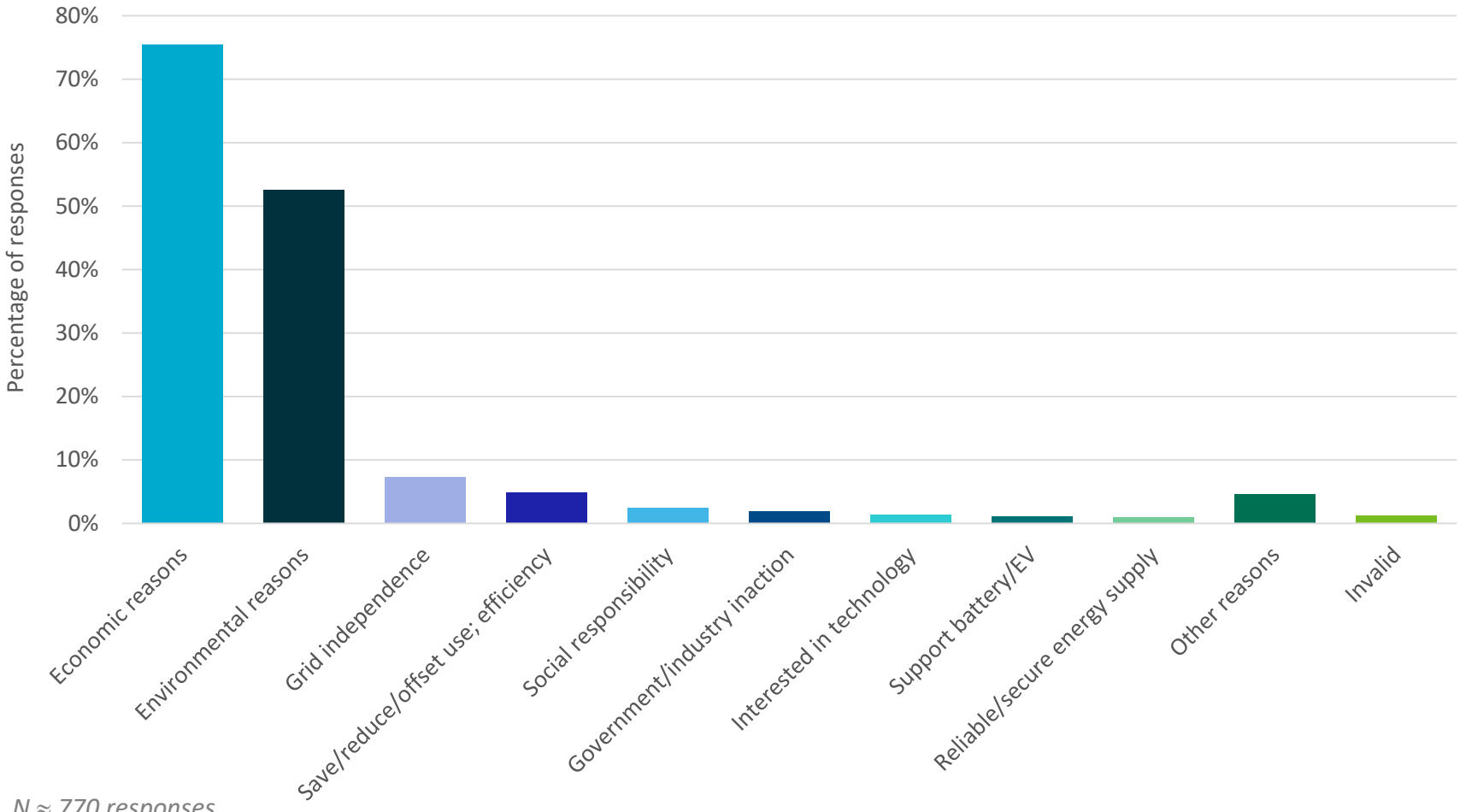
Why did your household purchase solar panels?

Category	Description	Example comments		Percent
Poor decisions and (in)actions of government and/or industry	Frustration, discontentment or concern over the (in)actions, conduct, decision-making, etc. of government, policymakers and/or industry	• *Stick it to the man…the energy generators and poor government direction* • *Sheer frustration at the politics and poor national management of the grid* • *Because the government isn't doing enough* • *To "stick it to the greedy power companies"* • *Frustration at lack of government action on the environment*		**~2%**
Interest in solar technology	Interest in and/or support of solar technology; keeping up-to-date with latest technology	• *To learn more about the technology* • *Personal taste (ie. it's a technology that I like)* • *Enthusiasm to support the technology*	• *Interesting technically to do* • *Always interested in solar* • *Cool tech gadget*	**~1%**
Support battery and/or electric vehicle	To support an existing or future battery storage system and/or electric vehicle	• *Prepare for upcoming batteries and electric vehicles* • *To charge an electric car in the future* • *Charge our electric car which has a 100kWh battery*	• *Future staging for battery system* • *Recharging electric vehicles* • *Provide solar charge for battery*	**~1%**
Reliable/secure energy supply	Ensure energy security; back-up power supply; protection against blackouts or grid unreliability	• *Wanted to have a more secure supply of power* • *To have reliable, resilient and cheap electricity* • *Because of the number of blackouts we had* • *Additional security of supply as also has battery*	• *Unreliability of the grid in our area* • *Provide backup electricity* • *To offset probable power cuts during peak times in summer*	**~1%**
Other reasons	Reasons that do not fit into one of the above categories	• *Provide extra shade for the roof in summer* • *I just LOVE the use of solar. It just makes sense* • *Old panels; needed more capacity*	• *Add value to property* • *Seemed like a good idea* • *Investment*	**~5%**
Invalid response	Response does not make sense and/or fails to answer the question			**~1%**

N ≈ 770 responses

Key drivers of uptake – current solar PV owners

Why did your household purchase solar panels?



N ≈ 770 responses

Key drivers of uptake – current solar PV owners

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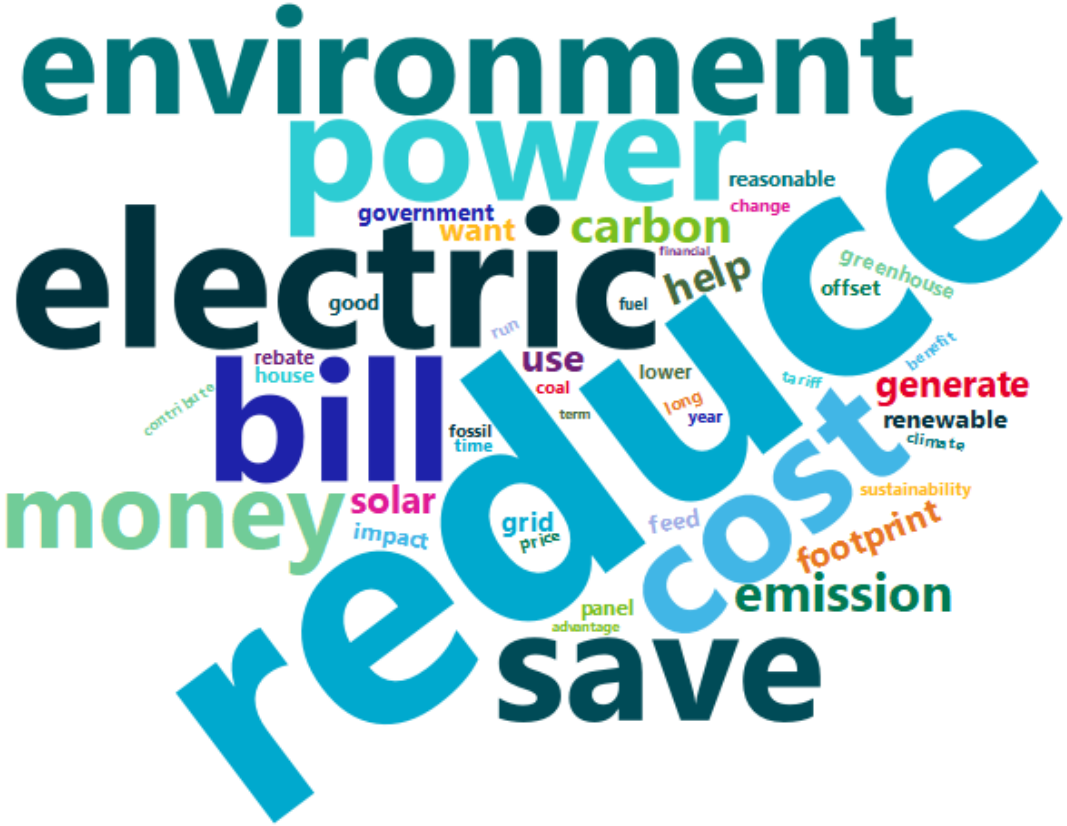


N ≈ 770 responses

Key drivers of uptake – future solar PV owners

Why does your household plan to purchase solar panels?

Category	Description	Example comments		Percent
Economic reasons	Save or make money; reduce energy bills and costs; cost-effectiveness	• *Reduce energy costs* • *Cheaper electricity* • *Limit price rise impact* • *Cost effectiveness*	• *Generate return* • *Save money* • *To cut our power bill* • *Cost savings*	**~61%**
Environmental reasons	Help environment; generate clean/renewable energy; reduce fossil fuels, greenhouse gases, carbon emissions, etc.; sustainability; any other reference to environmental reasons	• *To generate green electricity* • *Reduce reliance on fossil fuels* • *To reduce carbon footprint* • *Environmental benefits*	• *Help the environment* • *Save the planet* • *Environmentally friendly* • *Cleaner energy*	**~57%**
Grid independence	Reduce reliance on grid/network; control, self-sufficiency and autonomy; decentralised power; ability to self-generate power; going off grid	• *Self sufficiency and independence* • *To disconnect from the grid and remove my reliance from the power grid* • *Want to be self-sufficient and off grid*	• *Energy independence* • *I want to be free of grid* • *Building off grid home* • *Want to go 'off grid' completely*	**~12%**
Save/reduce energy, offset usage, improve efficiency	To save energy, improve energy efficiency, reduce or offset energy consumption (including offsetting power usage of specific appliances), reduce demand/load on grid	• *Save energy and energy efficiency* • *Reduce strain on the grid during high-peak events (eg heat waves)* • *Want to reduce electricity consumption*	• *Better energy efficiency* • *Offset usage* • *Reduce the load on the grid* • *Power savings over time*	**~4%**
Social responsibility	To be responsible, do the 'right' thing, set a good example to others, contribute to society, generate change, help future generations	• *Socially responsible, feels good* • *Because everyone needs to their bit* • *Socially responsible thing to do*	• *To contribute…* • *It is the right thing to do* • *Better for society overall*	**~2%**

N ≈ 550 responses

Key drivers of uptake – future solar PV owners (cont.)

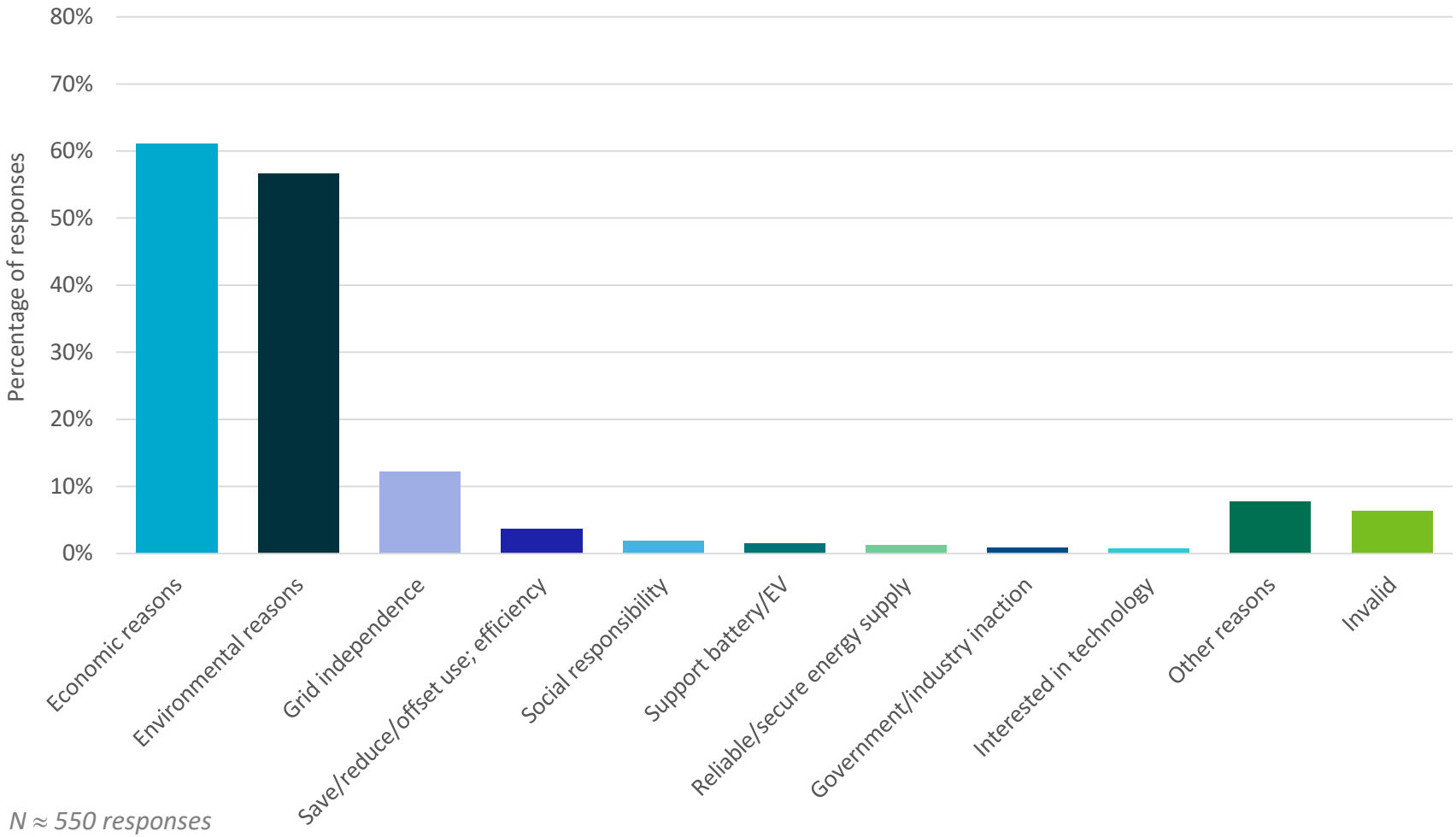
Why does your household plan to purchase solar panels?

Category	Description	Example comments		Percent
Support battery and/or electric vehicle	To support an existing or future battery storage system and/or electric vehicle	• *Plan to install batteries to run AC and electric vehicle* • *Pair with upcoming electric car purchase*	• *So that we can charge batteries* • *Prepare for battery storage* • *Future plans for electric vehicle*	**~1%**
Reliable/secure energy supply	Energy security/stability; back-up power supply; protection against blackouts or grid unreliability	• *Help reduce power outages* • *Have backup if the grid goes down* • *Improve reliability of supply as we have so many blackouts*	• *To improve our energy security* • *To store the energy in case of blackout in the summer months…*	**~1%**
Poor decisions and (in)actions of government and/or industry	Frustration, discontentment or concern over the (in)actions, conduct, decision-making, etc. of government, policymakers and/or industry	• *If the government won't help the people then I will help myself and my family* • *Hopefully the power companies will be brought to task for stealing home generated electricity*	• *Essentially to 'stick it' to the power companies* • *Seems it's up to individuals because the government is inactive on this*	**~1%**
Interest in solar technology	Interest in and/or support of solar technology; keeping up-to-date with latest technology	• *Support the technology* • *I'm very interested on [sic] emerging renewable technologies*	• *An under utilised resource that I would love to be an advocate for* • *Upgrade to newer technology*	**~1%**
Other reasons	Reasons that do not fit into one of the above categories	• *It seems like a good idea* • *Everybody is going for it*	• *Solar is awesome!* • *Sensible investment*	**~8%**
Invalid response	Response does not make sense and/or fails to answer the question			**~6%**

N ≈ 550 responses

Key drivers of uptake – future solar PV owners

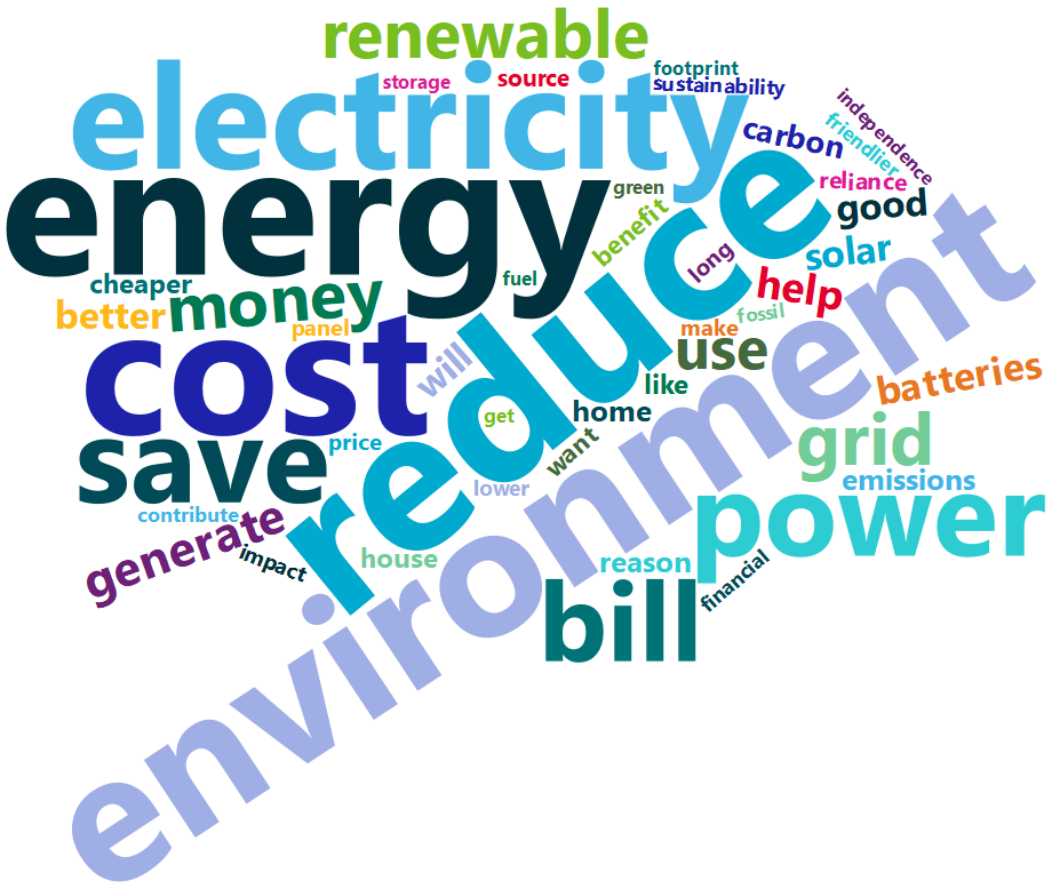
Why does your household plan to purchase solar panels?



N ≈ 550 responses

Key drivers of uptake – future solar PV owners

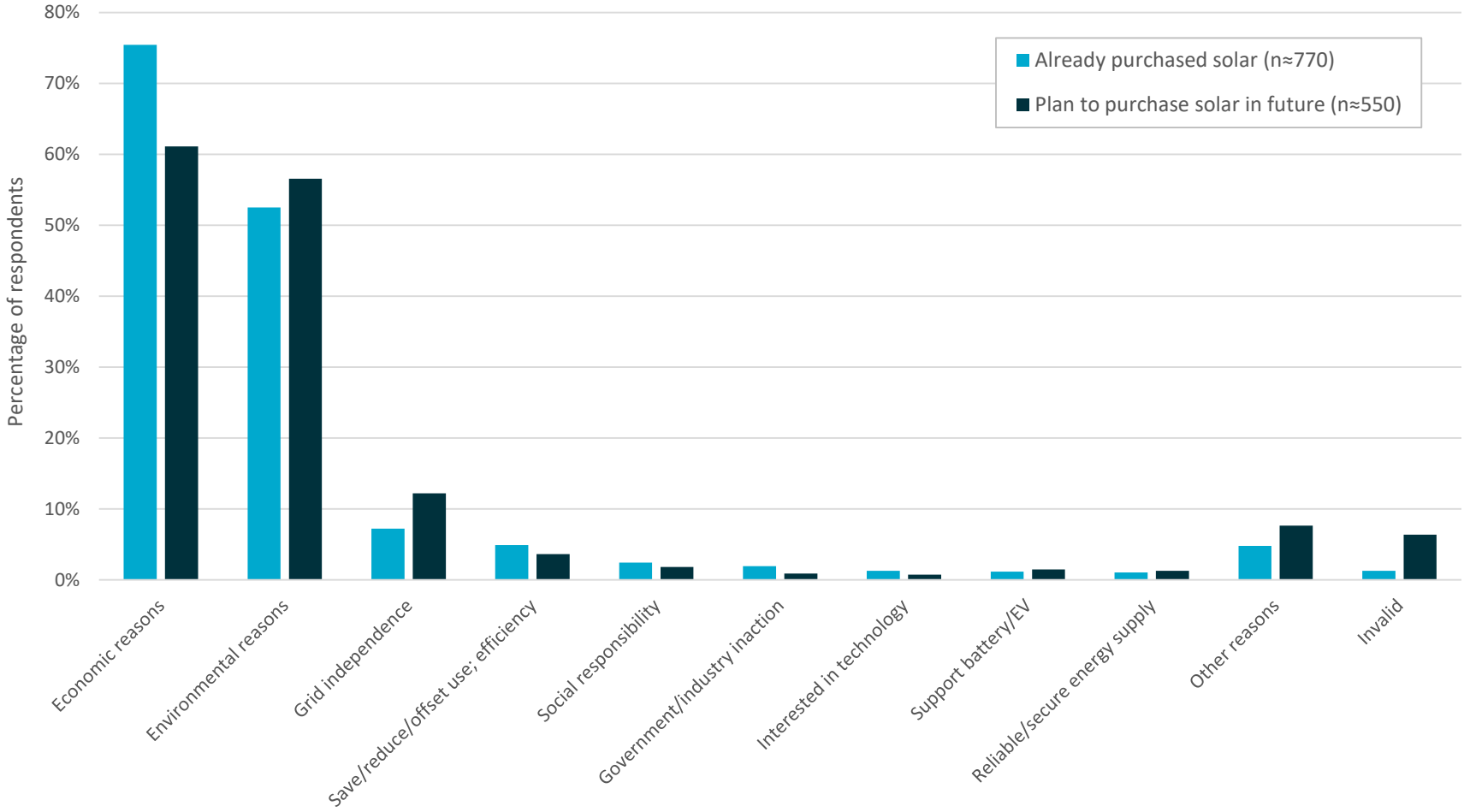
Why does your household plan to purchase solar panels?



N ≈ 550 responses

Summary: Key drivers of solar PV uptake

Sub-sample comparison of current vs. potential future PV owners



Key barriers to solar PV uptake

Please tell us why your home doesn't have (or can't have) solar panels

Category	Description	Example comments		Percent
Economic reasons	Too expensive; financial constraints; cannot afford upfront costs; need to save money first; not cost-effective; poor return on investment	• *Cost benefit/payback not enough* • *Return on investment is too low* • *Dollars do not stack up as we use minimum power* • *Don't have the spare cash to invest in panels* • *Initial cost and not worth the feed in tariff…*	• *Too expensive* • *Can't afford them* • *Waste of money* • *Cost* • *Not cost effective yet*	**~38%**
Renting/not home owner	Not the home-owner (e.g. renting the property, government housing etc.); no choice/option due to rental status	• *Not the sole owner of the property* • *Renting and not my decision* • *Rental (don't own, can't install)* • *I'm in public housing, sadly no option*	• *Rental property* • *Landlord choice* • *Government housing* • *I don't own the house*	**~28%**
Not possible due to dwelling type and/ or body corporate	Solar not possible or practical due to dwelling type (e.g. unit, apartment); limited choice or control due to body corporate/strata title constraints	• *I live in an apartment and can't install solar* • *I live in a block of flats so solar panels are not practical* • *Block of apartments. Body corporate won't go for it* • *Strata managed apartment requires strata approval* • *I live in a block of flats so solar panels are not practical*	• *I own a ground floor unit* • *Strata plan / apartment* • *Body corporate* • *Unit complex* • *Due to body corporate rules*	**~19%**
Suboptimal land and/or property characteristics	Solar not suitable due to aspects of the property, such as limited sunlight (e.g. too much shade, surrounding trees) and roof size, orientation or condition	• *Not enough sunlight - very heavy tree cover* • *Roof is overshadowed by neighbours trees* • *Orientation of the roof and shade* • *Low angle, lack of space, partial shadowing*	• *Bad roof design makes solar panels impossible* • *Size and position of my roof* • *Roof not facing enough sun*	**~10%**
Other home repairs, renovations or expenses required	Solar is not highest priority due to other home repairs/renovations (e.g. roof needs replacing, other property investments) and household expenses; planning to re-build/develop property	• *Recently bought house. Need to replace roof first* • *We've got other things to buy for the house first* • *We plan to replace our roof fairly soon* • *Need to get the house repaired (leaking roof, painted etc.) before investing in solar*	• *Putting in pool, renovations* • *We're plan to renovate soon, and are putting it off until then* • *Waiting for renovations* • *Other spending priorities*	**~5%**

N ≈ 950 responses

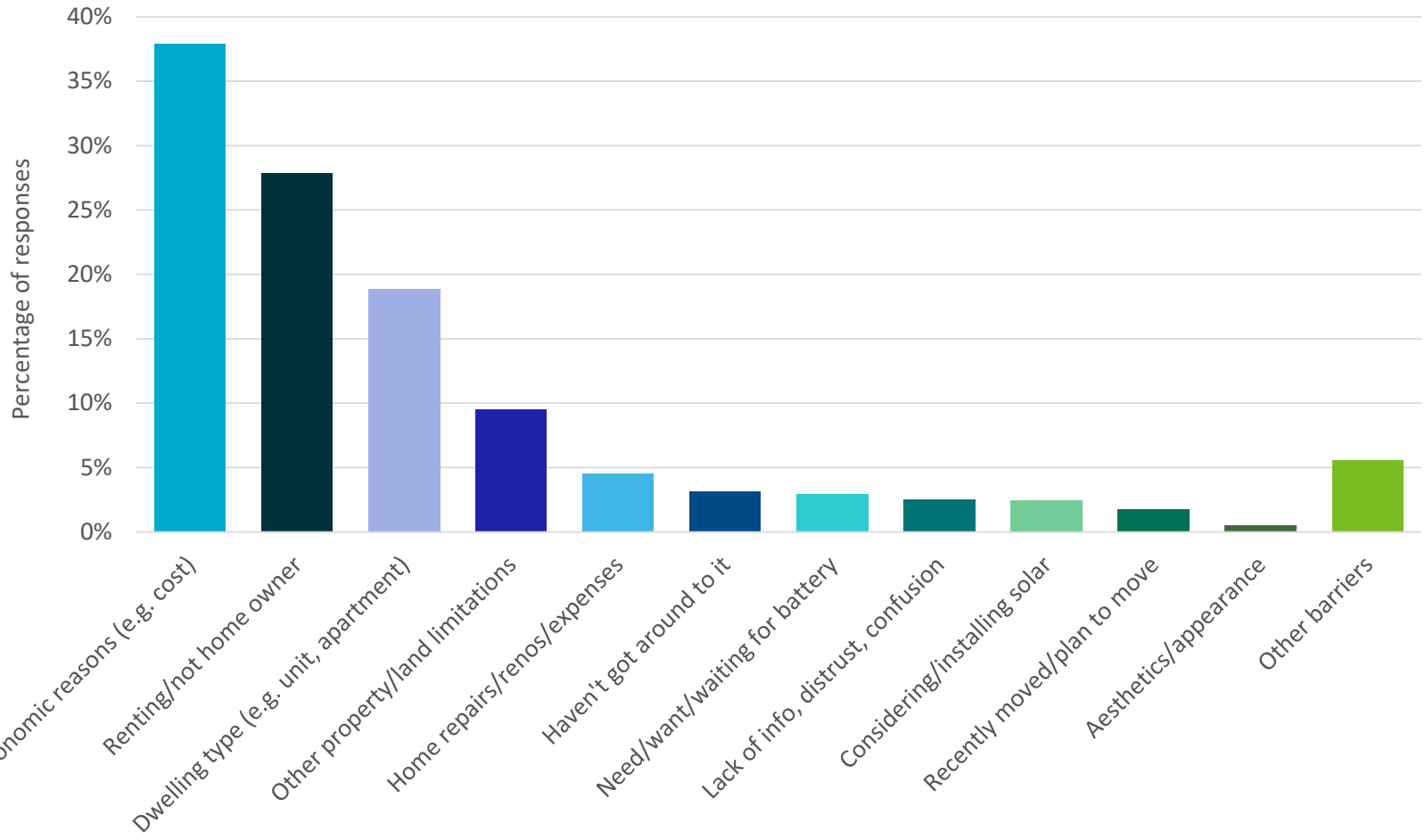
Key barriers to solar PV uptake (table continued)

Please tell us why your home doesn't have (or can't have) solar panels

Category	Description	Example comments		Percent
Haven't considered or got around to it	Haven't made time/effort to look into solar or arrange installation; laziness, procrastination, inertia and apathy	• *I haven't got around to installing solar yet* • *Have not found the time to look into it properly* • *There's probably an element of laziness too* • *Never bothered to look at it*	• *Yet to get organised* • *Haven't looked into it* • *Haven't considered* • *General apathy*	**~3%**
Need/want battery storage first	Don't have batteries to make the most of solar; waiting for battery storage to be more affordable or for technology to improve first; want solar plus battery package	• *Waiting for the cost of storage batteries to decrease* • *To get maximum value I think battery storage is also required* • *Once batteries are more cost effective will consider again* • *Need to install expensive battery to gain any significant benefit from solar panels and reduce electricity cost*	• *Waiting for better more affordable storage options for batteries…* • *I want a package that includes batteries*	**~3%**
Lack of credible info, consumer confusion or distrust, decision-making difficulties	Lack of knowledge/information to make right choice; uncertainty or confusion around available deals, best option, product features etc.; hard to find trustworthy advice or get quotes; consumer distrust	• *Uncertainty about what's best…lack of understanding of options* • *Lack of knowledge on the most suitable type* • *Hard to find reliable advice on what to choose - so many options* • *Still trying to decide what's best. Too many opinions!* • *Concern about making the correct choice, not sure where to obtain reliable subjective advice…*	• *Too difficult to get a quote when we tried* • *Confusing to buy* • *Unsure of deals* • *Unable to find credible solar providers*	**~3%**
Solar installation is being considered or currently underway	Considering solar installation in near future; looking into options; installation currently underway	• *Looking into solar. Installing within 2 mths* • *We are researching now to install them* • *We've paid a deposit on a 4.5kw solar system and we're waiting for the installation*	• *Solar rep visiting today* • *Are just about to have them installed* • *They are on order*	**~2%**
New home or plan to move to new home	Recently moved (e.g. new home) or planning to move in near future	• *New build, did not have panels when it was built* • *Contemplating moving and not keen to invest*	• *Recently bought the house* • *Thinking about moving soon*	**~2%**
Aesthetics	Don't like visual appearance or aesthetics of solar panels	• *I also don't like the look very much* • *I don't really like the aesthetics of the solar panels on a roof*	• *Appearance* • *Aesthetics*	**<1%**
Other barriers	Reasons that do not fit into one of the above categories	• *Waiting for better technology* • *Don't want to change power meters*	• *Limited lifespan* • *Want to get off gas first*	**~6%**

Key barriers to solar PV uptake

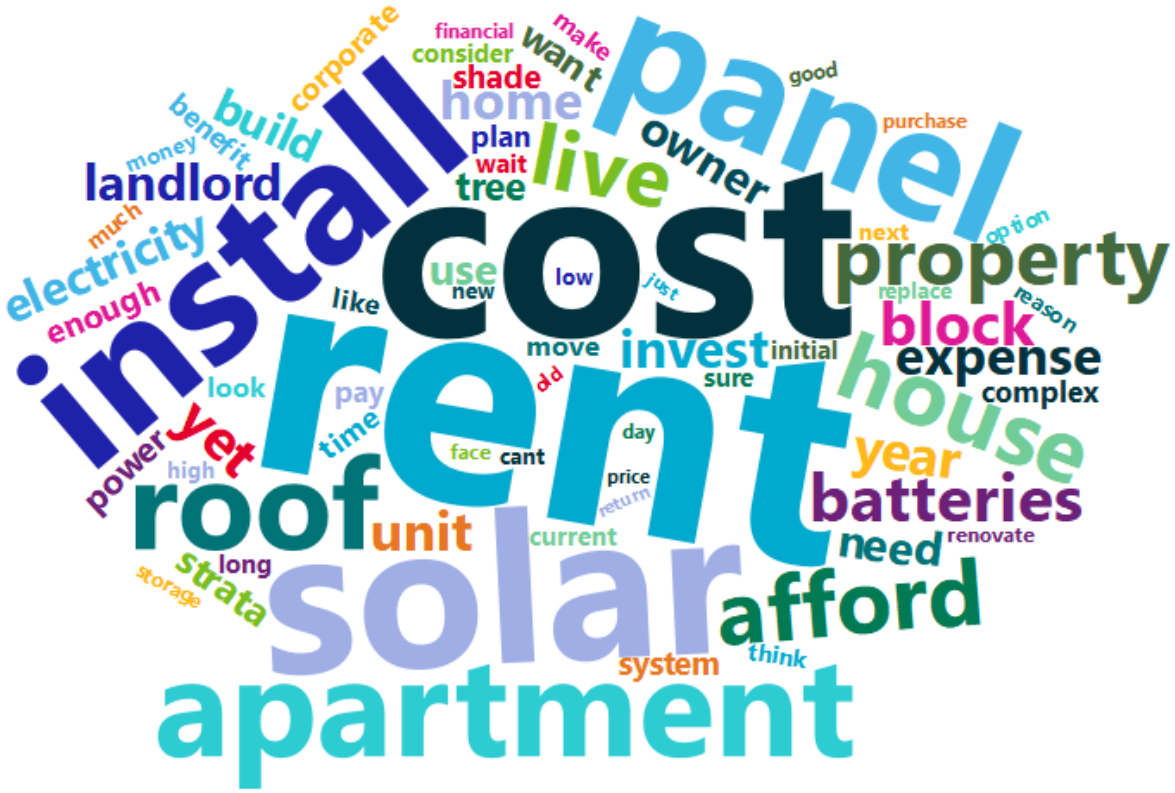
Please tell us why your home doesn't have (or can't have) solar panels



N ≈ 950 responses

Key barriers to solar PV uptake

Please tell us why your home doesn't have (or can't have) solar panels



N ≈ 950 responses

Section 5:
Key drivers for the uptake of battery storage

Assessing key drivers

- Alongside questions about solar panels, the survey included two open-ended questions to collect qualitative data (free-text comments) on the key drivers for uptake of home energy battery storage.
- Different questions were asked depending on whether or not the home already had battery storage, and whether there was an intention to purchase batteries in the future.

Variable	Sample	Question	Response format
Drivers of uptake of battery storage	Respondents who currently have batteries installed	*Why did your household purchase battery storage?*	Open-text field
	Respondents who plan to install batteries in the future	*Why does your household plan to purchase battery storage?*	Open-text field

- Open-ended data was analysed using the same multi-step process described earlier.
- Again, results are presented in multiple ways: tables, figures and word clouds.
  - Note: thresholds have been applied for the minimum number of times a stem must appear in the open-ended comments in order to be included in the cloud (freq. ≥5 for first question, freq. ≥15 for second).

Key drivers of uptake – current battery owners

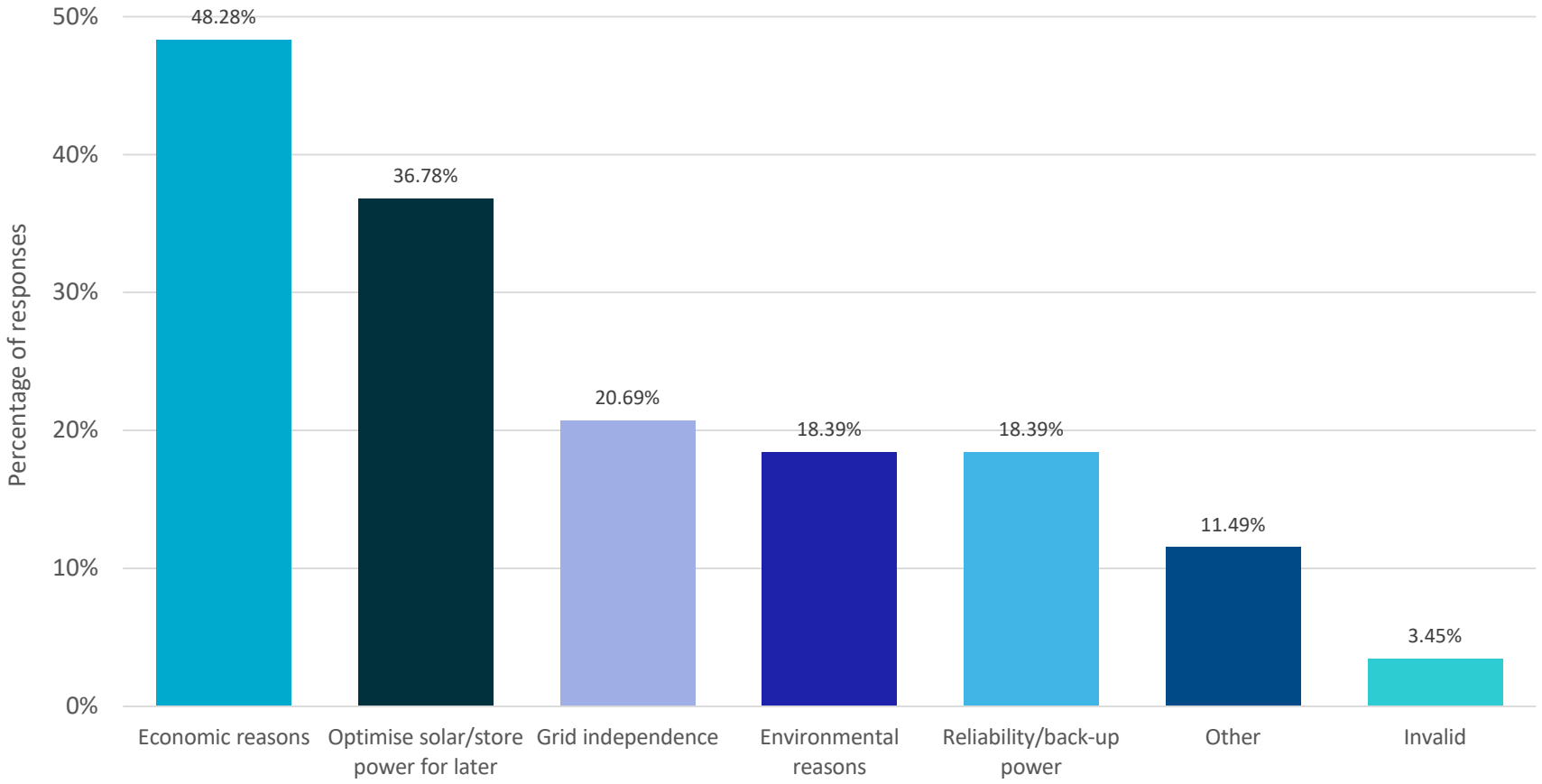
Why did your household purchase battery storage?

Category	Description	Example comments		Percent
Economic reasons	Save money; reduce energy bills/costs; maximise financial benefits/payoff from solar; unappealing solar feed-in tariffs *(Note: ~10% referred to suboptimal FiTs)*	• *Helps to keep power cost down* • *Save money in long term* • *Sick of low feed-in tariffs* • *Reduce ripoff power bills*	• *Lower electricity costs* • *To reduce electricity bills* • *To reduce peak energy costs* • *Cheaper power at nights*	**~48%**
Optimising solar and/or storing power for later use	To support solar panels, make better use of solar energy, ability to use solar in peak times or night/cloudy periods (e.g. load shifting; offsetting usage in evenings)	• *To store surplus power to use in the peak* • *Maximise solar self consumption* • *To make better use of our solar generation* • *To help reduce power usage at night*	• *To use solar energy at night* • *Maximise solar energy capture* • *To enhance the solar* • *After daylight power offset*	**~37%**
Environmental reasons	To help the environment; support or generate clean/renewable energy; reduce fossil fuels, greenhouse gases, carbon emissions, etc.; sustainability; any other reference to environmental reasons	• *Support the shift to green energy* • *Increase our use of renewable energy* • *Help to provide clean power to the grid* • *To make the home more sustainable*	• *To create a sustainable future* • *Reduce fossil fuels* • *Reduce carbon emissions* • *For environmental reasons*	**~18%**
Grid independence	Reduce reliance on grid/network; control and autonomy; self-sufficiency; ability to self-manage power; going off grid	• *We did not want to connect to the grid* • *To make me more self-sufficient* • *Batteries are required for off-grid!*	• *Reduce my reliance on the grid* • *Reduce grid import* • *Maximise grid independence*	**~21%**
Reliability/security (e.g. back-up power)	Energy security; back-up power supply; protection against blackouts or grid unreliability	• *Unreliability of the grid* • *Blackout protection* • *Back up power during back out*	• *Ability to continue powering our home when the grid is down* • *Security*	**~18%**
Other reasons	Reasons that are distinctly different from the aforementioned categories	• *Peak demand management* • *For fun*	• *Set a good example to my children for their future*	**~11%**
Invalid response	Response does not make sense and/or fails to answer the question			**~3%**

N ≈ 90 responses

Key drivers of uptake – current battery owners

Why did your household purchase battery storage?



N ≈ 90 responses

Key drivers of uptake – current battery owners

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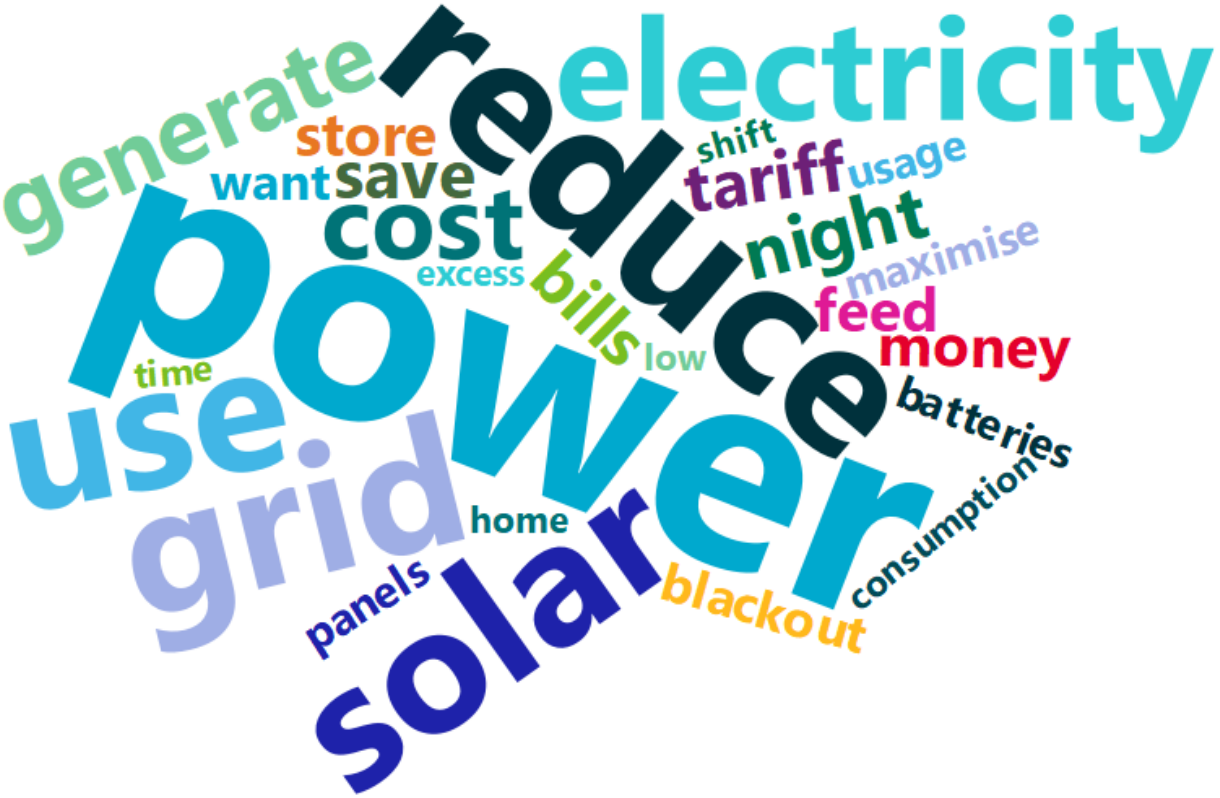


N ≈ 90 responses

Key drivers of uptake – future battery owners

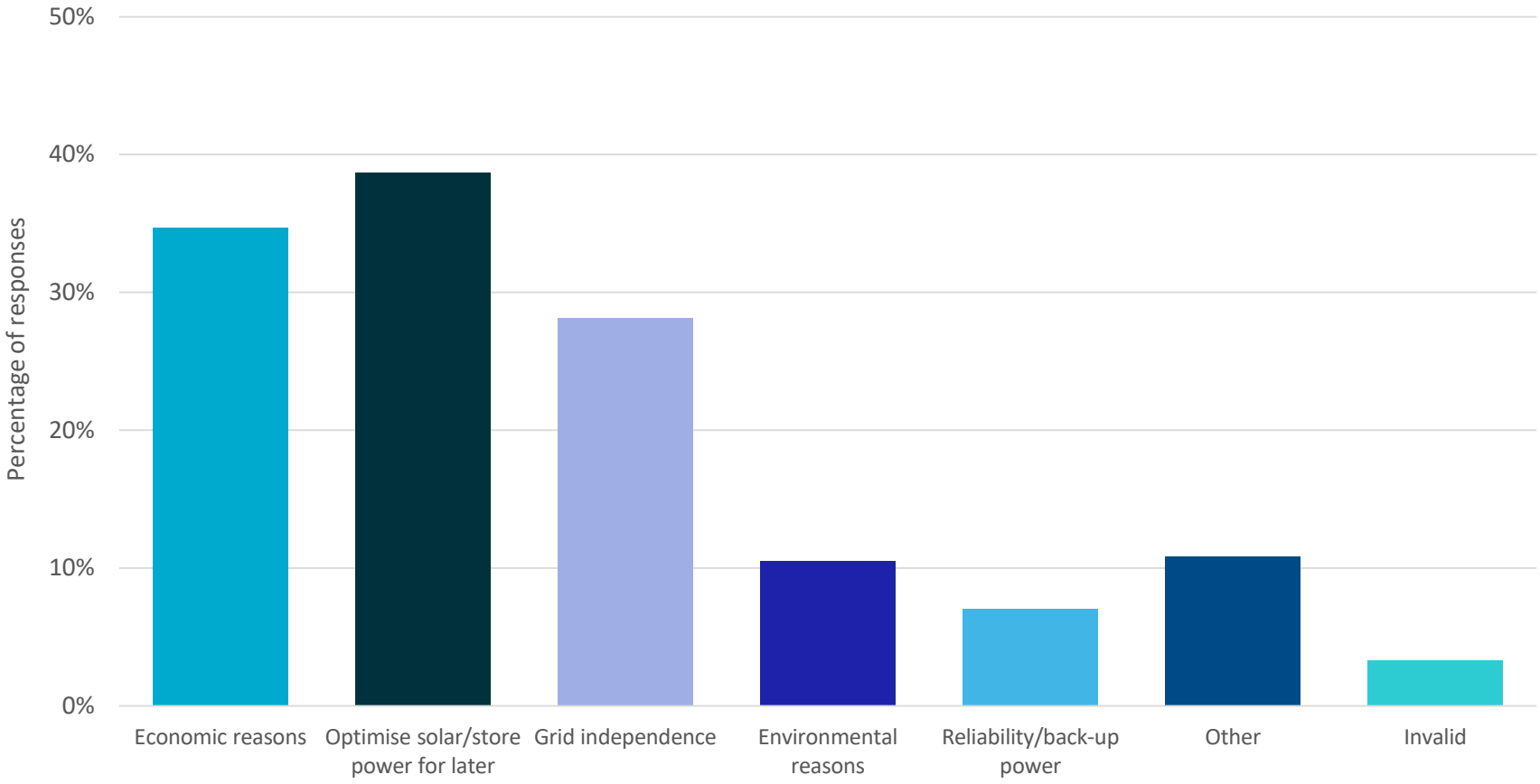
Why does your household plan to purchase battery storage?

Category	Description	Example comments		Percent
Optimising solar and/or storing power for later use	Supporting solar panels, making better use of solar energy, ability to use solar in peak time or night/cloudy periods (e.g. load-shifting)	• *To access solar power as often as possible* • *Solar without storage seems a waste* • *Increases efficiency of solar panels* • *To store the excess solar generation*	• *Make better use of solar generated power* • *So we can use the suns energy in the evening too!*	**~39%**
Economic reasons	Save money; reduce energy bills and costs; maximise cost/financial benefits of solar; unappealing feed-in tariffs for solar power	• *To have no more power bills* • *Save more money* • *Given low feed in tariffs a battery makes economic sense*	• *Keep electricity costs down* • *Cheap electricity* • *We anticipate increasing power prices and diminishing FIT*	**~35%**
Grid independence	Reduce reliance on grid/network; control and autonomy; self-sufficiency; ability to self-manage power costs; going off grid	• *To reduce reliance on the grid* • *To be as self sufficient and off grid as possible* • *We want to go off the grid*	• *Autonomy* • *Self sufficiency* • *To go off grid*	**~28%**
Environmental reasons	To help the environment; sustainability; support or generate clean/renewable energy; reduce fossil fuels, carbon emissions, greenhouse gases; any other environmental reasons	• *Environmental sustainability* • *To reduce CO2 emissions* • *Better for the environment* • *Move away from fossil fuels*	• *Clean energy* • *Support renewables* • *Save the planet* • *Limit environmental impacts*	**~11%**
Reliability/security (e.g. backup power)	Energy security; back-up power supply; protection against blackouts or grid unreliability	• *To provide power in blackouts* • *Back up power* • *Improve reliability of supply*	• *Additional protection from power outages due to the grid failing* • *Power security*	**~7%**
Other reasons	Reasons that are distinctly different from the aforementioned categories.	• *Seems like a good idea* • *Greater flexibility* • *Wish to support the technology*	• *It makes sense* • *Long term value* • *Investment*	**~11%**
Invalid response	Response does not make sense and/or fails to answer the question			**~3%**

N ≈ 880 responses

Key drivers of uptake – future battery owners

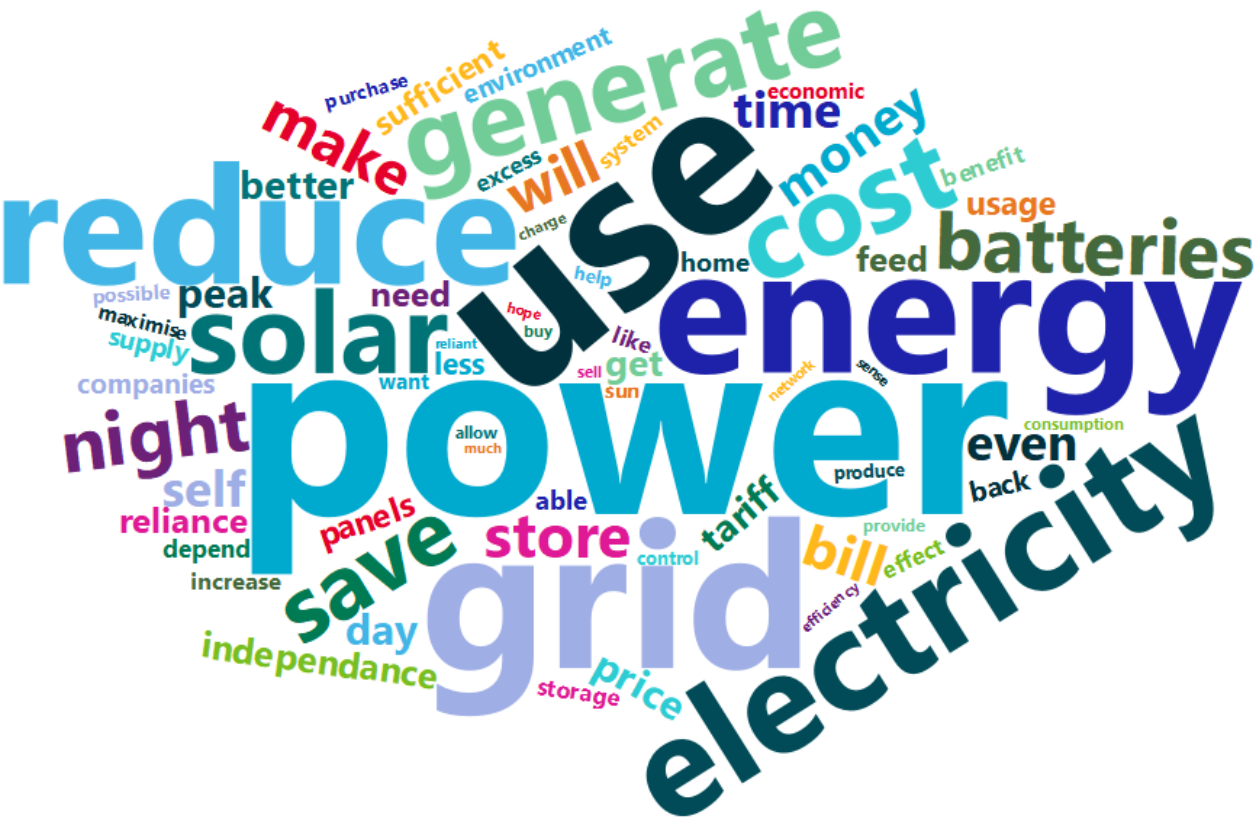
Why does your household plan to purchase battery storage?



N ≈ 880 responses

Key drivers of uptake – future battery owners

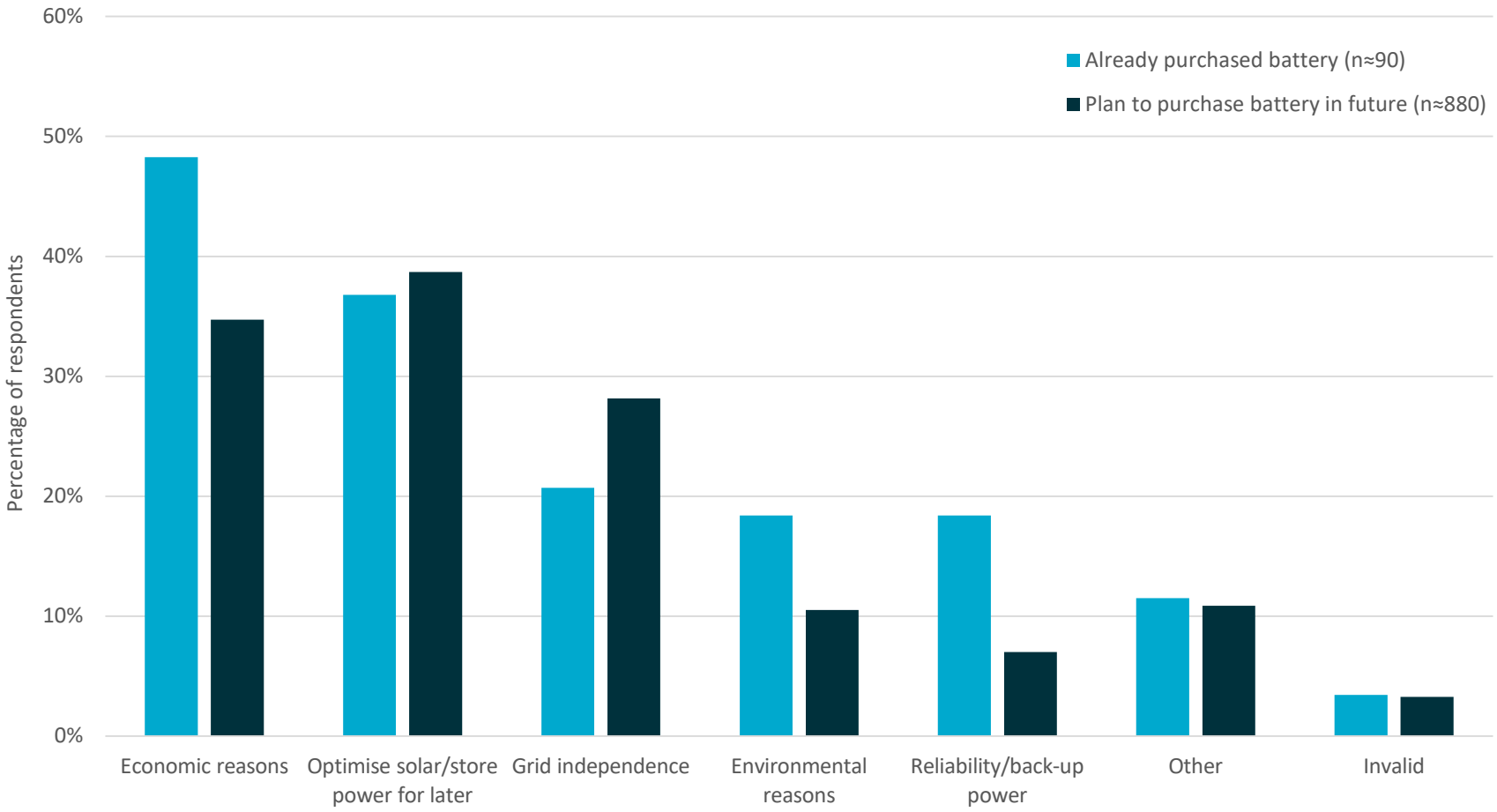
Why does your household plan to purchase battery storage?



N ≈ 880 responses

Summary: Key drivers of battery uptake

Sub-sample comparison of current vs. potential future battery owners



Section 6:
Conclusions

Conclusions

- Uptake of solar PV:
  - Key drivers of uptake include economic and environmental factors, respectively. This pattern was evident for both existing and potential future PV owners.
  - Motives such as grid independence, saving/offsetting energy usage, and reliability/security of power were less frequently cited.
  - Key barriers to uptake include economic factors (e.g. upfront costs), followed by no home ownership (e.g. renting) and dwelling type (e.g. apartment/unit).

- Uptake of battery storage:
  - Key drivers of uptake include economic factors and a desire to optimise solar panels (i.e. make the most of solar PV). However:
    - Among existing battery owners, a greater proportion cited economic reasons (~48%) compared to a desire to optimise solar (~37%); however, this difference was not statistically significant at $p < 0.05$, likely due to the small sample size.
    - Among those who plan to buy batteries in the future, a slightly greater proportion cited a desire to optimise solar (~39%) compared to the economic reasons (~35%)
  - The next most commonly cited motives for battery storage were a desire for grid independence, environmental factors, and reliability/backup power.

Limitations and future research

- While this research has yielded some interesting insights, a few caveats should be noted when interpreting the results:
  - The survey's sample was limited to users of the CSIRO Energise app. In turn, participants were not fully representative of the broader Australian population, which may have implications for the external validity and generalisability of results.
    - In terms of demographics, the CSIRO Energise sample tends to be skewed towards individuals with higher levels of education and household income. Uptake of solar PV is also higher among CSIRO Energise users than the general Australian population.
  - Questions aimed at existing battery owners had very small sample sizes, which may impact the reliability and representativeness of findings for those questions.
  - Data was self-report in nature, so it remains to be seen whether self-reported intentions (e.g. plans to buy solar/batteries) translate to actual behaviour in future.
  - As with all research, replicability is important to have confidence in the validity and reliability of results across diverse settings and samples of consumers.
- There are several avenues for future research in this area, especially as solar and battery technologies evolve. This includes monitoring how consumer perceptions and intentions change over time as these technologies improve and become more affordable.

Section 7:
Appendix – survey questions

Appendix: Survey questions

#	Variable	Question	Format
1	Solar PV uptake	First, does your home have solar panels to generate electricity? Solar panels are different to solar hot water systems, so for the purpose of this survey please only consider solar panels that generate electricity. - Yes, my home has solar panels to generate electricity → *Go to Q2* - No, my home does not have solar panels to generate electricity → *Go to Q12*	Single-select list
First subset of questions – PV owners			
2	PV installation date	Approximately, how many years ago were your solar panels installed? Please give your best estimate, rounding to the nearest whole year. If you don't know the answer, please leave the question blank and press 'NEXT' to continue.	Numeric
3	PV installation choice	Was your household responsible for purchasing the solar panels, or were they already installed when you bought or moved to the property? - My household was responsible for purchasing the solar panels → *Go to Q4* - Solar panels were already installed at the property → *Go to Q5* - Both of the above, e.g. solar panels were already installed and my household purchased more panels → *Go to Q4* - None of the above → *Go to Q5*	Single-select list
4	Reason(s) for buying PV	Why did your household purchase solar panels?	Open-text
5	Battery storage uptake	Are your solar panels connected to a battery storage system? - Yes, my household's solar panels are connected to battery storage → *Go to Q6* - No, but my household plans to purchase battery storage in the future → *Go to Q17* - No, and my household does not plan to purchase battery storage in the future → *Go to final question* - No, my household has battery storage but it's not connected to the solar panels → *Go to Q6* - Don't know → *Go to final question*	Single-select list
6	Battery make and model	What is the brand (i.e. manufacturer) and model of your battery storage system? If you don't know the answer, please leave the question blank and press 'NEXT' to continue.	Open-text
7	Battery storage capacity (usable)	What is the capacity (in kWh) of your battery storage system? By capacity, we mean how much energy the battery system can store. If your battery storage system lists two capacity figures (e.g. total/nominal and usable), please provide the usable capacity. If you don't know the answer, please leave the question blank and press 'NEXT' to continue.	Numeric
8	Battery power output (continuous)	What is the power output (in kW) of your battery storage system? By power output, we mean the standard rate at which the battery system releases (i.e. discharges) energy. If your system lists two output figures (e.g. continuous and peak/maximum), please provide the continuous output. If you don't know the answer, please leave the question blank and press 'NEXT' to continue.	Numeric

Appendix: Survey questions

#	Variable	Question	Format
9	Battery installation choice	Was your household responsible for purchasing battery storage, or was this already installed when you bought or moved to the property? - My household was responsible for purchasing battery storage → *Go to Q10* - Battery storage was already installed at the property → *Go to Q11* - Both of the above, e.g. battery storage was already installed and my household purchased more battery storage → *Go to Q10* - None of the above → *Go to Q11*	Single-select list
10	Reason(s) for buying battery	Why did your household purchase battery storage?	Open-text
11	Off-grid intentions	Does your household plan to disconnect from the electricity grid (i.e. go 'off-grid') sometime in the future? Please select one of the seven options below. - No - Yes, in the short-term future (i.e. within 2 years) - Yes, in the medium-term future (i.e. 3-5 years) - Yes, in the long-term future (i.e. more than 5 years) - Don't know - N/A – my home is already off-grid - Skip question *All response options go to final survey question*	Single-select list
Second subset of questions – non-PV owners			
12	Reasons for no solar PV	There are a range of reasons why a home might not have solar panels to generate electricity. Thinking about your household, please tell us why your home doesn't have (or can't have) solar panels.	Open-text
13	Intentions to buying PV	Does your household plan to purchase solar panels sometime in the future, either at your current home or at another future home? - Yes → *Go to Q14* - No → *Go to final question* - Don't know → *Go to final question*	Single-select list

Appendix: Survey questions

#	Variable	Question	Format
14	Reasons for buying PV	Why does your household plan to purchase solar panels?	Open-text
15	Timeframe for buying PV	When does your household plan to purchase solar panels? - In the short-term future (i.e. within 2 years) - In the medium-term future (i.e. 3-5 years) - In the long-term future (i.e. more than 5 years) - Don't know	Single-select list
16	Intentions to buy battery storage	Does your household plan to purchase a battery storage system to connect to the solar panels? - Yes → *Go to Q17* - No → *Go to final question* - Don't know → *Go to final question* - N/A – home already has battery storage → *Go to Q19*	Single-select list
17	Reason(s) for buying battery	Why does your household plan to purchase battery storage?	Open-text
18	Timeframe for buying battery	When does your household plan to purchase battery storage? - In the short-term future (i.e. within 2 years) - In the medium-term future (i.e. 3-5 years) - In the long term-future (i.e. more than 5 years) - Don't know	Single-select list
19	Off-grid intentions	Does your household plan to disconnect from the electricity grid (i.e. go 'off-grid') sometime in the future? Please select one of the six options below. - No - Yes, in the short-term future (i.e. within 2 years) - Yes, in the medium term future (i.e. 3-5 years) - Yes, in the long term future (i.e. more than 5 years) - Don't know - N/A – my home is already off-grid	Single-select list
Closing question – all			
20	Other comments	In terms of your thoughts about solar power and battery storage in Australian homes, is there anything else you would like to tell us before finishing the survey?	Open text

Thank you

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