

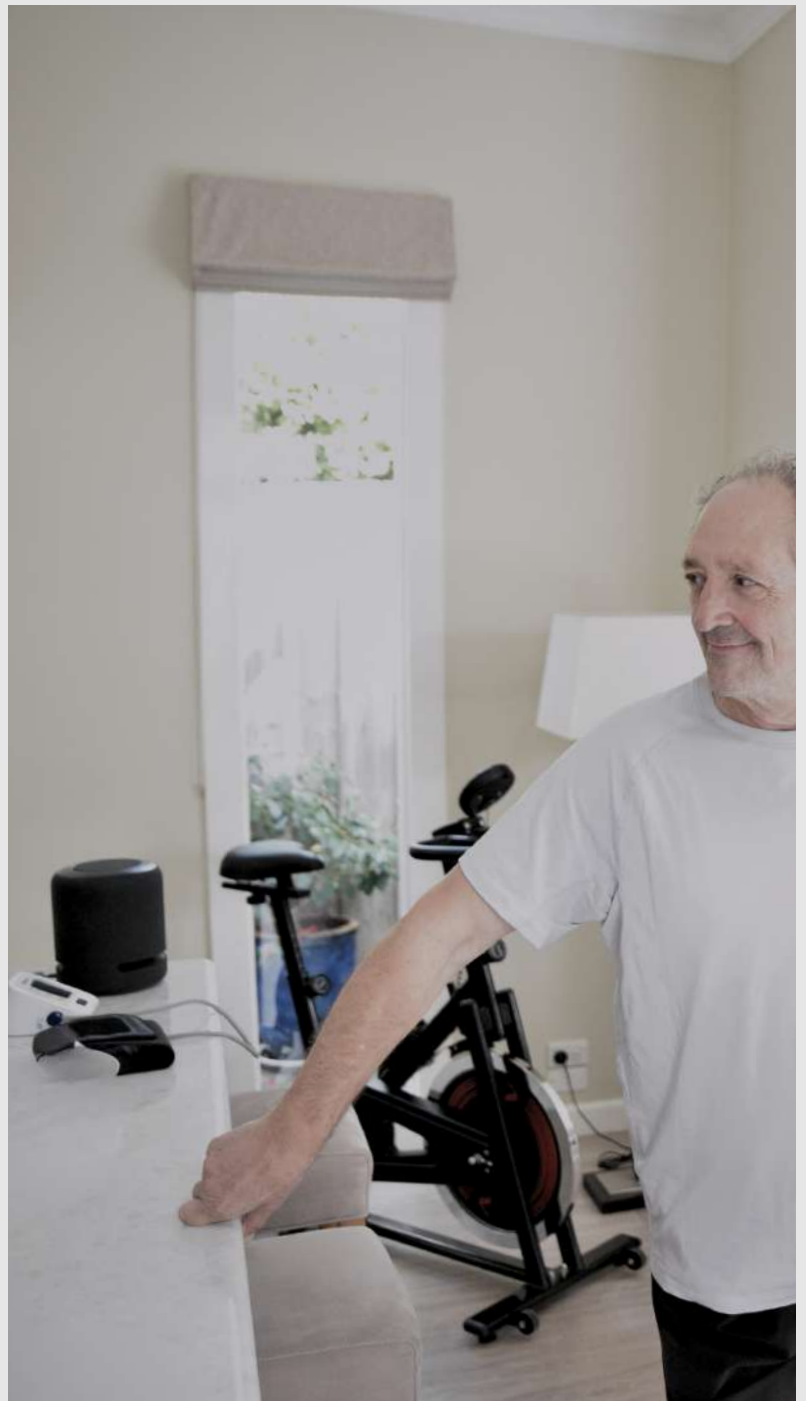
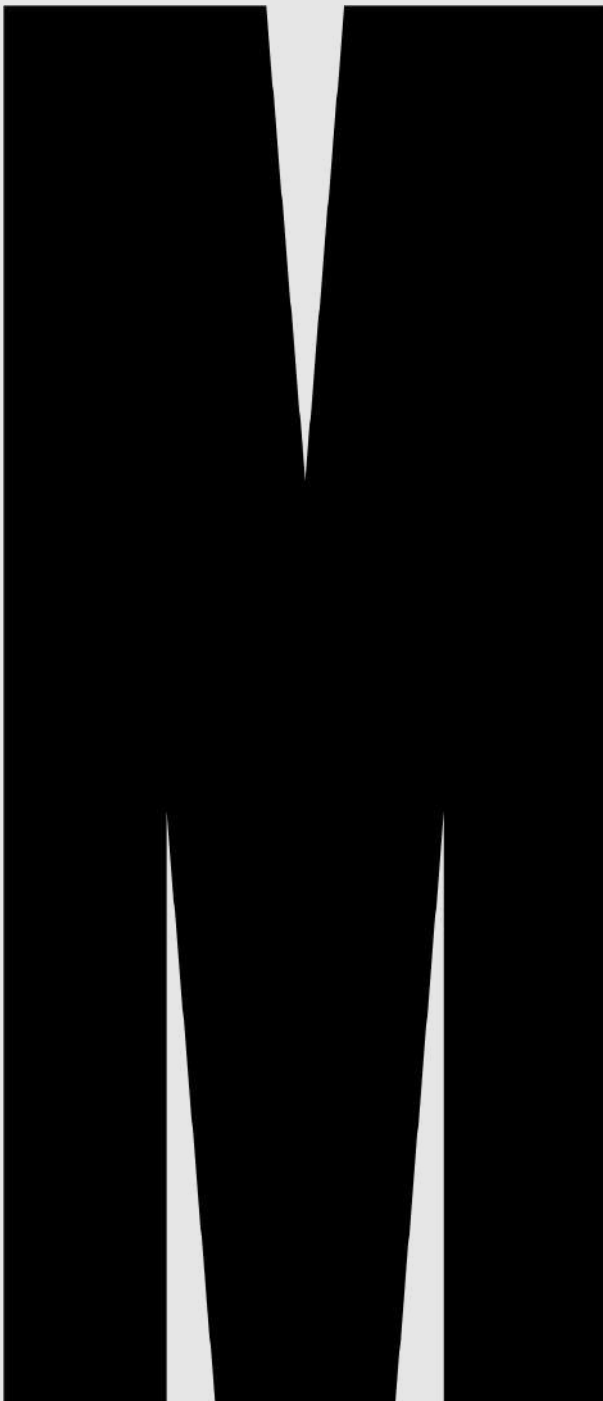
# FUTURE HOME DEMAND:

ANTICIPATING ENERGY  
AND EVERYDAY LIFE  
TRENDS ACROSS THREE  
VICTORIAN NETWORKS

**OCTOBER 2023**

Dr. Kari Dahlgren  
Dr. Hannah Kormeyer  
Dr. Fareed Kaviani  
Dr. Rex Martin  
Professor Yolande Strengers  
Professor Sarah Pink

[monash.edu/mada/emergingtechlab](https://monash.edu/mada/emergingtechlab)  
[monash.edu/digital-energy-futures](https://monash.edu/digital-energy-futures)



# FUTURE HOME DEMAND:

OCTOBER 2023

## Authors

Dr Kari Dahlgren  
Dr Hannah Korsmeyer  
Dr Fareed Kaviani  
Dr Rex Martin  
Professor Yolande Strengers  
Professor Sarah Pink

## Published by

Emerging Technologies Research Lab  
Monash University Caulfield campus  
900 Dandenong Road  
Caulfield East VIC 3145

## Layout and Illustrations

Illustrations by Steve Elliget,  
<https://epicsteve.com/work>  
Layout by Fareed Kaviani

## Photography and participant materials:

All ethnographic photographs and materials were created by the Emerging Technologies Research Lab team or by participants who granted copyright to the research team.  
©Emerging Technologies Lab 2023. Where relevant, other image sources are acknowledged in the report.

## Suggested citation

Dahlgren K, Korsmeyer H, Kaviani F, Martin R, Strengers Y, and Pink S. 2023. Future Home Demand: Anticipating energy and everyday life trends across three Victorian networks. Emerging Technologies Research Lab (Monash University). Melbourne, Australia.

# ANTICIPATING ENERGY AND EVERYDAY LIFE TRENDS ACROSS THREE VICTORIAN NETWORKS

## Acknowledgement of Country

We wish to acknowledge the people of the Kulin Nations, on whose land we work. We pay our respects to their Elders, past and present.

## Funding acknowledgement

The research was funded by CitiPower, United Energy and Powercor in partnership with Monash University. We gratefully acknowledge our partner organisations for their time and contribution.

## Participant acknowledgement

We thank the 36 households who participated in our household research. They kindly opened their homes to us, and shared the details of their lives as well as their hopes and goals for the future. All photos in this report come from our participants' homes and we are grateful for their willingness to share these images with us.

The views expressed herein are those of the authors and are not necessarily those of the project partners.

# CONTENTS

Executive Summary .....	5
Emerging Trends .....	7
Survey Findings .....	12
Implications for Energy and Forecasting: Mobility and Charging .....	14
Demand Management Opportunities .....	15
Future Peak Scenarios .....	18
Foresights for Energy Futures .....	20
Household Values and Values-Based Demand Management Designs .....	22
Values-Based Demand Management Designs .....	24
Glossary of Terms .....	26
Project Background .....	28
Part 2: Research Process and Methodology .....	31
Stage 1: Recruitment Survey .....	33
Stage 2: In-Depth Ethnographic Research with 36 Households .....	35
Process Part 1: Ethnographic Home Tours .....	36
Process Part 2: Futures Design Activity .....	39
Stage 3: Forecasting Workshop .....	43
Stage 4: Household Survey .....	44
Peak Scenario Methodology .....	50
Accounting for Differences between Distribution Businesses and Their Customers .....	51
Use of Participant Data .....	52
Part 3: Emerging Digital and Energy Trends in Everyday Practice .....	53
Mobility and Charging .....	55
Emerging Trends .....	56
Mobility and Charging: Implications for Energy and Forecasting .....	66
Mobility and Charging: Demand Management Opportunities .....	67
Storm Charging Peak .....	68
Caring at Home .....	69
Emerging Trends .....	70
Caring at Home: Implications for Energy and Forecasting .....	75
Caring at Home: Demand Management Opportunities .....	76
Holiday Hosting Peak .....	77
Cooking and Eating .....	78
Emerging Trends .....	79
Cooking and Eating: Implications for Energy and Forecasting .....	84
Cooking and Eating: Demand Management Opportunities .....	85
Major Event Peak .....	86
Smart Home and Automation .....	87
Emerging Trends .....	88
Smart Home and Automation: Implications for Energy and Forecasting .....	94

Smart Home and Automation: Demand Management Opportunities .....	95
Automation Override Peak .....	96
Recreation and Play .....	97
Emerging Trends .....	98
Recreation and Play: Implications for Energy and Forecasting .....	104
Recreation and Play: Demand Management Opportunities .....	105
School Holiday Peak .....	106
Working and Studying at Home.....	107
Emerging Trends .....	108
Working and Studying at Home: Implications for Energy and Forecasting .....	113
Working and Studying at Home: Demand Management Opportunities .....	114
Friday Work From Home Peak .....	115
Healthy Indoor Air and Thermal Comfort.....	116
Emerging Trends .....	117
Healthy Indoor Air and Thermal Comfort: Implications for Energy and Forecasting .....	121
Healthy Indoor Air and Thermal Comfort: Demand Management Opportunities .....	122
Thunderstorm Asthma Peak.....	123
Cleaning, Showering and Laundering.....	124
Emerging Trends.....	125
Cleaning, Showering and Laundering: Implications for Energy and Forecasting.....	128
Cleaning, Showering and Laundering: Demand Management Opportunities .....	129
Bushfire Peak .....	130
Making, Saving, Sharing, Shifting and Storing Energy .....	131
Emerging Trends .....	132
Making, Saving, Sharing, Shifting and Storing Energy: Implications for Energy [...] .....	142
Making, Saving, Sharing, Shifting and Storing Energy: Demand Management [...].....	143
Diversifying Demand Troughs .....	144
Part 4: Foresights for Energy Futures.....	145
Reactions to Future Scenarios .....	146
Solar Smoothing Future.....	147
All-Electric Future.....	150
Afternoon Hot Water Future .....	152
Extreme Weather Future .....	154
Vehicle-to-Grid Future.....	156
Guiding Household Values .....	160
Implications for Demand Management and Forecasting .....	162
Values-Based Demand Management Designs .....	163
Implications for Demand Management and Forecasting .....	173
References .....	174
Appendix: Survey Instrument .....	175

# EXECUTIVE SUMMARY

The Future Home Demand Report presents the findings of a multi-staged research project with 36 households across the three distribution businesses: CitiPower, United Energy and Powercor, as well as a survey with 1,325 responses from their customers.

This research builds on the methodology and process developed through the Digital Energy Futures Project (DEF), a partnership between Monash University, The Australian Research Council, Energy Consumers Australia, Ausgrid and AusNet Services. The research methodology was tailored to capture the most critical and relevant issues to CitiPower, United Energy and Powercor households and their energy futures, as well as draw on background research already conducted as part of DEF.

This report identifies 51 emerging digital energy future trends in everyday household life, and foresights for energy futures which capture the values, concerns and designs of CitiPower, United Energy and Powercor households about emerging digital and energy technologies.

The report also provides implications for energy forecasting, including demand management opportunities, and possible peak scenarios for consideration in energy planning.



#### **CITY AND INNER-SUBURBS**

CitiPower  
Powercor  
United Energy



#### **OUTER SUBURBS**

United Energy  
Powercor



#### **RURAL AREAS**

Powercor



#### **SEACHANGE AND HOLIDAY DESTINATIONS**

United Energy  
Powercor

---

*Icons are used throughout to represent trends and foresights that are particularly relevant for consumer groupings within and between distribution businesses.*

---

# EMERGING TRENDS

Fifty-one emerging digital energy trends were uncovered through in-depth qualitative research with 36 households. The trends are organised across nine practice domains, which represent the major areas in domestic life where energy demand occurs or which are facing significant future change.



01

## Mobility and charging



*Electric vehicles will present new opportunities as well as new challenges for the electricity grid. Understanding how and when people will charge their electric vehicles is crucial for network planning. This research reveals that it is crucial to understand EVs within a larger set of mobility options and challenges, as well as in the context of existing understandings about battery charging, preparing for contingencies and in relation to automation and control.*

**Trend 1:** Electric vehicles are increasingly desirable for a variety of reasons

**Trend 2:** Electric vehicles are increasingly envisioned as part of a mix of transport options



**Trend 3:** Electric vehicle charging continues to take place at home primarily

**Trend 4:** Access to charging facilities will continue to affect EV purchases



**Trend 5:** Maintaining control over charging continues to be a priority over relying on automation



**Trend 6:** Vehicle-to-grid technology is increasingly appealing as a household energy back-up

**Trend 7:** Charging routines and priorities continue to be important and influential

**Trend 8:** Interchangeable batteries are accelerating the electrification of garden and power tools

## Caring at home



*Caring is a central and crucial aspect of household life, and one in which emerging technologies are playing an increasingly important role.*

*Households envision technology continuing to support them in caring for themselves and other members of the household, including pets. Energy used for caring is increasing and inflexible due to its importance for providing health, safety and comfort.*

**Trend 1:** Pets are increasingly seen as family members with their own non-negotiable energy needs

**Trend 2:** Occasional hosting of guests is increasingly important in household decision-making



**Trend 3:** Caring increasingly requires being prepared for unforeseen circumstances



**Trend 4:** Self-care is increasingly important and connected to physical and mental health

**Trend 5:** More at-home care is increasing energy demand and limiting load flexibility

## Cooking and eating



*The gradual electrification of cooking is seeing a growing number of small appliances in kitchens, creating unclear outcomes for future demand. Refrigeration and freezer capacity is also expanding due to household trends around preparing for the unexpected, as well as increasing the lifestyle, recreational and hosting capacities of the home.*

**Trend 1:** Continuing proliferation of small electric cooking devices

**Trend 2:** Household electrification is beginning in the kitchen, but occurring gradually

**Trend 3:** The size and use of fridges and freezers is increasing



## Smarthome and automation



*Interest in smart home technologies is relatively limited, gendered and often viewed as adding unnecessary complexity to the household. Despite the increasing prevalence of digital voice assistants, they are rarely used for broader household automation and many remain sceptical of increasing the automation of their homes. This will limit the role of automation in energy management.*

**Trend 1:** Interest in smart home technology and automation continues to be relatively low overall

**Trend 2:** Smart home technology is continually and creatively adapted to suit the particular needs of each household

**Trend 3:** Smart home technology acceptance and use continues to be highly gendered

**Trend 4:** Smart home and energy management technology is increasingly frustrating when the initial installer is no longer resident in the home

**Trend 5:** Smart home technology is increasing the frustration of electricity outages



**Trend 6:** Automation is increasing household complexity, leading some to reject it

**Trend 7:** Households continue to desire 'final say' and the ability to easily override automation

## Recreation and play



*As a result of the ongoing COVID-19 pandemic and increased cost-of-living pressures, households are spending more time at home. Consequently, there is greater focus on household comfort, as well as investments in home improvements and digital devices that provide further opportunities for entertainment and recreation. This is an anticipated growth area for electricity demand.*

**Trend 1:** Expanding expectations for the home are encouraging increasingly luxurious upgrades (by people's own standards)



**Trend 2:** Multiplication of screens and increasing simultaneous use of devices

**Trend 3:** Gaming is an increasingly common form of entertainment

**Trend 4:** Electric vehicles are increasingly used for recreation

**Trend 5:** Increasing technology-use for exercise at home

06

## Working and studying from home



*The COVID-19 pandemic saw many working and studying from home. People purchased new digital technologies and adapted their homes to accommodate these new working arrangements. Even as lockdowns have ended, many continue working from home in a hybrid manner that typically involves working remotely two to three days per week. Post-lockdown schools have returned to in-person learning. However, more hybrid forms of learning continue, particularly at the tertiary level.*

**Trend 1:** Working from home continues in a hybrid model

**Trend 2:** The home is changing to respond to increased working and studying from home

**Trend 3:** Working and study at home is increasing household computer needs

**Trend 4:** Working from home increasingly facilitates afternoon load shifting

**Trend 5:** The particularities of working from home are increasingly important in generating heating and cooling needs

07

## Healthy indoor air and thermal comfort



*Household comfort is expanding beyond heating and cooling to include a growing interest in managing air quality in the home, including protecting the home and its occupants from bushfire smoke, allergens, mould and unpleasant odours. This means that the management of household air is becoming a household priority linked to health and safety, making it increasingly essential and therefore less flexible.*

**Trend 1:** More rooms and spaces in (and on the edges of) the home are being heated and cooled

**Trend 2:** Increasing concerns about indoor air quality

**Trend 3:** Households increasingly looking to technology such as air purifiers and dehumidifiers to manage air quality

**Trend 4:** Growing interest in improving indoor air quality through both increasing and decreasing natural ventilation

**Trend 5:** Increasing interest in improving indoor air quality through the electrification of gas cooking

**Trend 6:** Increasing interest in improving indoor air quality through electrification of wood fired heating



## Cleaning, showering and laundering



*Maintaining cleanliness is considered essential for household health and well-being. While emerging energy and digital technologies present new possibilities, many households have strong routines and preferences around maintaining cleanliness and hygiene. Therefore these practices may be inflexible and the availability of hot water for such practices is considered necessary.*


**Trend 1:** Showering continues to be embedded in other routines, and is increasingly important for maintaining structure for the day

**Trend 2:** Concerns with air quality are encouraging dryer use

**Trend 3:** Continued mismatch between energy management and household cleaning priorities

**Trend 4:** Inherited cleaning advice continues to affect appliance usage

## Making, saving, sharing, and storing energy



*Households have considerable interest in the opportunities that new energy technologies give them to engage in the transitioning energy system, especially opportunities to contribute to decarbonisation and to resourcefully share solar energy. However, many household activities remain inflexible and some resist the adoption of smart technologies for energy management, preferring instead to maintain more hands-on control.*

**Trend 1:** Interest in smart home technology is a precursor to energy technology interest

**Trend 2:** Households continue to show little knowledge of or engagement with their tariff

**Trend 3:** Solar self-consumption is increasingly appealing to households

**Trend 4:** People increasingly interested in sharing and resourcefully using renewable energy

**Trend 5:** Increasing solar-self consumption is motivated by a desire to be resourceful

**Trend 6:** Responding to demand management is increasingly not motivated by financial incentives alone

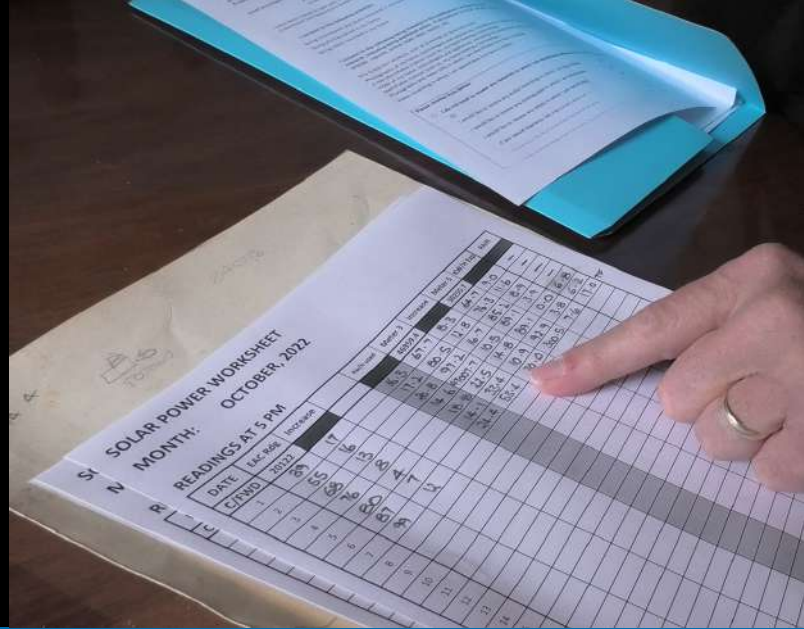
**Trend 7:** Demand management to increase demand is creating greater confusion for households

**Trend 8:** Differential access to CER is accelerating inequitable participation in the energy transition



# SURVEY FINDINGS

In-depth qualitative research with the 36 households informed the development of a survey with 1,325 CitiPower, United Energy and Powercor customers which explored the relevance and impact of emerging trends.



## Charging and mobility

Do you currently have a place where you could (or already) charge an electric vehicle?



■ Yes ■ No ■ Unsure

### CitiPower



### Powercor



### United Energy



3.4% of survey respondents currently have an EV or plug-in hybrid vehicle, but 26.7% of respondents intend to purchase one in the next five years.

77 % of survey respondents with or intending to purchase an EV in the next 5 years (n=399), do or would charge their EV at home, with greater percentages in Powercor and United Energy distribution areas.

Future Home Demand Survey, Question 42.  
All households (n=1325) grouped by provider: Powercor (n=477), CitiPower (n=439), United Energy (n=409). Row % displayed.

## Smarthome and automation

Which of the following ways of using smart appliances would you prefer in your home?



- Happy to be automated provided I can override manually
- Fully manage myself, setting timings / control settings
- I would not use smart appliances
- I am happy with full automation



Only 3% of survey respondents are happy for smart appliances to be fully automated, whereas 46% of respondents wanted the ability to override automated settings, another 31% want to set the timings or control the settings and 20% want no smart appliances.

Future Home Demand Survey, Question 18.  
Baseline: All households (n=1325)

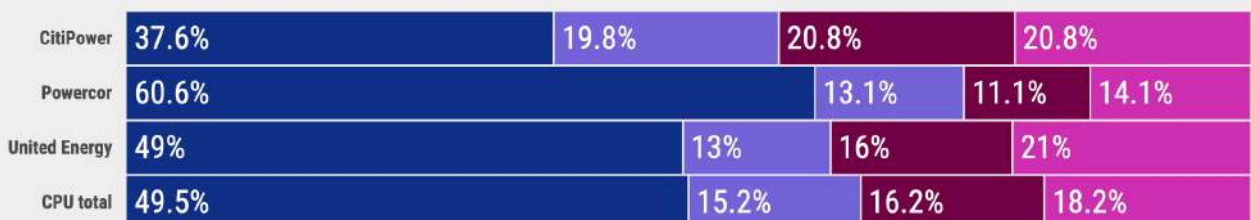
## Working and studying from home

In a usual week, how many days per week is your home occupied by someone 'working from home' (staying home while doing paid work)?



49.5% of all respondents do paid work from home at least one day per week. This is highest in the CitiPower network.

Days: ■ None ■ 1-2 ■ 3-4 ■ 5+ ■ Unsure



Future Home Demand Survey, Question 6.  
All households (n=1325) grouped by provider: Powercor (n=477), CitiPower (n=439), United Energy (n=409). Row % displayed

## Making, saving, sharing, and storing energy

If, during a very hot period, there was such a campaign asking people to reduce their energy use, would you be willing to reduce your energy use?



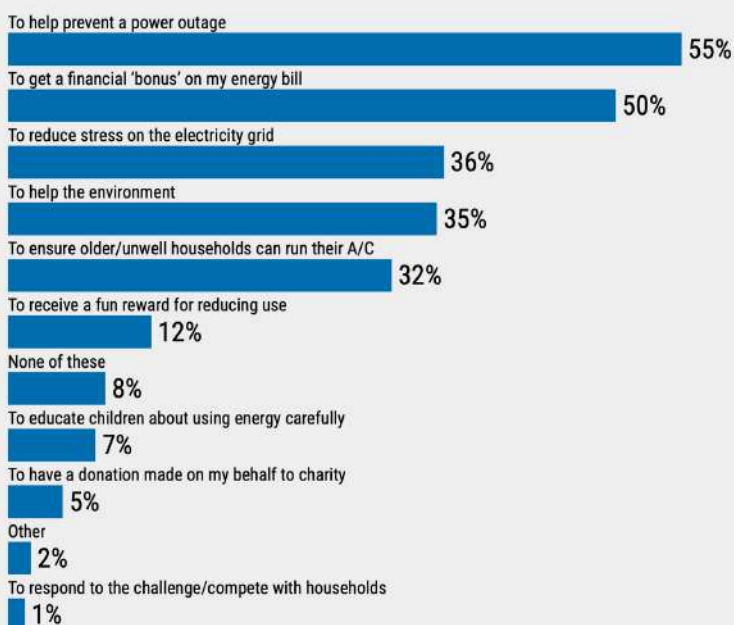
47% of survey respondents said that they would respond to a demand management program to reduce their energy usage *even without a financial incentive*.

■ Yes w/o financial incentive ■ Yes w financial incentive ■ No ■ Unsure



Future Home Demand Survey, Question 16.  
All households (n=1325)

During times of high demand, people said they would reduce their energy for the following reasons:



52.3% of survey respondents ranked "comfort, health and safety" as their first and primary household value, followed by "affordability and cost-effectiveness" (24%) and then "sustainability" (8%).



Future Home Demand Survey, Question 15.

# Implications for Energy and Forecasting


A workshop with CPU forecasters helped to refine the relevance of the research findings to develop the most relevant implications for forecasting. The workshop led to a focus on insights for EVs and charging practices, demand management opportunities and future peak scenarios.


---


*(For energy and forecasting implications of the other eight practice domains, see full report.)*



## Mobility and Charging:



Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Reasons for purchasing an EV reflect varied priorities in relation to charging EVs which will affect charging patterns, acceptance of automated charging and price responsiveness. 

Acceptance of smart charging of EVs may be high, but people will want to maintain the option to override or control settings themselves, which may create peaks such as in advance of public holidays, storms, heatwaves and bushfire risk days, etc. 

While cost savings and using renewable energy are the main preferences for charging EVs, high levels of convenience charging and preferences to keep EV batteries fully charged also exist, and may have significant material impact with higher EV uptake in the near future. 

Rural area households  are likely to maintain an ICE vehicle, even as they begin to adopt EVs. Although facing greater distances required for essential travel, they may be more willing to automate charging due to having the ICE backup. 

The strong preference for at-home charging may lead to particular geographies of EV purchases, in relation to off-street parking access that may run counter to current assumptions about high income areas and EV adoption. There may be lower EV adoption than expected in high income areas without off-street parking in the city and inner suburbs. Further analysis by suburb is recommended to better target local EV uptake projections.  



# Demand Management Opportunities

This research has identified opportunities that exist for engaging or intervening into the emerging trends in each practice domain to better align practices with needs of the electricity grid.

---

## Mobility and Charging:

- Ensure householders understand and are able to maintain control over charging incentives and programs, including those which are automated.
- Target household routines and beliefs around charging existing battery-powered devices (phones, powertools, stick vacuums) as a means of both familiarising households with battery care, and ways of shifting charging in connection with demand and supply peaks. If properly guided, these capacities could aid future demand management of larger batteries, including household batteries or those in EVs.

## Caring at Home:

- Develop initiatives that meaningfully engage with the challenges and realities of caring for people, pets and home, which often depend on consuming energy (e.g. air conditioning).
- Partner with health authorities, community groups and other trusted organisations like the RSPCA to develop and promote initiatives which focus on low-energy or lower peak demand ways of providing care.

## Cooking and Eating:

- The continued popularity of refrigeration for non-perishable beverages (e.g. a beer fridge) offers an opportunity to target demand management messaging at this discretionary and often seasonal load.
- Promote energy efficiency information for the growing range of electric kitchen appliances, and encourage use of appliances with smart or timer delay functions to help consume daytime solar generation and flatten evening peak demand.

### Smart Home and Automation:



- Offer a range of manual and high-tech ways for householders to engage with both the opportunities and challenges presented by automation and smart home technologies.
- Increase householders' acceptance of smart tech or direct load control by better explaining why such interventions are necessary, or through programs that offer cheap or free energy.

### Recreation and Play:



- Energy is an important facilitator of recreation and play, which is increasingly taking place in people's homes and in more energy-intensive ways that often entail further forms of energy consumption, such as heating and cooling. Encourage households to (re)engage with recreation outside the home during peak periods or peak events, including through incentives to visit cinemas, playgrounds, shopping centres or pools.
- Promote 'log out and switch off' messages that encourage recreation and play devices to be switched off or powered down when not in use, beginning by targeting energy-intensive activities or devices including high-end gaming computers, spa baths, home saunas or additional screens.

### Working and Studying at Home:



- The normalisation of working and studying from home offers opportunities to promote self-consumption of solar energy generated during the day. Increased solar self-consumption would provide a benefit both to consumers (through lower energy costs) and energy networks (via reduced needs to upgrade infrastructure).

- Working and studying from home is associated with higher heating and cooling demand, including through daytime occupation of the home's edges (spaces like garages, offices or studios). There is scope to promote lower-consumption forms of comfort while working and studying from home; examples include information campaigns or incentives that support the use of low-energy devices like fans and heated blankets, encouraging improved insulation, or promoting zoned heating and cooling.

### Healthy Indoor Air and Thermal Comfort:



- Promote less-energy intensive heating and cooling by encouraging low-consumption adaptations that heat/cool the person as a first step towards improving comfort, rather than heating/cooling space. Examples could include changing clothing, consuming warming/cooling beverages and food, and using fans or hot water bottles to improve comfort.
- The electrification of services like gas cooking and wood heating offer opportunities to avoid or mitigate associated energy consumption through increased needs for air purification.

### Cleaning, Showering and Laundering:



- Messaging around shifting controlled load hot water to afternoon heating should account for the importance of showering and bathing in relation to other important routines, such as preparing children for bed. In order to maintain the general acceptance of controlled load hot water, communications should use accessible terminology, and directly respond to householders' concerns (such as those around a general lack of hot water or a reduced morning hot water service).



There is also scope to frame hot water as a form of (thermal) storage, thereby illustrating to householders the wider importance of shifting controlled load hot water.

- Worsening air quality, extended periods of poor weather or intensifying standards of cleanliness may contribute to high-consumption forms of washing and drying; messaging could reassert the continued effectiveness of lower-consumption forms of cleaning, such as using a cold wash cycle or hanging clothes up to dry.

#### **Making, Saving, Sharing, Shifting and Storing Energy:**



- Demand management programs need to engage householders beyond financial terms, as people show interest in participating in managing energy for a wide variety of reasons, including out of generosity, from a sense of community, or through a desire to be resourceful.
- The high uptake of CER – which is occurring at the same time as working and studying from home are both being normalised and facilitated by new technologies – represents an opportunity to encourage greater self-consumption of solar power. Promoting the use of self-generated energy need not follow conventional demand management paths into automation or targeted messaging about peak times, but could instead draw on the existing strategies, capacities and desires people draw on to make the most of their solar generation.

# Future Peak Scenarios



The analysis of all research findings identified nine possible emerging peaks with the potential to impact network businesses from 2030 onwards, if demand response opportunities are not implemented.



## Holiday Hosting Peak

During the holiday season, increased convenience charging of EVs alongside high and inflexible energy demand creates localised peaks in areas popular with holidaymakers.



## Storm Charging Peak

Prior to forecasted storms, home batteries and electric vehicles automatically respond to storm warnings to maintain their charge, and households charge up other mobile battery powered devices to prepare in case of a power outage.



## Major Event Peak

Growing expectations for the home and new digital technologies increase the energy needs of entertaining, which create significant demand peaks during major sporting or cultural events.



## Automation Override Peak

Smart home devices with automated settings are increasingly common, however rather than being set to respond to energy signals, the smart devices exacerbate evening peaks by privileging comfort and convenience.



### **School Holiday Peak**

Staying at home with more technology and comfort during winter school holidays creates new peaks on cold overcast days.



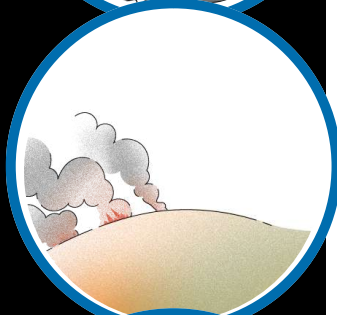
### **Friday Work From Home Peak**

Increased working from home on Friday, alongside EV charging in preparation for the weekend, creates demand peaks on Friday.



### **Thunderstorm Asthma Peak**

Serious health and air quality concerns during asthma thunderstorms encourage closing up the home, running A/C and air purification which coincide with reduced solar production.



### **Bushfire Peak**

Increasingly common bushfires create prolonged smoky conditions, limiting solar production while people stay home and increase their energy use to create safe and healthy air at home.



### **Diversifying demand troughs**

More CER alongside changes in household practices and increasingly efficient appliances increase the frequency and intensity of demand troughs.

# Foresights for Energy Futures

As part of the household research, participants were asked to imagine how their current routines might shift in different future scenarios. These are the key implications for demand management and energy forecasting that come from research participant's reactions to the possible future scenario presented below.



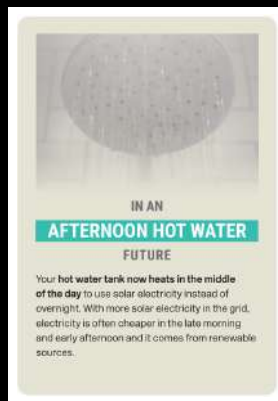
## Solar Smoothing Future

Different demand management programs should offer specific suggestions and guidance and directly target flexible practices such as when to run the dishwasher and do the laundry rather than asking for general load shifting. Messaging can also target the opportunities offered by increased working from home to accomplish these chores in the middle of the day even without smart or automated appliances.

## All Electric Future

Cooking will be increasingly electric in the near future. However, this is likely to be an inflexible practice, and therefore highly likely to add to evening peak demand unless offset by increased efficiency and smaller appliances. Forecasters should prepare for potential increased load from electric cooking. Electric heating is more flexible and likely to be a slower transition, which will first happen in new builds, such as in new estate and high growth areas in outer suburbs.






## Afternoon Hot Water Future

It is crucial that any messaging around shifting the time of heating hot water be carefully explained, and households be informed that any changes would not impact on the availability of hot water for existing showering and bathing routines.

## Extreme Weather Future

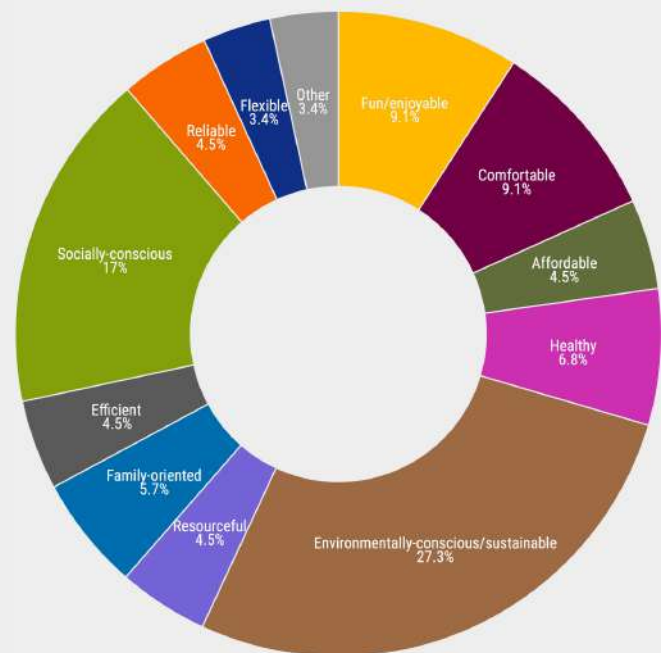
Increasing summer temperatures and extreme weather events may create significant changes to household routines in the future. Energy forecasting should incorporate climate projections into more than supply forecasts and recognise that demand is also likely to be significantly affected by a changing climate.

## Vehicle-to-Grid Future

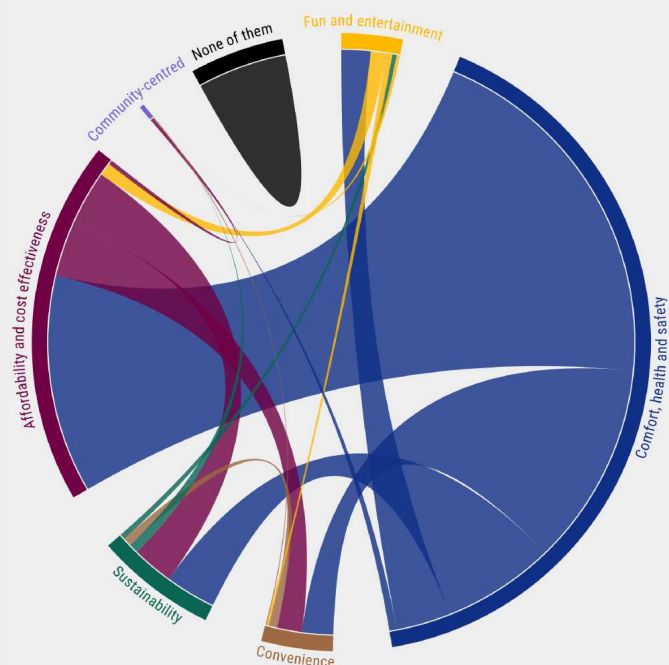
V2G was highly appealing to households, as this technology becomes more widely available it is likely to increase uptake of EVs, including in rural areas where the appeal of the EV as a backup battery is high. This may create unexpected patterns of high EV uptake in rural areas . However, people are hesitant about direct load control of EV charging, even more so as the importance of the vehicle becomes both about mobility as well as the home's back up battery. This is likely to limit the ability of V2G technology to serve energy management objectives of balancing the grid and may create new charging peaks (see Storm Charging Peak).

# Household Values and Values-Based Demand Management Designs

As part of the design activity stage of the research visit, households were asked to choose a few key values that are important to their household. Survey respondents were also asked to rank a set of values in order of importance for their household.



Distribution of household values identified in household research.



Future Home Demand Survey, Question 29.  
All households (n=1325)

Graph representing the flow from survey respondents' first selection to their second.

"Comfort, health and safety" was most respondents' primary household value (52.3%) in survey results, with affordability and cost-effectiveness the second most common primary value (31.7%).







**These findings on key household values and priorities have important implications for demand management and forecasting including:**

- A continuing focus on cost-reflective pricing or financial rewards and penalties will likely undermine demand management potential in CPU's customer base, particularly if economic measures are perceived to compromise comfort, health and safety.
- "Sustainability" and appeals to the environmental benefits of demand management are powerful, but they must similarly account for the importance of values like comfort, health, safety and affordability.
- Values commonly overlap; for example comfort, health and safety are directly linked to a better environment for many, evidenced in the rise of greater concerns about air quality in the context of bushfires and health concerns (see [Healthy Indoor Air and Thermal Comfort Trend 2](#)).
- Comfort, health and safety values also include concerns with community health and safety, as evidenced by survey responses on why people would respond to demand management, which emphasised preventing outages in the community and protecting vulnerable customers (see [Making, Saving, Sharing and Storing Energy Trend 6](#)).
- The prevalence of values around being socially conscious in the household research reflect this complexity, and represent opportunities to frame demand management in ways that appeal to these varied values.

## **Values-Based Demand Management Designs**

With their key values in mind, participants were asked to design demand management programs or technologies using a card game technique. The designed objects and services reflect household desires and aspirations for energy management, ways that energy management can better align with their existing priorities and values, and household desires for future and more diverse engagement with the energy sector.



Participants designed:

### **Appliance-specific, real-time data and notifications**

Some want the option to get real-time feedback on detailed household energy consumption via notifications including which appliances are using the most energy as well as the source of their energy to encourage greater use of renewable energy.

### **Ambient feedback**

Some wanted ambient notifications about their energy (e.g. a chime or glowing lamp placed in the home). This was envisioned to encourage making energy management a shared responsibility with other members of the household (such as children and those less interested in energy management and traditional data), and created a more intuitive way to understand the relationship between household practices and energy consumption.

### **Digital and energy technology integration services**

People sought solutions to the everyday challenges of trying to integrate smart and energy technology, such as services where a knowledgeable person comes to the home to install, educate and help manage technologies and energy efficiency in the house.

### **Advocacy services**

People envisioned advocacy to be a form of service or community initiative that would help them to manage their energy and participate in the transitioning energy system, such as advocacy services which enable renters to access CER.



### **New energy technologies and technology services**

People imagined alternative energy resources like mobile or rentable batteries that would enable more diverse forms of participation, while also avoiding the high upfront costs associated with current CER.

### **Smart devices for remote control**

When participants imagined smart technologies, they were largely intended to increase remote control over appliances, such as via an app. They did not imagine full automation or third party management of devices.

### **Place-based, built environment and renewables initiatives**

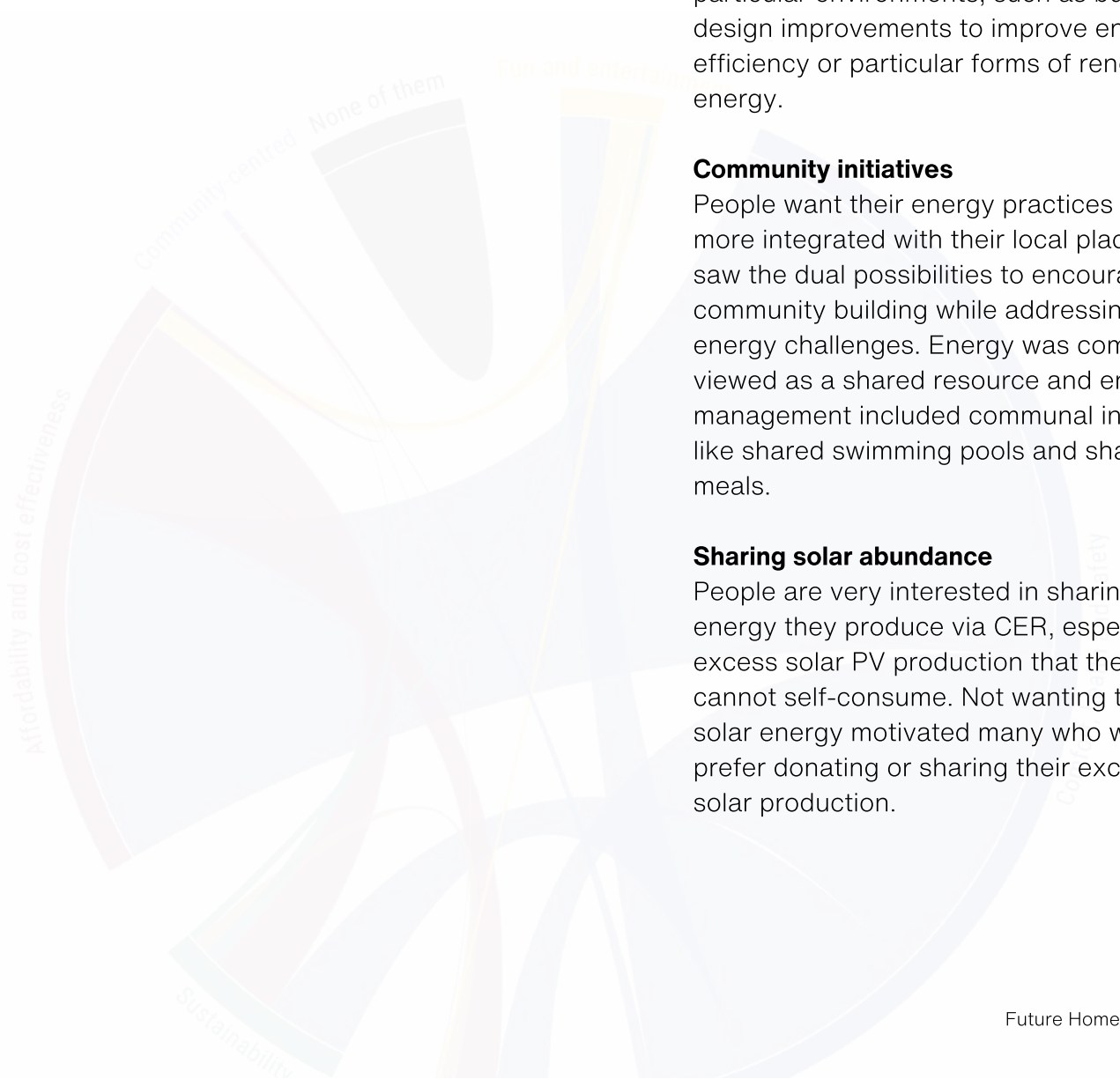
Deep knowledge of place and weather patterns influences what solutions householders design for their homes in particular environments, such as building design improvements to improve energy efficiency or particular forms of renewable energy.

### **Community initiatives**

People want their energy practices to be more integrated with their local place and saw the dual possibilities to encourage community building while addressing energy challenges. Energy was commonly viewed as a shared resource and energy management included communal initiatives like shared swimming pools and shared meals.

### **Sharing solar abundance**

People are very interested in sharing the energy they produce via CER, especially excess solar PV production that they cannot self-consume. Not wanting to waste solar energy motivated many who would prefer donating or sharing their excess solar production.



# **GLOSSARY OF TERMS**

**CALD** – Culturally and linguistically diverse. Participants were categorised as culturally or linguistically diverse if a language other than English is the primary language spoken at home, they are not fully fluent in English, or they were born and lived the majority of their lives in places other than Australia, New Zealand, the UK and North America.

**CER** – Consumer energy resources. A term used to refer to energy technologies that consumers add to their lives, such as solar PV panels, home batteries and electric vehicles.

**CPU** – CitiPower, Powercor and United Energy.

**Digital voice assistant** – A device or operating system which responds to voice commands and can perform tasks, often embedded into smart speakers or phones (e.g. Amazon Alexa, Apple's Siri and Google Home).

**Demand management program** – Programs that seek to alter consumers' energy demand and/or usage (e.g. battery storage and discharge) during specific time periods to manage peak electricity demand or to support grid stability, efficiency and/or sustainability of the energy system.

**Electric vehicle (EV)** – Any vehicle, usually an automobile, that uses an electric motor for propulsion (including plug-in hybrids).

**Forecasting** – To predict or anticipate the most likely/probable future or trend and estimate their uncertainties.

**Foresights** – Knowledge developed about the future.

**Futures** – The plurality of possible and imagined future worlds or the plurality within any given future.

**Load profile** – A graphic display of energy demand (and local generation) over time.

**Load shifting/ smoothing** – A load management technique involving moving electricity demand from one time period to another, including to reduce peak demand, access lower energy prices or use available renewable electricity.

**Off the grid** – Disconnection from, or lack of, mains electricity services in favour of on-site energy generation and provisioning (may also be used in reference to other utilities).

**Peak electricity demand** – The period in which the overall amount of electricity used is at its highest. May refer to daily, seasonal, critical or annual peaks.

**Peak event/demand response event** – Periods when electricity demand is projected to be particularly high, usually in response to extreme weather. Some energy retailers or distributors offer incentives to customers to reduce their energy demand during these times.

**Solar peak** – The period during which electricity generated from a solar system is at its greatest, typically from late morning to early afternoon.

**Smart** – Infrastructure or appliances that are automated and/or connected to the internet that generate and communicate data. Also known as the Internet of Things.

**Solar smoothing** – Any technique that mitigates the intermittencies and power fluctuations of solar energy.

**Tariff** – The rate (price) at which the electrical energy is sold to a consumer.

**Time-of-Use (tariff) (ToU)** – An electricity tariff that charges different rates for electricity use at different times of the day. In Australia ToU refers to a three-part daily tariff (peak, off-peak and shoulder).

**Vehicle to Grid (V2G)** – Technology that allows the electricity stored in an electric vehicle battery to be discharged to the grid.

# PROJECT BACKGROUND



**Guided by long-standing social science research which has emphasised that energy is meaningful to people through the everyday practices which it makes possible, the Future Home Demand project focuses on household life and everyday practices to guide understandings of possible and plausible futures.**

Foresights and trends were identified through in-depth research with 36 households using ethnographic and futures design research methods. These trends and foresights were then surveyed with a sample of 1,325 CPU customers. CPU is used throughout this report to refer to all three businesses: CitiPower, Powercor and United Energy. The evidence from both stages of the research were used to inform implications for energy forecasting.

The Future Home Demand report presents the findings of a multi-stage research project with 36 households across the three distribution businesses: CitiPower, United Energy and Powercor, as well as a survey with 1,325 respondents from customers of the three businesses (CitiPower n=439; Powercor n=477; United Energy n=409).

This report identifies 51 emerging digital energy trends in everyday household life, and future foresights which capture the values, hopes and concerns around emerging digital and energy technologies. These are used to generate critical implications for energy forecasting.

This research builds on the methodology and process developed through the Digital Energy Futures Project, a partnership between Monash, The Australian Research Council, Energy Consumers Australia, Ausgrid and AusNet Services.

Emerging household trends are organised by nine domains of everyday practice where most energy demand takes place, where significant demand management opportunities exist and where significant changes are emerging.

**The remainder of this report is structured into three additional sections:**

**Part 2** presents the research methodology and detailed information about the research participants.

**Part 3** presents the emerging digital energy future trends organised across nine everyday practice domains. Each everyday practice domain describes the trends evidenced with participant quotes, case studies and survey results, as well as implications for energy and forecasting, including potential future peaks and demand management opportunities.

**Part 4** presents the foresights for energy futures deriving from the futures focused activities conducted with households, including their reactions to future scenarios, guiding household values and values-based demand management designs.



01

**Mobility and charging**



02

**Caring at home**



03

**Cooking and eating**



04

**Smarthome and automation**



05

**Recreation and play**



06

**Working and studying from home**



07

**Healthy indoor air and thermal comfort**



08

**Cleaning, showering and laundering**



09

**Making, saving, sharing, and storing energy**

# **PART 2: RESEARCH PROCESS AND METHODOLOGY**

*The Future Home Demand Project adopted an innovative methodology, successfully utilised in the Digital Energy Futures Project, to conduct research with customers of CitiPower, United Energy and Powercor.*

The Future Home Demand Project directly builds on the methodology and process developed through the Digital Energy Futures Project, a partnership between Monash, The Australian Research Council, Energy Consumers Australia, Ausgrid and AusNet Services. This world-first project used in-depth knowledge of Australian households' everyday lives and their future visions for energy and digital technology to inform energy forecasting.

A tailored version of the Digital Energy Futures (DEF) research was conducted with customers of the CitiPower, United Energy and Powercor distribution networks. This project also draws on background research already conducted as part of DEF, such as mapping of mainstream industry visions, assumptions and scenarios for the future, and demand management opportunities. For more on this background, see the five DEF reports and video archive available at: <https://www.monash.edu/digital-energy-futures>.

The Future Home Demand research project was approved by the Monash University Human Research Ethics Committee.

### **The Future Home Demand Research was conducted in four stages:**

**Stage 1:** Recruitment survey (from 667 customers)

**Stage 2:** In-depth ethnographic research (with 36 households)

**Stage 3:** Forecasting workshop (with four CPU forecasters)

**Stage 4:** Household survey (from 1,325 customers)



# Stage 1: Recruitment Survey

The research team designed a household recruitment survey which included questions about respondents' appliances, energy bills and tariffs, energy and digital technologies, lifestyle, occupation and demographic details. The recruitment survey was sent to 66,000 Powercor customers, 25,000 CitiPower customers and 85,000 United Energy customers in early 2022. Responses were received from 498 CitiPower customers, 493 Powercor customers and 539 United Energy customers. Around 43-45% of respondents (per distributor) agreed to pass their details on to the Monash University research team and to be contacted about further research activities, totaling 667 responses (222 CitiPower customers, 210 Powercor customers and 235 United Energy customers).

A number of key selection criteria were agreed upon between Monash and CPU to ensure a diverse representation of customers, including across income, gender, cultural and linguistic diversity (CALD), geography, household type and digital and energy technology ownership.

Participants were also selected across each distribution area, to reflect the respective population of each distribution area. In total, the research included 12 United Energy customer households, 14 Powercor customer households and 10 CitiPower customer households.

Selected participants were contacted by the Monash team. Where participants declined to participate, a replacement that matched their criteria as closely as possible was contacted. This iterative process resulted in a diverse participant pool totalling 36 households, with 41 people actively participating in the research. The following page details the research participant demographics.



# 36 Households

# 10

CITIPower

# 14

PowerCor

# 12

United Energy

Gender within households



# 9

CALD

HOUSEHOLDS

# 4

BATTERY STORAGE



# 4

ELECTRIC VEHICLES

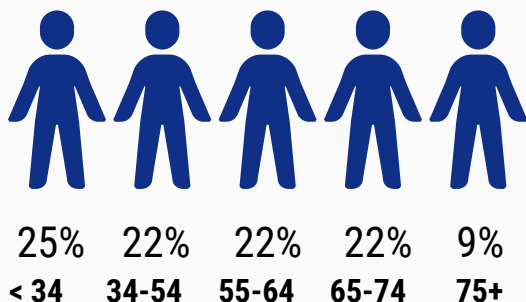


# 19

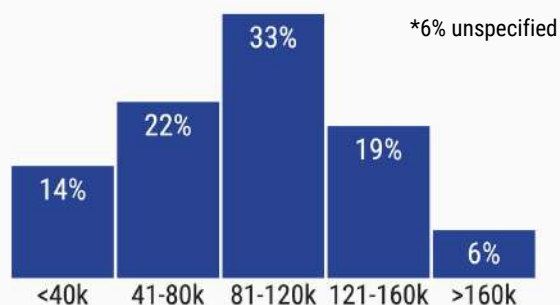
ROOFTOP SOLAR



Age groups



Income range



5 x No-tech

19 x Low-tech

12 x Digi-tech

7 x Energy-tech

# Stage 2: In-Depth Ethnographic Research with 36 Households

## Overview

A mix of online and in-person ethnographic research was conducted with 36 households across CPU customers.

Eighteen visits were conducted online via Zoom, due to participant preferences and concerns about health through the ongoing Covid-19 pandemic. The other 18 visits were conducted in person with up to two researchers visiting participants in their homes.

Each research visit lasted from two to three hours and was conducted in two parts: ethnographic home tour, and an ethnographic design activity. (One household participated in two shorter in-person visits).







---

## Process Part 1: Ethnographic Home Tours

After introductions, the research team explained the research to participants and obtained their consent. Participants then walked the research team through their daily routine within the spaces of their home. Participants were asked to show and recreate their usual routines, from when they wake up in the morning, to when they leave the house, return home from work (if they work away from home), to when they go to sleep. Researchers asked participants to focus on a typical weekday, while asking how routines might also differ on weekends.

Home tours were guided by household routines in order to understand the timing of energy use, as well as to probe the possibilities for load shifting. However, the researchers also asked about deviations to the usual routine, including why and when these occurred.

If there were spaces of the home that the researchers did not encounter during the home tour – such as a rarely-used shed or garage – they also asked participants to show these areas, or enquired about when and how such spaces are used.

If multiple family members were present, the researchers attempted to understand when and how these routines came together in the same spaces. If ethnographic home tours only included one participant, the researchers asked about the routines and practices of others in the home.

Throughout the ethnographic home tour, researchers asked follow up questions in relation to the activities and technologies present in the home.



The research team followed a similar methodology when the research was conducted online. Participants used a mobile device with a camera to walk the researchers through their home while recounting their routines and practices.

These home tours and discussions took approximately one and a half hours to complete, as the researchers asked detailed questions in relation to the nine practice domains that guided the research visit.

## Purpose

The purpose of the household tour and in depth ethnographic research with households was to:

- Generate knowledge about household routines and practices in context
- Uncover emerging trends that are currently overlooked
- Enable deep engagement with participants to gather insights on difficult or complex concepts like trust or control

- Understand households' anxieties and hopes for the future within the context of their everyday lives
- Gather insights into probable and realistic futures

## Analysis

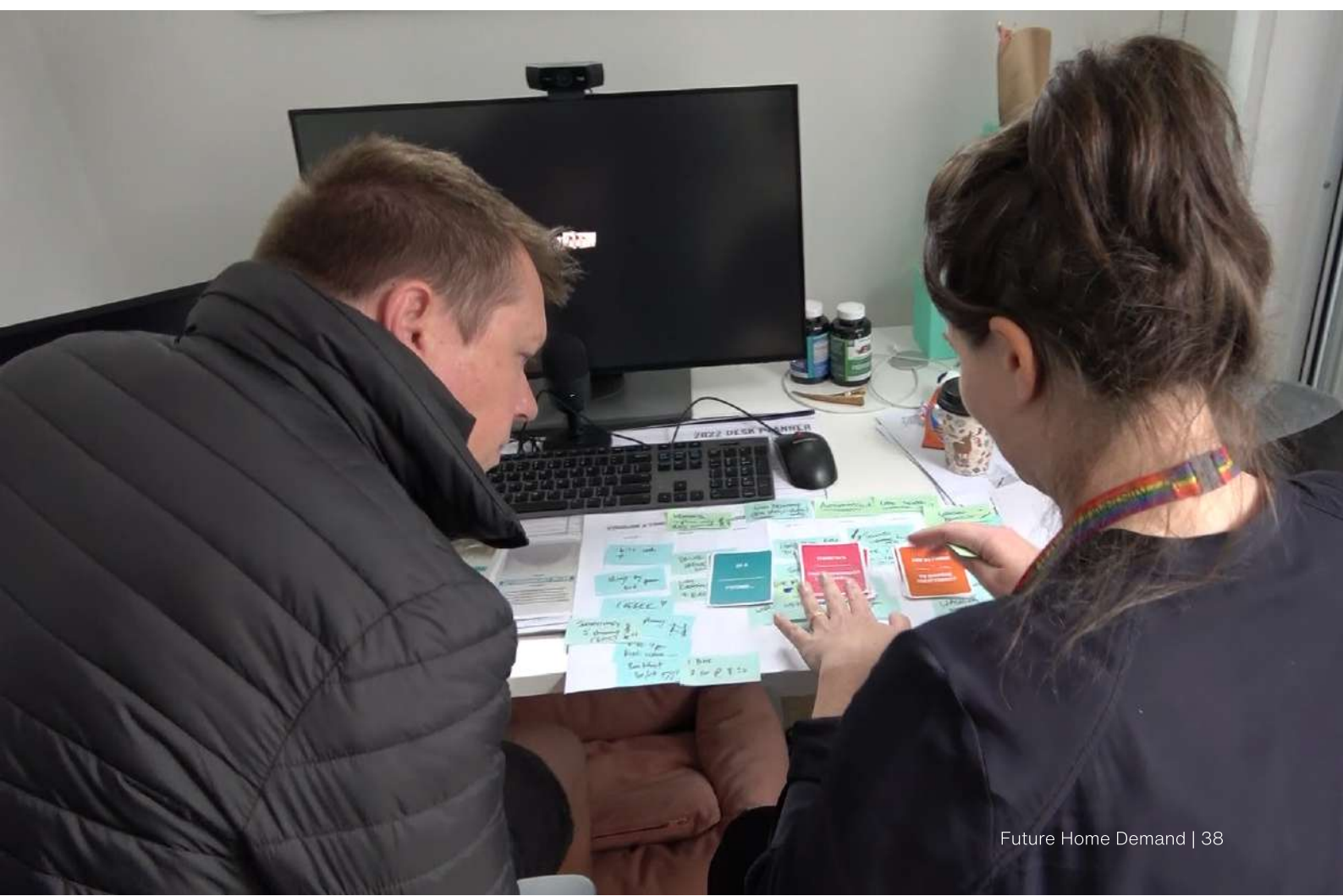
All household ethnographic research visits were audio and video recorded with the consent of participants. The audio recordings were sent to an external firm, Outscribe, for transcription. The research team then uploaded the transcripts to Nvivo qualitative research analysis software and coded them into an established coding structure organised by everyday practice domain. The coding structure was derivative of the coding structure developed and tested through previous DEF research. Once coded, transcripts were organised across each practice domain, which allowed for qualitative analysis to identify trends across the research sample.

Transcripts were classified by distribution business, age group, cultural and linguistic diversity (CALD), gender, household income and level of digital and energy technology ownership. These classifications allowed for analysing identified trends across such demographics.

## Outcomes

The analysis of the ethnographic home tours and discussions identified:

- 51 emerging trends across nine everyday practice domains
- Implications for energy and forecasting ranked via their likely material impact, with red representing high impact, orange representing medium impact, and green representing low impact
- Demand management opportunities for each practice domain





## Process Part 2: Futures Design Activity



Five future scenario cards used in routine and load shifting research activity

### A) Routine and Load Shifting Activity

After walking through present-day household routines, participants were asked to map their routines onto a daily timeline. This allowed the researchers to capture anything missed in the home tour, and create an organised current routine to assist participants in thinking through how their activities might change in the future.

Research participants were then presented with one of five future scenario cards.

The future scenarios were designed in consultation with CPU to represent priority areas and plausible futures of relevance to the businesses' planning and forecasting, and drew on the team's previous research in the DEF project.

Households were presented with one or multiple scenarios if time allowed, and were asked how their routines and energy consumption might shift in response to future scenarios.

The scenarios that were presented to households are shown above. These scenarios were discussed with the household. Participants were asked how their current routines would shift in relation to these future scenarios, and to adjust their daily timeline in response.

### B) Values and Demand Management Design Activity

Participants were asked to identify important guiding values for their household and to fill out future household value cards where they wrote these values down.

Participants then engaged in a bespoke imagination game, based on an established design futures method (Candy, 2018). In this game, participants were asked to choose cards from three separate decks, which combined to form a statement about a possible future:

*“In a \_\_\_\_ future, there is a \_\_\_, that households like yours use to manage their energy between \_\_\_ and \_\_\_\_.”*  
*Participants used their personal values and drew cards to fill in the blanks, for example: ‘In a [healthy] future, there is a [technology], that households like your use between [9am - 12pm] to manage their energy.’)*



“In a [ **\_personal value\_** ] future...”

Participants filled in the first blank of the statement using their personal values and then drew random options for the second and third from a provided set of prompts.

“...there is a(n) [ **\_design prompt\_** ] that households like yours...”

The card options for the second blank included: service, device/technology, habit, building upgrade, incentive, community initiative, family tradition and object.

“...use between [ **\_time of day\_** ] to manage their energy.”

And the card options for the third card included various times of the day, such as 9am-12pm or 3pm-6pm.



The cards were used as conversation prompts to generate ideas about possible futures, and to discuss the strengths and weaknesses of the different possibilities and how people felt about each speculation.

The research participants were also asked to describe or draw their design ideas to ground their thinking in everyday life at home.

When conducted in person, this activity was done on paper with physical cards, pens and sticky notes. For online participants, this activity was conducted using the online collaborative tool Miro.

This futures design activity took approximately one to one and a half hours to complete for most participants.

## Purpose

The purpose of the futures design activity was to:

- Clarify and enable co-analysis of the data collected during the ethnographic home tours about present-day household routines with participants
- Introduce and explore relevant future scenarios with participants
- Understand how these scenarios might shape their everyday lives and household activities in the future (focusing in particular on the implications for load shifting)
- Allow for the co-design of demand management opportunities with households
- Reveal the importance of household values and priorities in imagining and creating plausible energy futures

## Analysis

All household ethnographic design activities were audio and video recorded with consent of participants. Alongside their transcripts from the household tours, the audio recordings were sent to an external firm, Outscribe, for transcription. The research team then uploaded the transcripts to Nvivo qualitative research analysis software and coded them into the established coding structure, which organised participant responses for analysis.

In particular the routine and load shifting activity transcripts were coded by each of the five future scenario cards they were responding to, and then the values and demand management design activity were coded into a separate node.

For each of the future scenario cards, participants' responses were organised to reveal which of their current everyday practices would shift, which current practices would not shift, how participants felt about each scenario, and the level of personal impact each scenario was expected to create for different households.

Participants' design ideas were organised by 'design cluster' (recurring ideas and significant themes), then by the underlying function and purpose that the speculative ideas enabled for households (e.g. helping households with understanding, storing, integrating, saving, making and/or shifting, energy), and by the type and focus of the design idea (e.g. technology, systems, place and/or practices). See the categories of participants' design ideas on the following page.

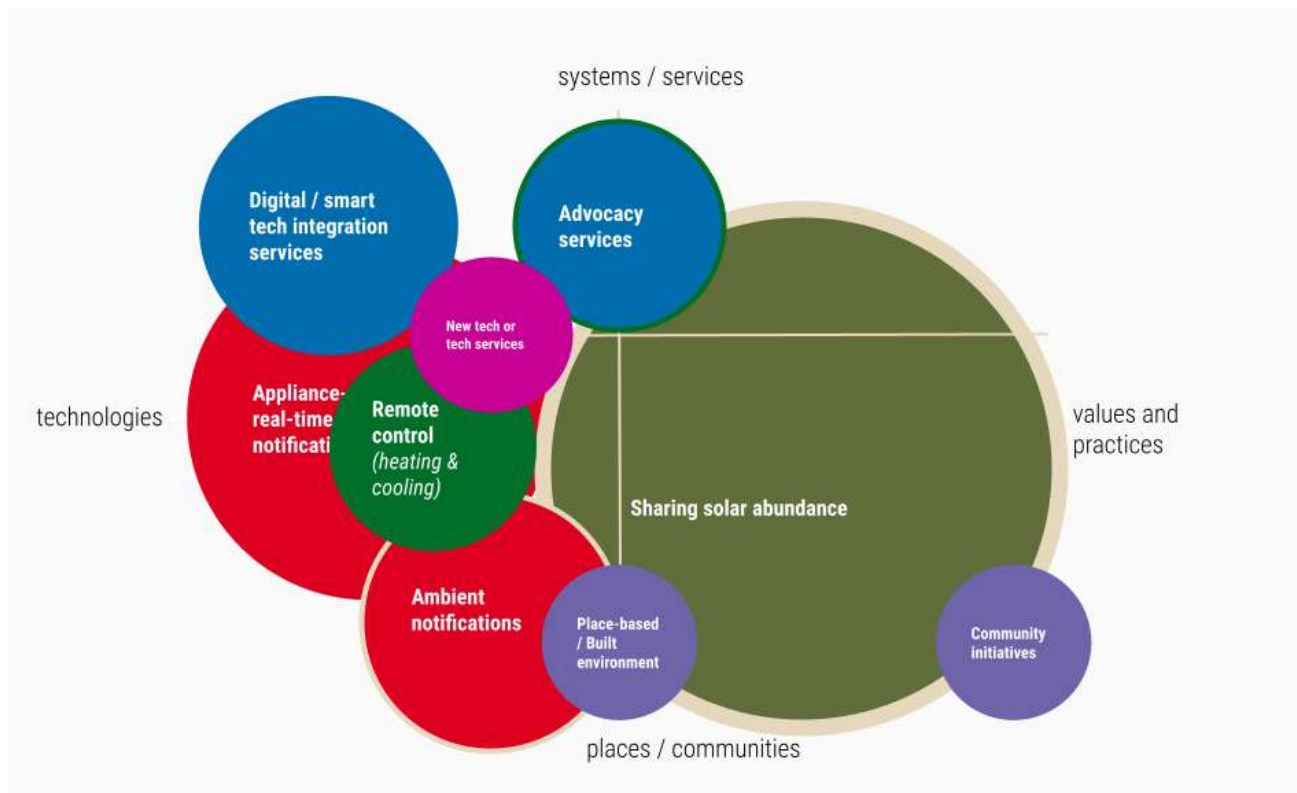
This allowed broader insight into what households anticipate to be their most important future energy needs and the kinds of changes that they expect—or would want—to unfold in the future grid to support their values and everyday lives. When designs had an important visual element, we looked through the video recordings to reference the visual creations of households.

## Outcomes

The outcomes of the analysis of the ethnographic design activities are presented in part four of this report including:

- Reactions to the five future scenario cards and their implications for demand management and forecasting
- Key household values and their implications for demand management and forecasting
- Participant values-based demand management designs and their implications for demand management and forecasting

Categories of participants' design ideas



# Stage 3: Forecasting Workshop

## Overview

After presenting preliminary results from household research, the Monash team met with four forecasters from CPU to exchange knowledge on current forecasting approaches used in the businesses, and to workshop opportunities for how the research Monash had done can be of use to their forecasting and consumer engagement.

## Purpose

The workshop helped to identify the key priorities and unknowns for CPU forecasters that Monash's household data could inform. It was agreed that the priority areas of interest were:

- Electric vehicles and insights on charging practices
- Demand response and customer motivations for load shifting, including insights on acceptance of automation
- Possible peak scenarios related to household actions and priorities.

## Process

The research team met with four people involved in the forecasting process in the CPU offices. The forecasters first presented their forecasting process to the Monash team. After clarifying questions, the Monash team briefly shared the kind of knowledge their research method generated for those unfamiliar with the project.

This knowledge exchange was followed by a workshop that was guided by the following questions:

- What is expected of CPU to facilitate Net Zero by 2045?
- What are the most important unknowns for the future?
- What current data or assumptions are relied on currently to inform projections around those unknowns?
- What insights and data can Monash's household research offer to improve current projections?
- How can the data with households be presented to maximise its usability in CPU's forecasting process?

After working in two groups, discussing and collecting answers to these questions, the workshop participants reunited, discussed and shared the workshop outcomes.

## Outcomes

In response to the identified priorities, this report includes:

- In-depth analysis of electric vehicles and charging practices, including insights on the acceptance of automated charging ([see Mobility and Charging practice domain](#))
- Implications for energy and forecasting throughout the report and ranked via their likely material impact
- Demand management opportunities throughout the report
- Nine future peak scenarios

# Stage 4: Household Survey

## Overview

Initial analysis of household data identified emerging trends of potential relevance for energy forecasting. These insights were used to design a survey, which was completed by 1,325 CPU customers.

## Purpose

The purpose of the survey was to:

- Test broader relevance of trends identified in in-depth household research
- Quantify trends, values and priorities of households
- Enable comparison and cross analysis of trends by demographic or place-based factors

## Process

The survey was designed by the Monash team and administered by Quantum, an independent market research company. Quantum complies with the Australian Privacy Act 1988 and The Research Society's Code of Professional Behaviour. The recruitment process began with 31,343 emails sent to a customer list provided by CPU. The sample was washed against Quantum's internal 'do not contact' list. Each email contained a unique survey link. Of the emails, 952 bounced; 17,982 respondents opened the email and of these 2,350 clicked through to the survey, 980 started the survey but did not complete it.

Four were disqualified (one because they indicated they were under 18 or did not consent to participate, and three because they had identical IP addresses and demographics so appeared to be coming from the same person).

A total of 1,325 completed responses were used in the analysis. The completion rate from the original mail out (only including valid emails, 30,391) was 4.5%, which is typical for this type of survey to customer lists. The survey ran from 31 March to 17 April, 2023. One reminder email was sent to those who had not yet completed the survey.

To improve the response rate, all participants who completed the online survey went into a draw for the chance to win one of three eGiftPay gift cards ([www.giftpay.com.au](http://www.giftpay.com.au)), valued at \$500 (first prize), \$300 (second prize) and \$200 (third prize). Quantum stored the personal details collected for the draw separately to the survey responses, and deleted those details once all prizes were claimed. Participants were eligible to participate in the survey if they were aged 18 years and older and were current customers of one provider (CPU). Participants took approximately 20 minutes to complete the online survey (full survey is attached in [Appendix A](#)). The results were cleaned, coded and de-identified prior to Monash University's retrieval of the data.

## Demographic characteristics

Survey respondents represented a broad range of demographic characteristics as shown on the following page.

# 1325

Respondents

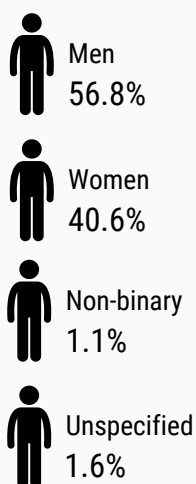
**33%**  
(n=439)  
**CITIPOWER**

**36%**  
(n=477)  
**POWERCOR**

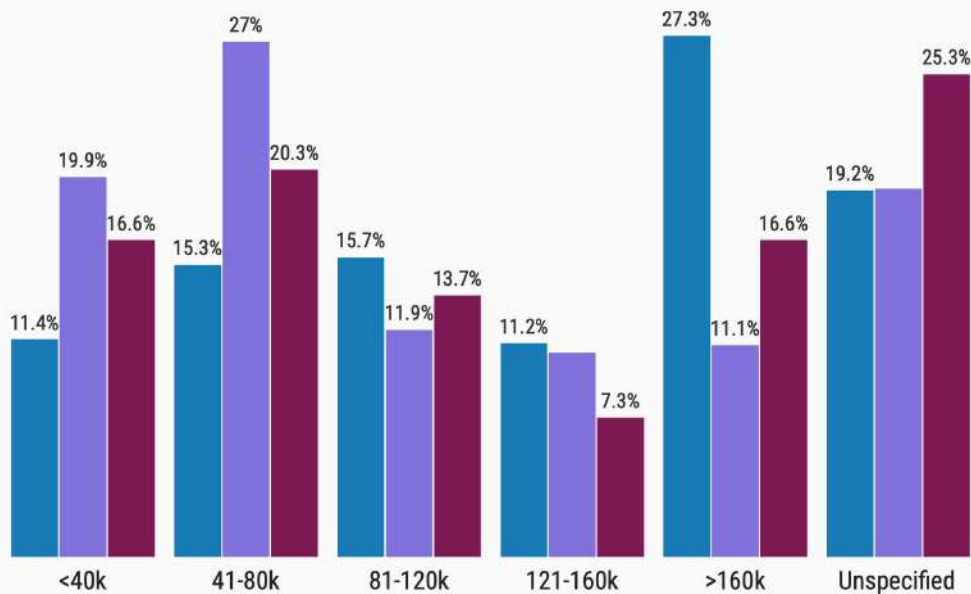
**31%**  
(n=409)  
**UNITED ENERGY**

## 93%

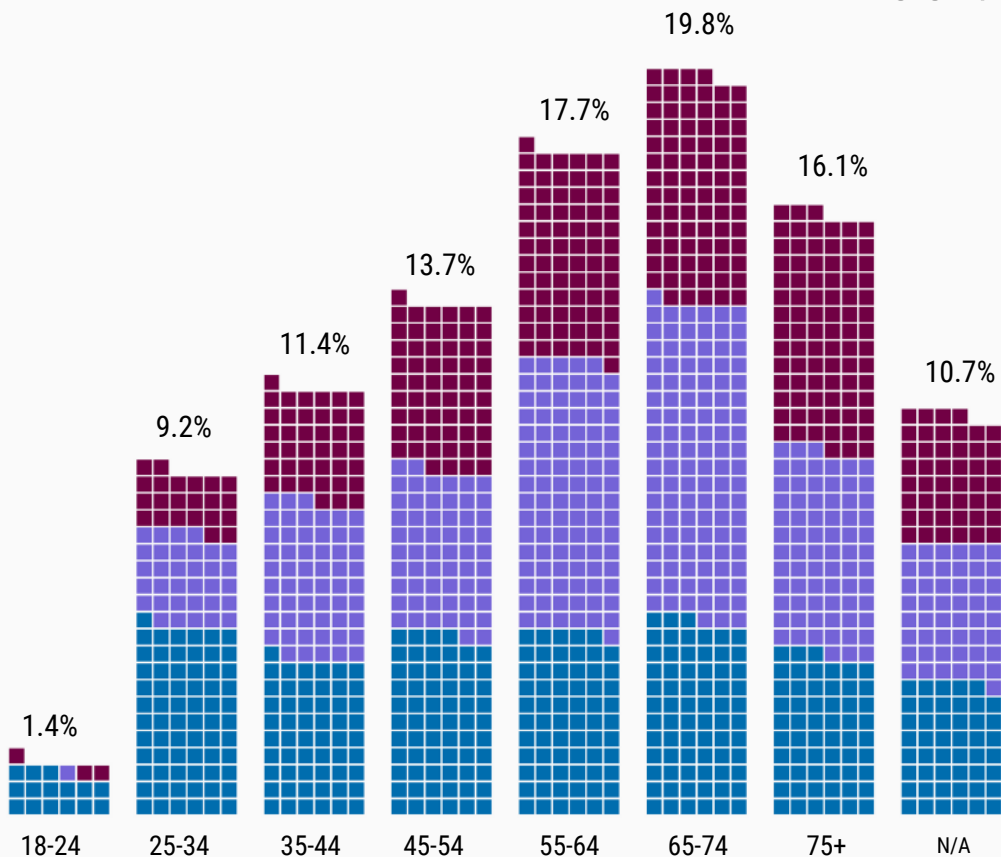
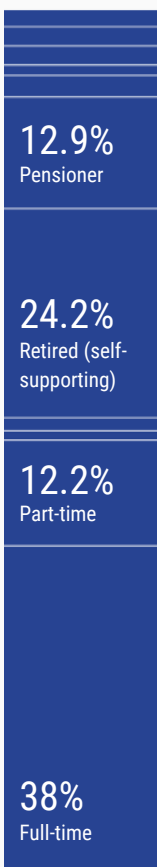
ENGLISH SPEAKING



Income (% within provider)



Age groups



The survey reached a significant number of people experiencing energy hardship (15.7%). Energy hardship was defined as having experienced at least one of the following in the last 12 months:

- Sought financial assistance from community/welfare organisation
- Did not have enough money to pay electricity bill on time
- Sought assistance from friends or family to pay electricity bill
- Could not pay for other important things, (e.g. food, other bills, rent or mortgage)
- Could not afford to use heating when I/we needed it
- Had electricity disconnected due to lack of money to pay
- Was at risk of electricity being disconnected
- Pawned or sold something to pay bills
- Been on a 'hardship' program because of unpaid electricity bills

## Representativeness of Survey Respondents

Survey results were compared with the Australian Bureau of Statistics' (ABS) state level data. The ABS data are not specific to the distribution businesses. However, they offer points of comparison to assess the representativeness of the survey in relation to Victoria's population, as well as indicate segments of possible over and under representation.

The following page provides a detailed comparison of survey respondent demographics against ABS data for the state of Victoria. Some general observations are as follows:

**Age:** Survey respondents had a higher median age (60 years-of-age) than the Victorian population (38 years-of-age), due to the high number of retired / older aged respondents.

**Gender:** Survey sample had a slightly higher representation of men (56.8%) than the Victorian population (49.2%).

**Income:** Survey respondents' income distribution is comparable, with slightly lower numbers identifying as middle income earners (those making approximately \$80-120,000). Fewer respondents disclosed their income details compared to the Victorian ABS data. \*note the different distribution categories in ABS data.

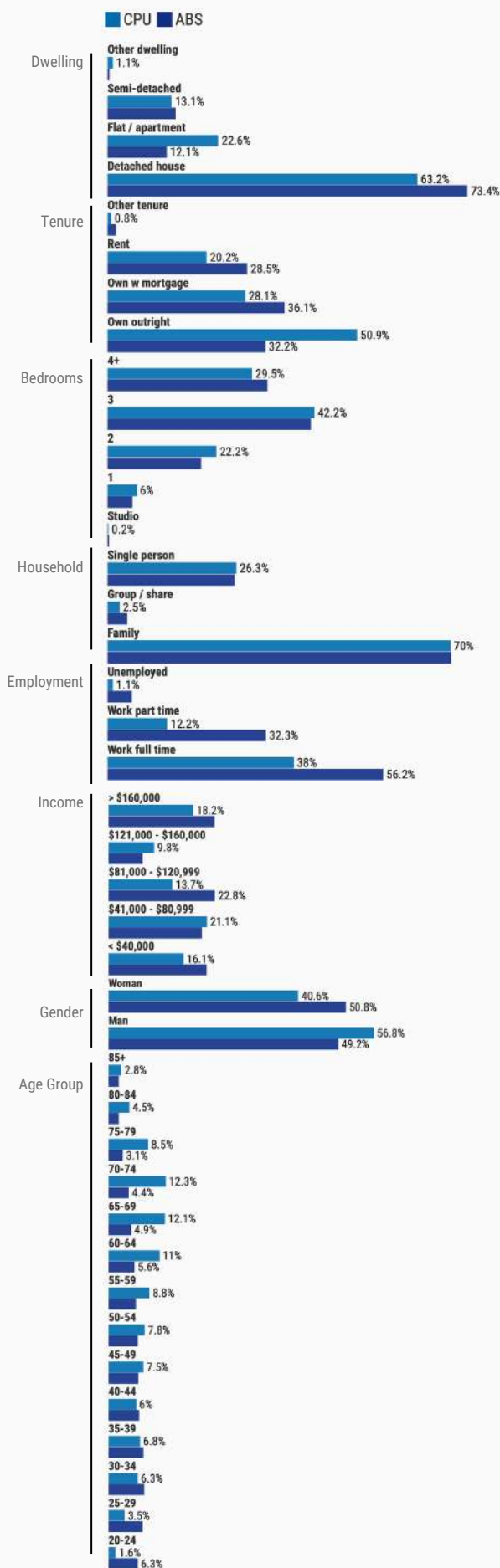
**Household composition:** Survey sample closely reflected the composition of Victorian households.

**Dwelling type:** Survey sample reflected Victorian dwellings, although it is more representative of flat/apartment dwellers, likely related to the prevalence of apartment dwellers within CitiPower's distribution area.

**Bedrooms:** Survey sample closely reflected household bedroom numbers of the Victorian population.

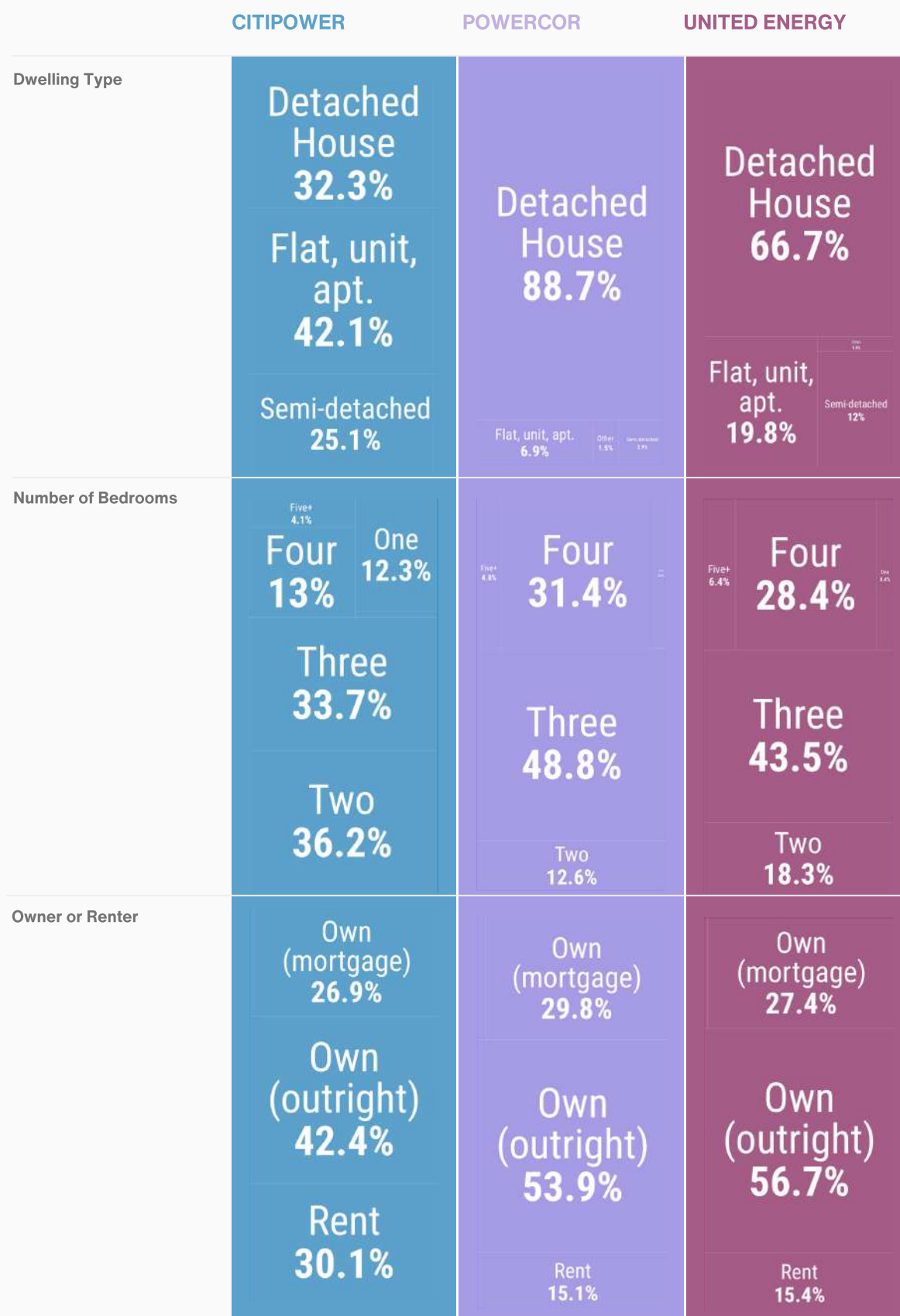
**Tenure:** Survey sample had an over-representation of homeowners who own their homes outright (without mortgage).





Comparison of survey respondent demographics against ABS data for state of Victoria

The survey sample also reflected demographic differences between the three distribution businesses. Although data specific to the distribution businesses was not available to compare against, the differences in tenure, dwelling size and type suggest that these significant differences were captured in the sample. See the following page for a breakdown of housing tenure, size and type by distribution business.



Breakdown survey respondents housing tenure, size and type by distribution business

## Analysis

Descriptive statistical analyses were performed using the IBM statistical software analysis package, SPSS v28. Various analyses were conducted to describe variations in the sample according to each provider. Analysis was conducted to examine the frequency of trends. Findings were cross referenced with other variables of interest such as demographic characteristics, while differences across each distribution businesses were examined to identify any generalisable patterns.

## Limitations

Because the survey was only available online, people who do not regularly use email were likely excluded from the survey recruitment. Therefore, results are likely to privilege those with at least basic internet usage and access, and digital skills. The survey was also only available in English, with no translation options provided. Therefore, people without English proficiency and literacy were excluded.

Relative to the Victorian population, the sample includes an overrepresentation of older people and homeowners (outright), male respondents, and apartment dwellers (explained through the prevalence of apartments in CitiPower's distribution area), which may have influenced some of the results. Without more specific data, it cannot be determined how this compares to CPU customer demographics (see section above).

The survey asked participants about hypothetical scenarios and future expectations that may not reflect their actual actions. While the survey findings are supported by ethnographic research, any data about the future is speculative and should be considered as an indication of future interest and opportunities.

## Outcomes

The results are presented throughout the report in the following ways:

- Broken down by distribution business, when significant differences were identified
- As total percentages of all 1,325 respondents
- As percentage of a select number of respondents, represented as n= number of responses, when a question was only asked of a selection of respondents (such as questions that were only asked of respondents with a specific technology)

# Peak Scenario Methodology

## Overview

All research data gathered across the four stages was used to inform the development of the future peak scenarios, including:

- Emerging digital and energy trends
- Reactions to the five future scenario cards
- Key household values
- Participant designs for energy futures
- Survey results

The scenarios represent future speculations in which the emerging digital and energy trends continue into the near future, from 2030. They are speculations which come from combining the forecasting implications, emerging trends and foresights on household values together with particular external conditions that create alignments of practices that exacerbate peak conditions. Such external conditions include special events such as holidays or cultural events, regular events such as emerging work routines and extreme weather events or natural disasters.

The scenarios are not predictive, but are intended to assist the energy sector in preparing for the plausible futures they represent and the potential for significant peak demand under certain external conditions which are currently insufficiently accounted for.

The future peak scenarios are presented in each domain of everyday practice. Although informed by a trend in that domain, they also draw on trends throughout the domains, and come from the combination of all research evidence and foresights.



Illustrations that accompany the future peak scenarios are by Stephen Elliget.  
<https://epicsteve.com/>

# Accounting for differences between distribution businesses and their customers

The three distribution businesses: CitiPower, Powercor and United Energy have different characteristics which affect the relevance of each trend, but also include diverse customers within them.

**Where significant differences across key demographic, lifestyle and place-based characteristics were identified, they are highlighted throughout the report and represented with the relevant icon illustrated on the right.**

Quotes and case studies drawn from the ethnographic fieldwork include the distribution business the quoted participant is a customer of. Where significant differences were found between distribution businesses survey results are broken down for each distribution business.

Survey results reveal that some differences can be seen between the distribution businesses, but that when aggregated across the whole business these differences are not as distinct as they are in more localised areas. More relevant are cross-cutting demographic, geographic and housing characteristics across the three distribution businesses.

## CITY AND INNER-SUBURBS

CitiPower  
Powercor  
United Energy



### **Characteristics include:**

- Higher proportion of renters,
- Higher proportion of apartment-dwellers,
- Less access to off-street parking and at home EV charging

*Sample postcodes: 3000, 3052, 3065, 3220.*

## OUTER SUBURBS

United Energy  
Powercor



### **Characteristics include:**

- Larger home size
- Higher proportion of new-builds
- Greater access to off-street parking and EV charging

*Sample Postcodes: 3168, 3171, 3174, 3020, 3023, 3024*

## SEACHANGE AND HOLIDAY DESTINATIONS

United Energy  
Powercor



### **Characteristics include:**

- Mix of regular residents and holiday homes
- Patterns of increased demand during holidays
- Coastal regions
- Higher proportion of detached housing

*Sample Postcodes: 3944- 3930 (Mornington Peninsula); 3232-3228 (Surf Coast)*

## Rural areas

Powercor



### **Characteristics include:**

- Experiences with more frequent outages
- Greater travelling distances required
- Greater access to off-street parking

*Sample Postcodes: 3444, 3418, 3483*



# Use of Participant Data

This report includes direct quotes from research participants collected during the research process. Either a pseudonym or the participant's real first name is used. Participants were given the option to choose which they preferred via the consent process.

Any [square brackets] indicate unspoken words by the participant that are needed to provide greater clarity or context. Ellipsis points (...) signal a break in the quote where the participant said other words that were removed for brevity.

This editing does not alter the meaning of the quote, but provides greater clarity for the reader. All images in this report come from the research and show the participants, their homes and technologies. All names, quotes and images are used with participants' consent, in accordance with our human ethics procedures.





# **PART 3: EMERGING DIGITAL AND ENERGY TRENDS IN EVERYDAY PRACTICE**

This section presents 51 emerging digital energy trends across the nine everyday practice domains where most energy demand takes place, where significant demand management opportunities exist and where significant changes are emerging.

Each domain provides the following content:

**Emerging Trends:** An overview of the concerns, practices, routines and priorities that are unfolding now or likely to unfold in the near future, involving digital and energy technologies. Trends are supported by quotes, case studies and survey results.

**Implications for Energy and Forecasting:** The likely outcomes of the trends for future residential electricity demand (including peak demand, average demand and other infrastructure or policy implications).

**Opportunities for Demand Management:** Opportunities that exist for engaging or intervening into the emerging trends to better align practices with needs of the electricity grid.

**Future Peak Scenario:** A speculative scenario of emerging peak demand (or negative demand) derived from the analysis of household and survey research. The future peak scenario includes the affected network businesses and areas, the peak demand forecast and brief demand management opportunities in relation to the peak.



01

**Mobility and charging**



02

**Caring at home**



03

**Cooking and eating**



04

**Smarthome and automation**



05

**Recreation and play**



06

**Working and studying from home**



07

**Healthy indoor air and thermal comfort**



08

**Cleaning, showering and laundering**



09

**Making, saving, sharing, and storing energy**

# Mobility and charging

Electric vehicles (EVs) present opportunities as well as challenges for the electricity grid. Understanding how and when people will charge their EVs is crucial for network planning. However, limited data currently exists on charging behaviour, and the little that does exist inevitably draws on the findings from early adopters participating in trials. Such findings need to be adjusted to take into account a wider range of practices, motivations, technical competencies and values from the broader range of households who will own EVs in the near future. This research reveals that it is crucial to understand EVs within a larger set of mobility options and challenges, as well as in the context of existing understandings about battery charging, preparing for contingencies and in relation to automation and control.





*“I’ve done 40,000 kilometres in the [Electric] car, 43,000, and I don’t regret a minute of it, it’s so pleasant to drive.”*

*Brian (United Energy)*

*[Why purchase an EV]: “Two reasons, one is, the proper reason, which is, it’s good for the environment and, I think, it’s a step in the right direction for everyone and the second reason is, I really like the cars, they’re really sexy, most electric cars.”*

*Gerard (Powercor)*

*“We do own e-bikes as well, so that gives us an alternate form of transport, and as I said, I’ve got access to—and that’s part of living fairly close to the city—there’s a lot of share car services.” David (CitiPower)*

## EMERGING TRENDS



*Trend 1: Electric vehicles are increasingly desirable for a variety of reasons*

The appeal of electric vehicles is multifaceted. Different motivations for purchasing electric vehicles will impact the speed of adoption, as well as people’s charging patterns and their willingness to adopt smart or automated charging.

*Trend 2: Electric Vehicles are Increasingly Envisioned as Part of a Mix of Transport Options*



EVs are commonly considered ideal for regular short commutes. However, their use for longer travel or as the sole mobility option is still viewed with considerable uncertainty. The exact energy implications of EVs will depend on their actual use. However, the anticipated roles of EVs suggest some potential impacts on energy demand, and also suggest important differences in the way that rural areas, outer suburbs and city and inner suburb households expect to use and charge EVs.

- In rural areas and outer suburb households envision keeping an ICE or hybrid vehicle for longer trips where an EV is viewed as less suitable. 
- City and inner-suburb residents view EVs as part of a mix of transport options including ride-sharing, public transport, walking and cycling. 





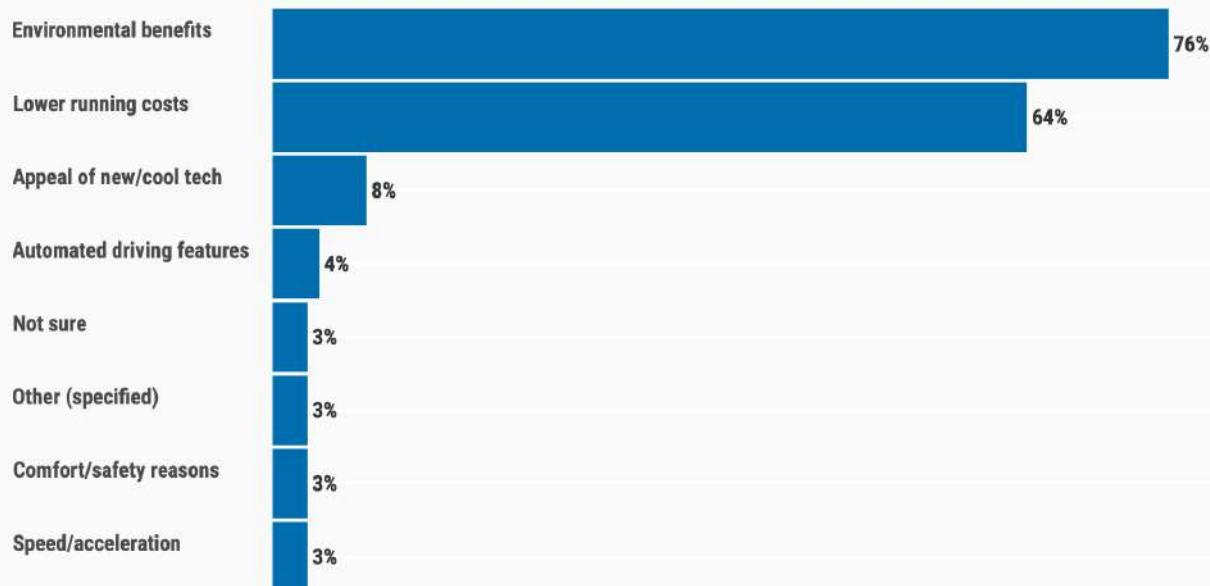
Only 3.4% of survey respondents currently have an EV or plug-in hybrid vehicle, but 26.7% of respondents intend to purchase one in the next five years.

*"I need to hang onto this [ICE] car for a bit longer. So it would be great to have an electric [bicycle] to tie me over. ...., the short trips we tend to do in the car that I think would be replaced really nicely by an electric bike." Maria (CitiPower)*

*"[My partner's] got a Toyota Corolla and I've got a Commodore. Both are about 10 years old now. My ideal situation would be replacing the Corolla with a full electric car that can at least do 300-400km. That would maybe do everything that we'd need to do for footy.... For mine, I think we'd need to go something a bit bigger in the end, and probably a hybrid [because of the range]." Jake (Powercor)*



## Reasons for purchasing an electric vehicle



Future Home Demand Survey, Question 9.  
Baseline: Households that currently own or intend to purchase an EV in the next 5 years (n=399)

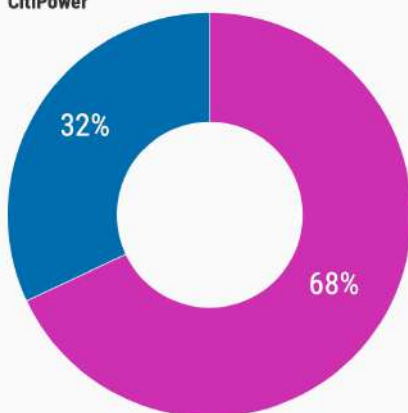
## How do/would you primarily charge your electric / plug-in hybrid vehicle?

77 % of all survey respondents with or intending to purchase an EV in the next five years (n=399), do or would charge their EV at home, with greater percentages in Powercor and United Energy distribution areas.

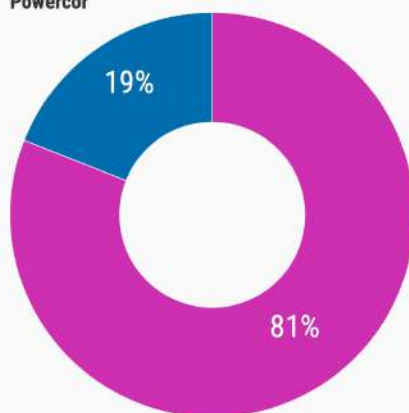


● Charge at home  
● Charge in public / other location

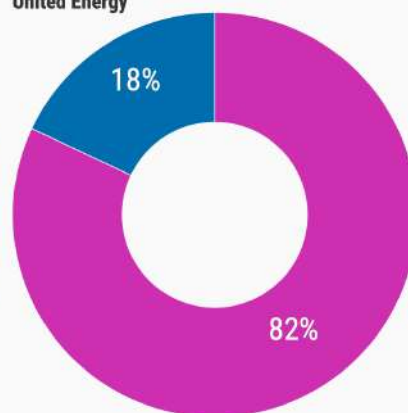
CitiPower



Powercor



United Energy



Future Home Demand Survey, Question 10.  
Baseline: Households that currently own or intend to purchase an EV in the next 5 years (n=399)





### *Trend 3: Electric Vehicle Charging Continues to Primarily Take Place at Home*

Households continue to prefer the convenience of at home charging. Most also envision that in the future they will charge their EV at home. Even when greater charging public infrastructure is available, people are still likely to prefer to charge at home.

### *Trend 4: Access to Charging Facilities will Continue to Affect EV Purchases*



Access to a location to charge EVs at home, such as off street parking or a garage, will significantly impact the rate of EV adoption. EV adoption may be limited by a lack of at-home charging access, especially in city and inner suburbs due to apartments lacking charging facilities, and the lack of off-street parking for standalone homes, including in affluent areas and suburbs which might otherwise be expected to have high EV adoption rates.

### *Trend 5: Maintaining Control Over Charging Continues to be a Priority Over Relying on Automation*



Automated charging of EVs is still an unfamiliar concept for both current and prospective EV owners. Many households envision being unwilling to hand over the management of their charging to a third party or automated system. Many are concerned about such systems' inability to account for their daily life contingencies and irregular but important priorities, such as having an EV with sufficient charge in case of an unexpected emergency.



*"...if we go and move to like an electrical car, which is like what we see now coming. Hybrid or electrical, this place, these buildings [older apartments], are definitely not designed for it. They are old buildings, and I will have to just move and find a place where I can actually charge during the night and have a proper garage." Florence (United Energy)*

*"The builder said make your mind up now if you think you'll ever want an electric vehicle, we'll facilitate that with the electrical design and so on." Martin (United Energy)*

*"That's one of the basic problems with electric cars, is what do you do when you normally have your car parked out on the street?" Arnold (CitiPower)*



This is especially true of:

- Rural areas- where distances to essential services are longer, and therefore having a near-fully charged EV is envisioned as necessary to be able to reach vital services like hospitals. 
- Seachange and holiday destinations- during summer and public holidays when irregular routines and convenience is prioritised over energy or cost savings. 
- Micromobility- where it is the main form of transport or required for access.
- Caring for children- where households have complex and inflexible schedules, and therefore cannot risk shifting transport modes should an EV be insufficiently charged. Children's safety seats also prevent using an alternative vehicle in case of an unexpected journey.



## CASE STUDY | DAVID | CITIPOWER

David lives in the high income suburb of Middle Park. He is interested in purchasing an EV and has a garage in which he could charge it. However, he has realised that he is one of the few households in his neighbourhood who has access to off-street parking, even though many homes in the area are standalone houses. He described how the council has started a trial to install charging infrastructure at the on-street car parks, but he hasn't seen any around yet.

Instead, he describes how a neighbour charges his Tesla by "run[ning] an extension cord from their house into the upper branches of the tree, and it just runs down the trunk of the tree." This is illegal, he noted, but is how his neighbour gets around the lack of off-street parking which is common in the high-income, and largely standalone homes in suburbs like Middle Park and Albert Park.

Do you currently have a place where you could (or already) charge an electric vehicle?

■ Yes ■ No ■ Unsure

### CitiPower



### Powercor



### United Energy



CitiPower customers have less access to locations where they could charge an electric vehicle compared to Powercor and United Energy customers.

Future Home Demand Survey, Question 42.  
All households (n=1325) grouped by provider: Powercor (n=477), CitiPower (n=439), United Energy (n=409). Row % displayed.

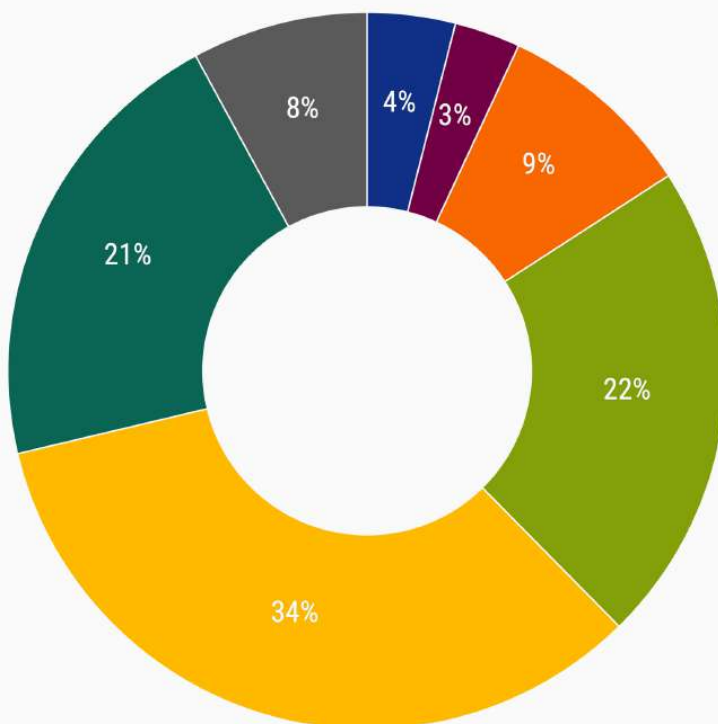


How do / would you primarily charge your electric / plug-in hybrid vehicle?

34% of respondents who own or plan to purchase an EV in the next five years (n=399), do, or plan to, use a smart charger at home.



- Private fast charger in public place (e.g. dedicated charger at workplace, or fleet charging station)
- Public fast chargers (for a price)
- Public fast chargers (free)
- Slow charge (standard three prong wall charger) at home
- Smart wallbox charger at home (responds to price or solar availability)
- Standard Wallbox charger at home (not automated to respond to price or solar availability)
- Other



Future Home Demand Survey, Question 10.  
Baseline: respondents who own or plan to purchase an EV in the next 5 years (n=399)

Respondents with preference for smart wall box (n=136): Which of the following ways of using smart appliances would you prefer in your home?

Of the 136 people who said they charged or would use a smart wall box charger at home, 56.6% said they would want to be able to override smart appliances; 35.3% said they would want to set or control the settings themselves, and only 3.7% said they would be happy for smart appliances to be fully automated.



- Happy to be automated provided I can override manually
- Fully manage myself, setting timings / control settings
- I would not use smart appliances
- I am happy with full automation



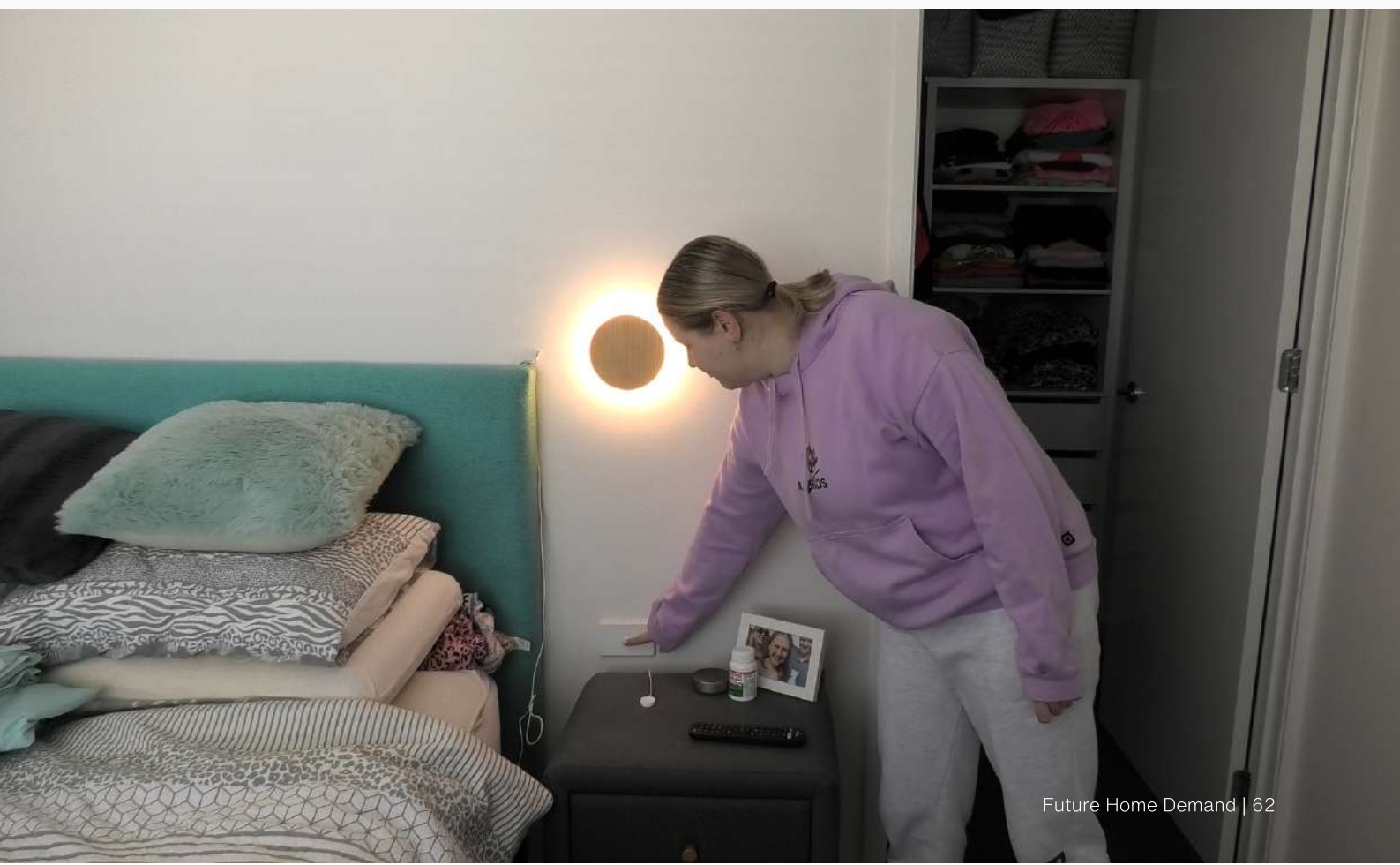
Future Home Demand Survey, Question 18.  
Baseline: Households that said they would charge their EV using a smart wall box charger at home that responds to price and solar availability (n=136)



### *Trend 6: Vehicle to Grid Technology is Increasingly Appealing as a Household Energy Back-Up*

Many households already use different fuel sources (wood, bottled gas) and technologies (extra vehicles, diesel generators) as forms of backup for use during blackouts and natural disasters. EVs with vehicle to grid functionality may fit into their households primarily as a form of energy storage or backup, rather than (only) as a vehicle. These forms of backup will likely become increasingly important as outages due to extreme weather become more commonplace.

*“I would like to get an EV for my next car as well. And ideally one that can be a bi-directional sort of battery so that I could use that also as more backup for the house too. So I could see myself and I don't drive an awful lot anyway I tend just to drive locally, but I could see myself in a situation where if there's storm weather forecast, that I would make sure both the home battery and the car battery were charged up so that they would be my two sorts of backups for the rest of the house.” Helen (CitiPower)*





### *Trend 7: Charging Routines and Priorities Continue to be Important and Influential*

People often have particular and fixed ideas around how and when to charge electronic devices like phones, smart watches, power tools and tablets. These charging routines are likely to translate into their practices around charging electric vehicles or home batteries including their automated settings and when they choose to override them. Rather than charging based on energy prices or energy availability, these habits and preferences exist to ensure that devices remain usable when needed, to protect the longevity of the battery and to fit into broader sets of routines or priorities.



*“I don’t think much about when I’m going to charge it [my electric vehicle]. There are probably variations in the price but I don’t worry about it. I just charge it when it needs it.....because the car’s so expensive you can’t expect to start saving money. If you want to persuade somebody that you’re doing it to save money you’ve got an uphill [battle].” Brian (United Energy)*

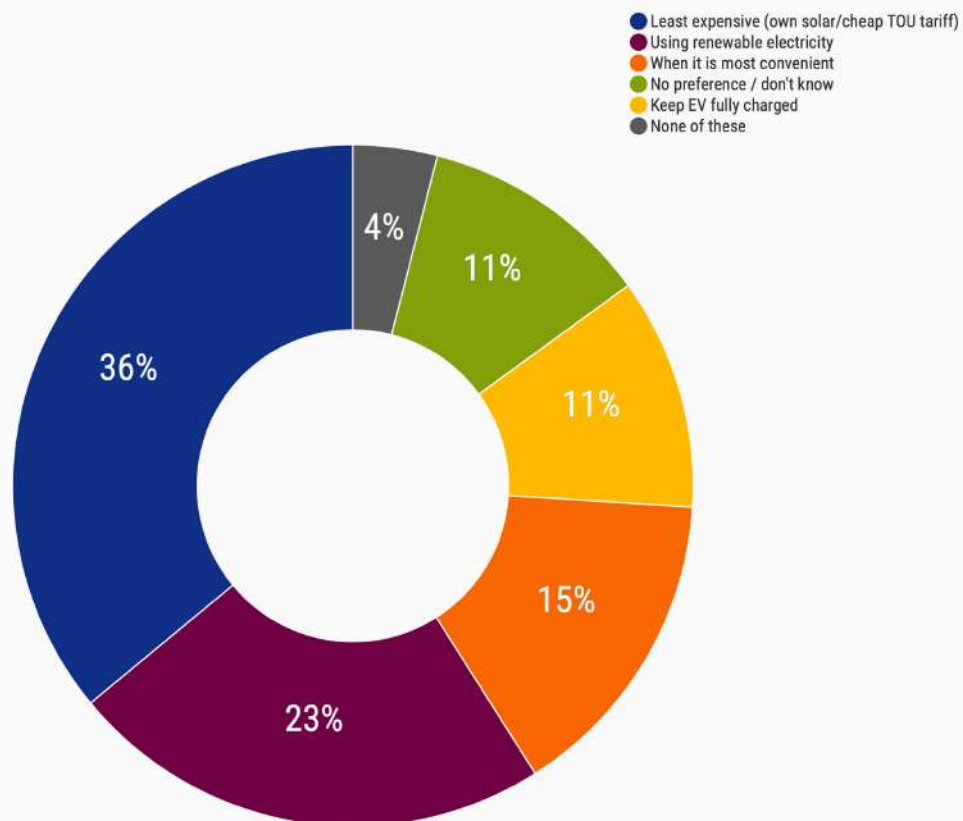
*[On why she keeps her electric wheelchair always plugged in and charging] “if I get ten minutes where I feel well enough to use [my electric wheelchair] it, I want it to be available right then. Because that might not happen again for another three years. So, I want it to be available whenever that happens.” Ricky (Citipower)*







Which of the following best describes how you prefer to charge your electric / plug-in hybrid vehicle?



Future Home Demand Survey, Question 11.  
Baseline: Households that currently own or intend to purchase an EV in the next 5 years (n=399)



## CASE STUDY | HELEN | CITIPOWER

Helen lives in the Citipower network, in an inner suburb which does not experience frequent outages. She also has easy access to public transport, taxis and can walk to a high street for shopping. She has solar panels and a Tesla powerwall. She was mostly motivated to install the battery because of her concerns with the environment and reducing her carbon footprint. When exploring the powerwall app, she noticed that the powerwall had a stormwatch setting, and she kept this on to notify her in advance of extreme weather events. During the flood events in Victoria in October 2022, she received a notification from the Tesla Powerwall app that stormwatch would be activated.

The storm watch setting automatically activates if the Australian Bureau of Meteorology sends a severe weather alert, and the powerwall then charges to its maximum capacity and maintains the charge while the alert is active. Although she wasn't particularly worried about the weather in the city, she accepted the app's automated setting and chose to keep her battery fully charged during the extreme weather warning just in case. Currently Tesla Powerwall's Storm Watch activates for: Tropical cyclone (watch or warning); Tropical storm (watch or warning); Thunderstorm or severe thunderstorm (warning); Tornado (warning); Blizzard (warning); High wind (warning); Flood (warning); Flash flood (warning); Bushfire (watch or warning). (Tesla Stormwatch) (Tesla, 2023).



### *Trend 8: Interchangeable Batteries are Accelerating the Electrification of Garden and Power Tools*

The availability of interchangeable batteries has created a shift towards using electric power tools and gardening equipment. This is because households can make a one-time investment in batteries that can be used across multiple devices. As a result, this trend is accelerating the electrification of garden and power tools and familiarity with interchangeable batteries.

*"Over the last few years, when I've needed to replace a power tool, I'd buy the brand that I've already got so, I've maybe got six power tools and three batteries, so I just switch the batteries around as necessary."*  
Gerard (Powercor)

*"To me, I accept the electric driller, if that dies. Or the circular saw or whatever, any other ...devices I've got, if they die, I'll replace them with electric I think. Because I've started buying batteries." Joe (CitiPower)*






## Mobility and Charging: Implications for Energy and Forecasting


Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Reasons for purchasing an EV reflect varied priorities in relation to charging EVs which will affect charging patterns, acceptance of automated charging and price responsiveness.

Acceptance of smart charging of EVs may be high, but people will want to maintain the option to override or control settings themselves, which may create peaks such as in advance of public holidays, storms, heatwaves and bushfire risk days, etc.

While cost savings and using renewable energy are the main preferences for charging EVs, high levels of convenience charging and preferences to keep EV batteries fully charged also exist, and may have significant material impact with higher EV uptake in the near future.

Rural area households  are likely to maintain an ICE vehicle, even as they begin to adopt EVs. Although facing greater distances required for essential travel, they may be more willing to automate charging due to having the ICE backup.

The strong preference for at-home charging may lead to particular geographies of EV purchases, in relation to off-street parking access that may run counter to current assumptions about high income areas and EV adoption. There may be lower EV adoption than expected in high income areas without off-street parking in the city and inner suburbs. 

*Further analysis by suburb is recommended to better target local EV uptake projections.*

## Mobility and Charging: Demand Management Opportunities

- Ensure householders understand and are able to maintain control over charging incentives and programs, including those which are automated.
- Target household routines and beliefs around charging existing battery-powered devices (phones, powertools, stick vacuums) as a means of both familiarising households with battery care, and ways of shifting charging in connection with demand and supply peaks. If properly guided, these capacities could aid future demand management of larger batteries, including household batteries or those in EVs.



**Example: Charging and demand management objective alignment as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 38, [View Link](#)):**

“With the charging routines of small energy consumption devices (e.g. consumer electronics) still evolving, there is an opportunity to engage via the growing home ‘project’ of keeping devices charged to support charging routines that are both good for device maintenance and which align with grid objectives. [In this capacity there is scope to] Establish the energy sector as a trusted source of charging-related advice to facilitate productive outcomes from the charging of emerging and higher energy devices (e.g. power tools, skateboards, scooters, EVs).”





## Storm Charging Peak

*Prior to forecasted storms, home batteries and electric vehicles automatically respond to storm warnings to maintain their charge, and households charge up other mobile battery powered devices to prepare in case of a power outage.*


As extreme weather events have become increasingly common and severe, and with more households owning or using batteries and EVs, this has led to a new energy peak prior to major storms. In the lead up to predicted storm activity and associated possible power outages, households charge up their household batteries as they prepare for the worst.

To ensure backup power supplies in case of emergency, many household batteries have automated systems that respond to extreme weather alerts put out by the Bureau of Meteorology, which set the battery to maintain a full charge while the storm warning is in place.

This maximum charging load extends to electric vehicles as well. People are willing to pay any cost to have their EVs charged fully, as they know that they will need the range to make essential trips or evacuations during any storm-related emergency. Those that have bi-directional charging also fully charge their EVs so that they may rely on their EV as spare energy storage for the home. This demand for backup power is further fuelled by the desire to fully charge other battery-powered devices, such as laptops, tablets and power banks for entertainment and to maintain contact.

Householders also charge up their battery powered tools and gardening equipment, so they can be used in the event of storm damage for cutting and clearing fallen trees and debris and for household repairs in the aftermath of the storm. As people are increasingly reliant on electrified charging, have more battery powered devices and expect uninterrupted power supply, the importance of maintaining fully charged batteries before potential outages from increased extreme weather continues to grow and exacerbates the charging peak.

**Year:** 2030

**Affected network businesses:** All, but more likely to affect areas with high uptake of EVs and battery storage and rural areas with more frequent outages. 

**Peak demand forecast:** Localised or widespread high demand prior to a storm-related weather event, depending on geographic range of the storm.

**Demand management opportunities:** Support and advice regarding pre-emptive/staged charging ahead of storms, working closely with the weather bureau and state emergency services.



# Caring at Home

Caring is a central and crucial aspect of household life, and one in which emerging technologies are playing an increasingly important role. Households envision technology continuing to support them in caring for themselves and other members of the household, including pets. Energy used for caring is increasing and inflexible due to its importance for providing health, safety and comfort.





*“Well putting aside the last couple of years part of the intention of this was that people would come down from Melbourne for dinner and stay over and in the school holidays, ...otherwise I wouldn’t be in a house this big.” Anthea (United Energy)*

*“When we bought the land, it was quite a big block, we went to Metricon and they said ‘Yes, for that kind of block, the way country people live, you should have a four bedroom house.’ ....Probably if we were making the choice again, we’d make the same choice because it is so nice to have the facilities here when we do want to have overnight guests.” Ron (Powercor)*

## EMERGING TRENDS

### *Trend 1: Pets are Increasingly Seen as Family Members with Their Own Non-Negotiable Energy Needs*

Pets are increasingly seen as important members of the family. As such, their energy needs – including thermal comfort, lighting, entertainment and security – are viewed as necessary. Accordingly, there are a growing number of smart digital technologies and other electronic devices used to maintain the well-being of household pets. These include:

- Heating and cooling for pets even when they are home alone
- Cooking for pets
- Electric water fountains for pets
- Refrigeration and freezer specifically for pet food
- Smart technologies for pets, including: automatic feeders, smart dog and cat doors and video monitoring

### *Trend 2: Occasional Hosting of Guests is Increasingly Important in Household Decision-Making*



Being able to comfortably host friends and family members is important to many households, particularly in **rural areas** and **seachange** and **holiday destinations** where visitors are more likely to stay overnight. Energy demand can be importantly shaped by the desire to host, which affects household decision making around:

- Appliance size
- The number of freezers and refrigerators
- Home size
- Hot water needs



## CASE STUDY | HELEN | CITIPOWER

Helen's cat Tippy, has a large appetite but a sensitive stomach. He has three automated feeders that feed him small amounts of food every hour if Helen is out of the house. However, Helen prefers to feed him manually when she is at home because it feels more caring to do it herself. Helen sets up a timer on her phone that chimes every hour to remind her to feed Tippy throughout the day. Tippy also has a smart cat door, which is only activated by a special collar he wears, meaning it will only open for him. The smart cat door also has a setting that allows Tippy to enter the house at night, but prevents him from leaving again until morning. This feature allows Helen to ensure Tippy is safe at home, even when she is away in the evenings.

25.4% of respondents would want to override smart or automated appliances if they were hosting (guests or events) at their home (n=610).



Helen also has a Tesla powerwall battery, a key benefit of which is that it ensures Tippy's smart technologies have a reliable source of power. As she described: "For instance with Tippy's cat door when the power went off, when the mains did go off...[the cat doors] reset themselves. So, if I was away and I had left him by himself and there was a power outage then... they wouldn't lock any more." Although Helen lives in CitiPower's network – which does not experience regular or extended electricity disruptions – the smart home technology she uses to care for her cat means that even a short disruption to the power supply can be significant. As she further described, "now that I've got my battery, I don't have to worry about that anymore."





### *Trend 3: Caring Increasingly Requires Being Prepared for Unforeseen Circumstances*



Caring for others is no longer simply about providing for basic needs, but also about anticipating unexpected needs, wants or events. This includes being ready for emergencies, changes in health, and other unpredictable situations such as unexpected guests. Preparing for the unforeseen can lead to increased energy consumption, as the demand for higher capacity appliances or technologies is often associated with greater energy use, and the desire to be prepared for the unexpected can make people hesitant to accept automated charging or direct load control, especially in rural areas where outages are more common and distances to emergency services are greater.

30.6% of respondents would want to override smart or automated appliances if someone in their house had an illness or health concern (n=610).



### *Trend 4: Self-Care is Increasingly Important and Connected to Physical and Mental Health*

Self-care and practices which support overall well-being are a priority for many households. People are relatively inflexible around practices of self-care because they are linked to maintaining good physical and mental health. Given the importance of self-care practices, the associated energy consumption is often framed as necessary. Consequently, baseline consumption will increase along with these non-negotiable practices. The inflexibility of some self-care routines also means the resulting energy consumption may not be easily reduced in quantity or shifted in time.



*“This is our [second] freezer ... We get things when they’re on special, we buy in bulk ... If we see something on special and we know the kids are going to come over, or we’re going to have guests, [we buy it] to have something that I can offer. We have unexpected people sometimes.” Eve (Powercor)*



### CASE STUDY | PAT | UNITED ENERGY

Retirees Pat and her husband live in a comfortable home in United Energy's distribution network. After a trip to Finland, and as part of enjoying themselves in retirement, the couple decided to fill some of the extra space in their house with an indoor sauna. Originally the couple thought about installing a spa bath, but after considering the associated energy use and cleaning, the couple decided that a sauna was the better option: "We turn [the sauna] on for half an hour, that's it, because [it's] warm enough for us to be there for 20 minutes. So, every time is only half an hour. That means three kilowatts, because [it costs] around a dollar something. It's still affordable."

Yet cost and energy consumption were only part of the equation around using the sauna. Although the couple could have used the sauna during the day to maximise consumption of their own solar power, Pat explained they had a fixed sauna routine. They used the sauna every second day in winter, and always around 4.30pm.

This routine was important because the sauna signified "time for relaxing... Winter time is dark, and then it's winding-down time, and we have to have a sauna, relax and then have dinner." Energy consumption and cost were thus important considerations for the couple, but self-care and enjoying life were also fundamental: "I will buy something I like. So by my age, I don't want to think too much about money. I need to enjoy it now when I can."

### *Trend 5: More At-Home Care is Increasing Energy Demand and Limiting Load Flexibility*

Healthcare and aged care are increasingly provided in people's homes, and this trend is expected to continue with advancements in technology and an ageing population.

Increased and often fixed demands for the services that energy provides, such as heating and cooling, cleaning and hygiene, or entertainment and leisure, mean that energy consumption is also growing alongside at-home care. This increased demand for at-home care means that energy reliability is even more critical, and that energy demand is often also less flexible.





## CASE STUDY | RICKY | CITIPOWER

Ricky lives with one roommate in a public housing unit within a block of rented apartments in CitiPower's network area. She is disabled and is currently supported by a team of care workers who are scheduled to visit at certain times of the day throughout the week. Ricky is a self-described environmentalist and is energy-conscious, but her care schedule highlighted challenges for load shifting: "Most of the things, really—that I have I need to control the timing of—because my disability makes me really sensitive to everything. With the heater, we only run it a few hours a week, but it has to be the hours when it's running because it's so that I can have a bed bath and the room has to be hot at the right time and the support workers only have a very limited window of when they're here, so I can't delay my bed bath by three hours if the sun's not shining because then they'll be gone."

Ricky's evolving care needs have also required additional 'always on' technologies, including an inflatable mattress and two air purifiers she bought following the 2019 bushfires. "I've also grown sensitive to pollen...And I discovered after I started using them for the bushfire smoke, that they're really good for that as well. It wasn't why I bought them, but it helps a lot. So, I've kept using them for that." Air purifiers, originally purchased for occasional use, have now become part of Ricky's everyday care routine. And though she bought them both at the same time, only one has smart capabilities. Since Ricky cannot currently leave her bed, the air purifier requiring manual control is running 24-7 in the background while the other gets turned on remotely via an app whenever another person visits for an extra "boost".





## Caring at Home: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Caring is an essential and critical part of domestic life, and energy use related to caring, health and self-care is highly inflexible.



75.4% of respondents ranked “Comfort, Health and Safety” as one of their top two household values. This was the highest ranked value.

Energy used for caring makes even short electricity outages difficult, encouraging frustration with unreliable power supplies and motivating the adoption of batteries.



Ensuring ability to deal with contingencies for caring, requires greater control of technologies and shapes resistance to automation, such as smart charging EVs, due to desires to be prepared for emergencies.



If hosting is considered when making decisions about the size of homes, appliances and hot water systems, this entrenches increased energy demand and/or can contribute to increasing demand peaks during common hosting times, such as school or summer holidays.



## Caring at Home: Demand Management Opportunities

- Develop initiatives that meaningfully engage with the challenges and realities of caring for people, pets and home, which often depend on consuming energy (e.g. air conditioning).
- Partner with health authorities, community groups and other trusted organisations like the RSPCA to develop and promote initiatives which focus on low-energy or lower peak demand ways of providing care.



**Example: The Comfy Critters Program as elaborated in the Future Grid Report (Engaging Households Towards the Future Grid (Strengers et al 2019, p. 33 [View Link](#))**

“The Comfy Critters program promotes low-energy ways for households to keep their pets warm and/or cool. Stay-at-home options include the provision of cosy beds and the use of coats and microwaveable heat packs in winter, and the use of fans, natural ventilation, cool mats and frozen treats in summer. New pet owners may receive a one-off voucher towards the purchase of these items. Out-and-about options include pet-friendly zones in temperature-controlled shopping centres, libraries and other public areas, and pet friendly businesses such as retail shops and pubs.”



## Holiday Hosting Peak:

*During the holiday season, increased convenience charging of EVs alongside high and inflexible energy demand creates localised peaks in areas popular with holidaymakers.*

It's the peak of the holiday season and families are arriving at their vacation homes in the United Energy and Powercor network areas. Some have rented these homes for the holiday and so won't be paying the electricity bills; others own the homes. They are not worried about the cost of electricity since it is a special occasion and the priority is enjoying their time off with friends and family. Homes are fitted with luxurious amenities such as hot tubs, saunas and pools which are kept heated during the holiday period. The air conditioning is on full blast to keep the large holiday homes cool as the electric oven and cooktop are cooking a large holiday feast.

The high energy demand is exacerbated because family members have plugged in their electric vehicles to recharge after the long drive from their homes and to prepare for tomorrow's outing to the wineries, beach or other local attractions. Convenience charging is preferred because of the longer than usual travelling distances while on holiday and the desire to focus on enjoying the holiday rather than charging the car. Electric vehicles used for recreation, such as electric boats, must also be charged in advance of early morning fishing trips.

### **Affected network businesses:**

Seachange and Holiday Destinations-United Energy and Powercor



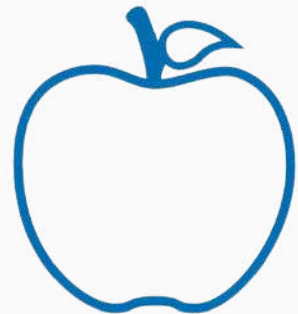
**Peak demand forecast:** Localised high demand during peak summer and holiday periods and public holidays, and particularly during the late afternoon and evening.

### **Demand management opportunities:**

Programs/ initiatives/ localised storage targeted specifically towards holiday makers and short-term holiday renters.

# Cooking and eating

The gradual electrification of cooking is seeing a growing number of small appliances in kitchens, creating unclear outcomes for future demand. Refrigeration and freezer capacity is also expanding due to household trends around preparing for the unexpected, as well as increasing the lifestyle, recreational and hosting capacities of the home.







## EMERGING TRENDS

### *Trend 1: Continuing Proliferation of Small Electric Cooking Devices*

Small electric cooking devices are replacing larger traditional appliances such as ovens, which are considered oversized and wasteful. Smaller electronic devices like air fryers are considered more appropriate for particular purposes and lifestyles, including:

- Older people who prefer smaller meals
- Single-person households, whose meals may likewise be too small to justify the use of an oven
- Large families with diverse dietary requirements and tastes, where different family members require individual meals cooked in separate smaller devices, or concurrently with larger appliances.

The potential energy implications of this trend are mixed: the electrification of cooking will likely increase demand, while the use of smaller and more efficient appliances may reduce consumption.

*“No, I don’t use the oven very often...I stopped using it for three to four years. I have this air fryer. It’s smaller. Good cooker for two persons instead of just [using the oven which is] a waste of energy and hard to clean. This one is much quicker. “  
Pat (United Energy)*





## *Trend 2: Household Electrification is Beginning in the Kitchen, but Occurring Gradually*



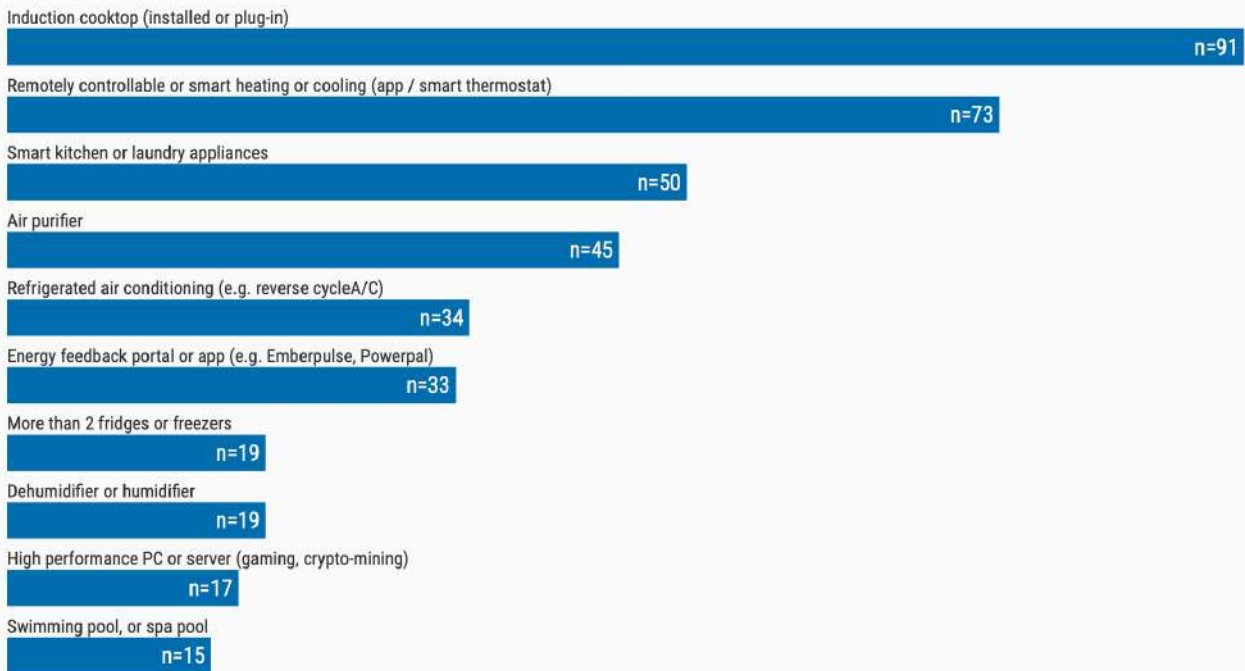
Rather than larger appliances, the move towards electric air fryers, thermomixes and small plug-in induction cooktops are leading the way in household electrification. Where it is taking place, full electrification is largely confined to newbuild homes. The demand consequences of electrification may therefore initially be clearest in areas with more new housing developments, such as in growth areas in the Outer Suburbs while in more established suburbs the evening cooking peaks may be less pronounced.

*“It was becoming more and more obvious then that that was the way to go [fully electric]. Like why pay a daily fee; why burn fossil fuels? It just seemed really dumb. We had this option to do it because we were starting from scratch on the site.”*  
*Maria (Citipower)*



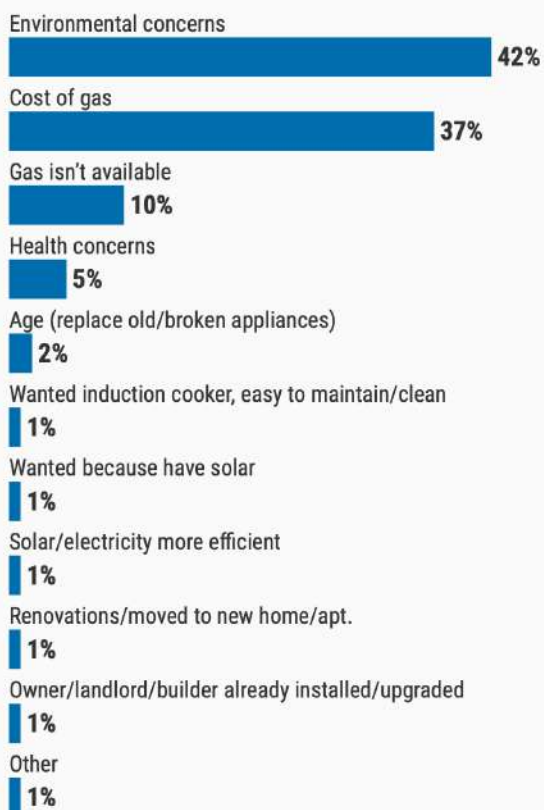


## Number of households that intend to purchase or install the following in the next 12 months



Future Home Demand Survey, Question 2.  
Baseline: All households (n=1325). Number of households displayed.

## Main reason gas appliances replaced with electrical appliances



Future Home Demand Survey, Question 5.  
Baseline: Households considering or have already replaced gas (n=511)

20.2% of households already have an induction cooktop (installed or plug-in). This was also the most common appliance people were planning to purchase in the next 12 months.





### *Trend 3: The Size and Use of Fridges and Freezers is Increasing*

Refrigeration and freezer space is expanding for a variety of reasons linked to other household trends. The result is an increase in baseline household energy consumption, and a reinforcement of the practices like bulk cooking which rely on greater fridge and freezer space. Household trends contributing to the increase in cold storage include:

- New electronic cooking devices. Many new and increasingly popular electric cooking devices encourage greater freezer use. For example, air fryers are linked to expanding freezer capacity, as many foods cooked in the air fryer are frozen. Similarly, devices such as the thermomix and slow cookers encourage meal prepping and freezing by enabling the preparation of food in bulk.
- Increased hosting needs. People prefer to have food stored in the freezer to be prepared for unexpected guests ([see Caring Trend 3](#)).

- Increased household luxury. Additional refrigerators, especially for storing beverages, are linked to increasing expectations of the home as serving more recreational purposes ([see Recreation and Play Trend 1](#))
- Care of pets. As important members of the family pets' diets are becoming increasingly complex, often requiring a combination of fridge and freezer storage for both fresh and frozen foods ([see Caring Trend 1](#)).

25% of households have more than two fridges or freezers. With the lowest percentage amongst CitiPower customers.

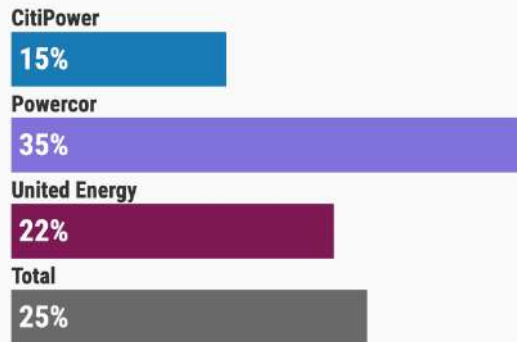


*“This freezer is pretty much just for him [Sonny the dog] too because he eats like a raw diet and I usually like will buy enough from and put it in this freezer” Maria (CitiPower)*





Households with more than 2 fridges or freezers



Future Home Demand Survey, Question 1  
Baseline: Percent within provider (CitiPower, n=439; Powercor, n=477; United Energy, n=409)

*“Yeah there’s a couple of pre-prepped items [in the spare freezer] that we just have to eat them. [The thermomix] makes so much in such a little time” Amy (Powercor)*







## Cooking and Eating: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Cooking is largely an inflexible practice concentrated in the evening peak, and therefore there is little opportunity for shifting cooking loads without specifically targeted messaging around alternatives.

New builds will lead the way with electrification, likely to mean higher electrification in outer suburbs with significant new developments, and slower electrification in already developed areas.



Those living in existing multi-dwelling developments like apartments and townhouses, more concentrated in city and inner suburbs, will electrify more slowly due to the challenges involved in transitioning communal infrastructures.



Electrification will happen in gradual ways, as people trial electric options and only replace gas appliances when they break.

As gas stoves and ovens are electrified, the increase in the electricity used for cooking may be mitigated by preferences to use smaller electric cooking devices like air fryers.

## Cooking and Eating: Demand Management Opportunities

- The continued popularity of refrigeration for non-perishable beverages (e.g. a beer fridge) offers an opportunity to target demand management messaging at this discretionary and often seasonal load.
- Promote energy efficiency information for the growing range of electric kitchen appliances, and encourage use of appliances with smart or timer delay functions to help consume daytime solar generation and flatten evening peak demand.



**Example: Food-focused approaches as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 47, [View Link](#)):**

“Peak event marketing or incentives could promote ‘fresh and cool’ recipes and prepared meal deliveries that involve no or minimal cooking (e.g. through partnerships with providers of prepared meal and meal kit deliveries). [Demand management programs could also] build on slow cooker, pressure cooker and multi-cooker trends to highlight how they can smooth or reduce household energy use.”



## Major Event Peak

*Growing expectations for the home and new digital technologies increase the energy needs of entertaining, which create significant demand peaks during major sporting or cultural events.*

Popular sporting, cultural or entertainment events like the AFL Grand Finals or new episodes of online streaming content lead to increased energy consumption as people collectively participate in major events from the comfort of home. The way that people engage with major events is now more energy intensive as new technologies proliferate, and expectations around entertaining in the home increase. People use increasing electricity to cook, keep food warm and drinks cool, and also to heat, cool and purify air in entertaining spaces (including outdoor areas) and to set the mood with smart lighting or music. Further luxury additions that require still more energy consumption proliferate including larger TV screens, home cinemas, massage chairs, and virtual reality systems which now enable more immersive experiences in major events.

Alongside shifting norms, the growth of entertainment and leisure activities, as well as the proliferation of smart technologies in the home contribute to exacerbate peak demand during major events. People are not responsive to energy price signals and are largely unwilling to shift the time of significant energy used for entertainment because of the time-specific nature of these events.

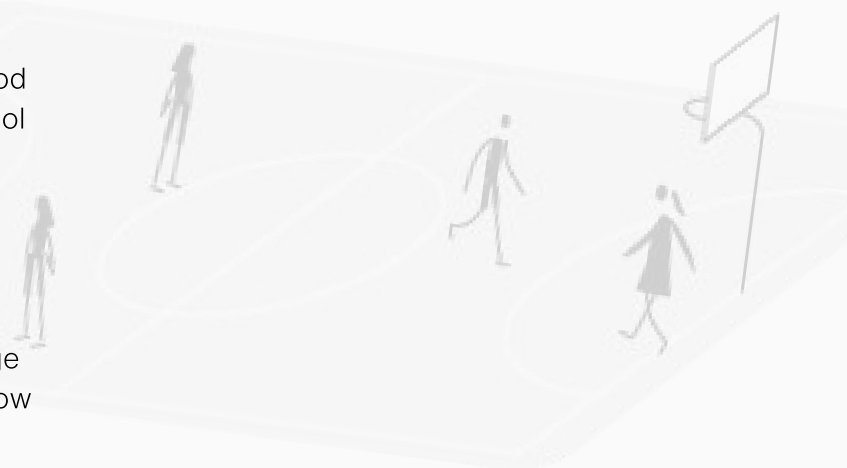
### **Peak demand forecast:**

**Affected network businesses:** All, but more likely to affect areas with large detached homes in outer suburbs; seachange and holiday destinations, and rural areas



### **Demand management opportunities:**

Targeted demand management messaging around major events, such as promoting lower energy consumption ways of entertaining and consider programs which encourage shared viewing in public places (e.g. pubs or cinemas).



# Smarthome and automation

Interest in smart home technologies is relatively limited, gendered and often viewed as adding unnecessary complexity to the household. Despite the increasing prevalence of digital voice assistants, they are rarely used for broader household automation, and many remain sceptical of increasing the automation of their homes. This will limit the role of automation in energy management.





## EMERGING TRENDS

### *Trend 1: Interest in Smart Home Technology and Automation Continues to be Relatively Low*

While some smart technologies are relatively widespread, their use tends to be confined to a limited set of simple tasks, and they are not necessarily integrated with other smart household devices. For example, while voice assistants are common they are mostly used to play music, set timers, or control voice activated lights. More involved household automation is still rare and many do not want significantly increased automation in their homes.

- 18% of respondents use apps to control or automate some appliances or devices
- 11.4% of respondents use a voice assistant to control or automate some home appliances
- 4.3% of respondents say their home has been described as a 'smart home' 'connected home' or 'digital home'



*"I guess I've probably a healthy distrust of systems. And what's the actual benefit of having a fancy app that, you go 'hey Google, hey Alexa, turn on the lights, turn on whatever'? I don't really see any huge benefit of using it. It's not that hard to get up and press something or turn a light switch on or turn it off."*  
Luke (United Energy)

*"If I was building from scratch I probably would do it [automation] but not in a place like this. I mean it's just the two of us and I like to do things by myself, I don't need all these gimmicks. I don't know what more I could do anyway."*  
Philippe (United Energy)







### *Trend 2: Smart Home Technology is Continually and Creatively Adapted to Suit the Needs of Each Household*

A lack of integration between various smart home technologies and platforms is contributing to the appeal of ‘tinkering’ among both technology enthusiasts and other users. The current lack of integration between various smart home technologies and platforms is encouraging households to adapt technologies to the particular needs of their household – including in cases when smart home technologies are purchased with a specific use in mind. As a result, the energy demand associated with smart home technologies may differ importantly from that anticipated by their designers, forecasters or the technology users themselves as people adapt them to their particular preferences, needs and the circumstances of their own homes including other technologies.

### *Trend 3: Smart Home Technology Acceptance and Use Continues to be Highly Gendered*

Smart home technology is often brought into the home by one member of the household with a particular interest in technology and automation. This is often, though not always, a male. The main user of smart home technologies also tends to be the person who introduced it. Meanwhile, other members of the household may find it frustrating or difficult to use new devices, and in response develop overrides or workarounds to engage with or avoid new technologies. This phenomenon can also complicate the use of smart home technologies for managing energy demand or accessing energy feedback.

*“He made all the lights Alexa-sensitive and the coffee machine and he’s got a switch on at the back. The only trouble is unless you know the zones and the instructions you can’t turn the bloody lights on, it’s a pain in the arse. So, it’s all right for him but [not] for the rest of us who might live there occasionally ... his wife and his children.”*  
Yvonne (Citipower)



## CASE STUDY | RICKY | CITIPOWER

Living in public housing, unable to work and often confined to her bed, Ricky does not fit the stereotypes associated with usual high-income 'early adopters' of smart home tech. However, she has adapted many devices and appliances in her home so she can control them remotely from a dashboard over her bed: "I've made an enormous amount of customised tech, so everything is just right. I got someone to make this trolley so that it holds my drinks at the top, and this little mini fridge here. Because I get a lot of migraines, and the best thing that helps is cold packs, and I can't get up and walk to the fridge to grab the cold packs...so, I figured out how to get the cold packs to come to me." Ricky uses a mix of smart home systems, second-hand objects and appliances, and analogue hacks like Sugru (a flexible adhesive putty) modifications allowing different kinds of grip or fall protection for her devices.

Her smart tech set up even incorporates a bass drum stick purchased on eBay which she uses to extend her reach to access the various tech stations surrounding her bed. Because she purchased and adapted her technologies over time, "not all of the things speak to each other...So, for example, I can close the blinds, or open them. But to open and close the curtain, I need to either use the physical remote control, or the app on my phone. And I can turn this air purifier on and off, but not that one." People adapt, hack and customise smart technologies to support needs or household practices which are particular to them.






#### ***Trend 4: Smart Home and Energy Management Technology is Increasingly Frustrating When the Initial Installer is No Longer Resident in the Home***

Both digital and energy technologies left in a home as the resident's change may not be used as efficiently or as planned by the initial installer. Inherited smart home and energy technologies may thereby complicate efforts to reduce or better manage household energy demand when new residents do not understand how the technologies work or are frustrated by attempting to operate them.

#### ***Trend 5: Smart Home Technology is Increasing the Frustration of Electricity Outages***

Even minor or short power outages can cause complications for smart home devices and systems. Increased dependence on smart home technologies means that resets during electricity outages can be frustrating for households and complicate the energy management done by smart home technologies. Consequently, it is increasingly critical to ensure that energy systems are reliable the more people have installed smart home technologies. This reliability is a particular concern in rural areas with more frequent outages. 

*“As soon as the power comes back on [after a blackout], all the lights default to on, so the whole house lights up like a Christmas tree, wherever there’s the smart lights. And then, because the wifi dropped out, I can’t tell Google to turn them off, because it hasn’t kicked in yet. So I have to go around and ... again, minor inconvenience, but in the middle of the night, go around and actually turn all the lights off manually, because everything else had decided to switch itself on.” Jake (Powercor)*



#### **CASE STUDY | MARIA | CITIPOWER**

Maria lives with her two primary school aged children in a large inner-city home built to meet the needs of a “family unit” three and a half years ago with her then husband, an engineer and digital technology enthusiast. During construction he took care of everything electrical, including powerpoints installed in the garage to meet the requirements of his envisioned workspace, a 24-hour CCTV to keep the family safe, and a ventilation system timed and zoned according to their expected family routines. However, after separating from her husband she has struggled to manage the complex system. “I don’t think the zoning’s working terribly well, like, I’ve tried so many different settings, it’s either just blasting or it’s not doing anything”.

Recently, Maria has updated the security system with Google cameras because she is unsure if the CCTV is even working, “I’ve just got it sitting there chewing power for nothing.” Since “inheriting” the responsibility of both household “roles”, Maria has had to learn to fix the toilet’s electrical pump, the timer on the heat pump and install draught proofing, among other things. Although she loves the joy of learning new things, her time constraints have left her admitting there’s “a little bit of resentment” towards the home’s inflexible set-up and wishes there were an easier way to reflect the change of status, “because then yeah, we would use less power.”





### *Trend 6: Automation is Increasing Household Complexity, Leading Some to Reject It*

Despite promising greater convenience, real-world experiences with smart home technologies and automation reveal that they often require significant effort to set up, maintain and use in the context of everyday life and people's evolving needs. As a result, negative experiences with managing smart home and automated technologies can encourage scepticism about future technologies, including those used for energy management and mechanisms like direct load control.

*"If I'm going to be out, I have [the robotic vacuum] set up to run in the afternoon and [the cat] usually vomits in the morning. Once I was away overnight and I had forgotten to even think about the fact that he might vomit when I wasn't home and when I came home it had vacuumed, ... up some of his vomit, spread it round."*  
*Helen (Citipower)*

*"I think if I wanted to, say for example, put the timer on the dishwasher, if I wanted to actually set that up, that means I've got to be organised, and make sure the dishwasher is unloaded and loaded, ready for me to do that. I've got to be pre-prepared to do all of that. I'm just not preprepared.... It's just not a feasible option, I don't think."*  
*Alison (United Energy)*





## Trend 7: Households Continue to Desire 'Final Say' and the Ability to Easily Override Automation

Some households are willing to cede a degree of control if automation brings benefits like increased convenience. However, most want to retain the ability to easily adjust settings on the fly, or to fully override automation as their circumstances change. The ability to retain a final say over devices is also strong in the households most interested in smart home technologies and other forms of energy automation.



Only 3% of survey respondents are happy for smart appliances to be fully automated, whereas 46% of respondents wanted the ability to override automated settings, another 31% want to set the timings or control the settings and 20% want no smart appliances.

*"So like a [smart] system like this, again, great in theory but there's always exceptions when sometimes you need the option. So I think that as a general rule, [it works] but with like a manual override or something that you can use occasionally if you need to." Luke (United Energy)*

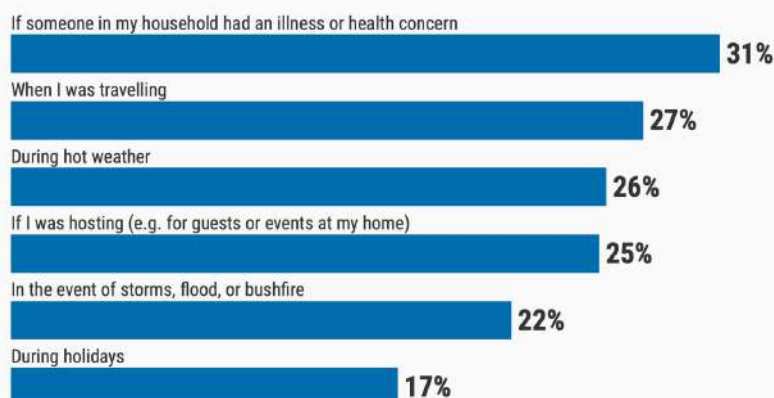
Which of the following ways of using smart appliances would you prefer in your home?

- Happy to be automated provided I can override manually
- Fully manage myself, setting timings / control settings
- I would not use smart appliances
- I am happy with full automation



Future Home Demand Survey, Question 18.  
Baseline: All households (n=1325)

Those who answered they would like to override automation (n=610), were asked a follow up survey question of "In what circumstances would you want to override smart or automated appliances":



Future Home Demand Survey, Question 19.  
Base: Respondents from Q18 that selected "happy for smart appliances to be automated provided they can manually override" (n=610)





## Smart Home and Automation: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Energy management through automation is minimal, and interest in smart home technology is guided by the goal of increasing convenience and comfort, and therefore may not reduce energy consumption or significantly increase flexibility.

Being able to override automation and easily adjust device settings is likely to be a precondition for people to accept automation, but may also cause challenges for the grid ([see future peak scenarios](#)).

Smart home technology often enables increased control rather than automation (e.g. through remote control via apps, voice control, etc.), meaning that energy automation may be less compatible with smart home technology than is often envisioned.

Gender differences in smart home interest and utilisation will lessen any potential energy shifting benefits as women's participation in using these technologies is necessary to see the full energy benefits they may offer.

Smart home technology increases the frustration of electricity outages, and may encourage the adoption of batteries, particularly in rural areas which experience more frequent outages.



## Smart Home and Automation: Demand Management Opportunities

- Offer a range of manual and high-tech ways for householders to engage with both the opportunities and challenges presented by automation and smart home technologies.
- Increase householders' acceptance of smart tech or direct load control by better explaining why such interventions are necessary, or through programs that offer cheap or free energy.



**Example: ‘Free energy’ offers as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 49, [View Link](#)):**

“Free energy is a clear concept up front – it is novel enough to attract interest and engage households in ideas of peak supply (of wind or solar energy) and demand response, and free energy does not require lengthy explanation or calculations...Offering free energy periods may increase the appeal of smart technologies and support acceptance of automation and direct load control in householders that may otherwise be sceptical or distrustful.”



## Automation Override Peak

*Smart home devices with automated settings are increasingly common, however rather than being set to respond to energy signals, the smart devices exacerbate evening peaks by privileging comfort and convenience.*

A large number of smart home devices have been integrated into homes. However, much of this digital smart home technology is not set to respond to energy price signals, but instead to provide comfort and convenience benefits for the home and its occupants. Therefore, many smart home technologies add to peak demand, such as air purifiers (integrated with home cooling and heating systems) which respond to air quality measurements that peak in the evening when there is significant activity and cooking in the house, or smart air conditioning which turns on automatically to a preferred temperature setting when detecting that residents have returned in the early evening – including if the temperature is relatively comfortable and residents might not think to manually turn it on.

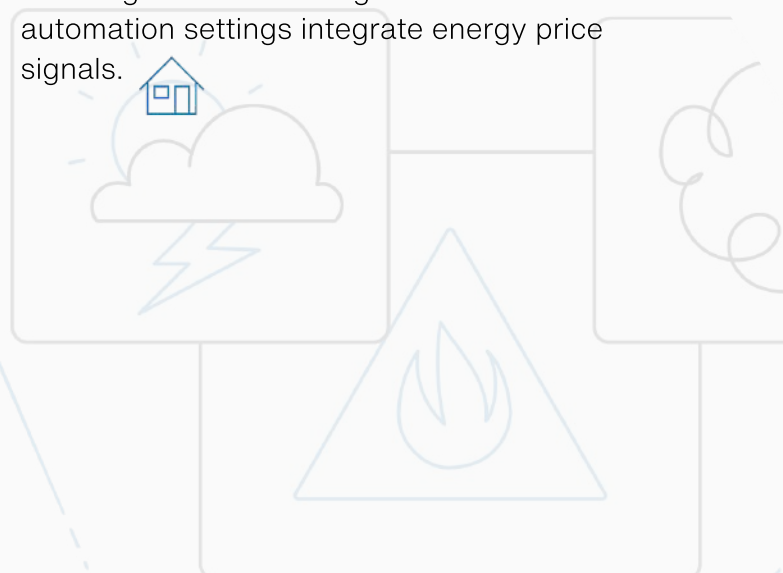
Some smart technologies are used for energy management but these are not often linked to other household digital technologies because of the piecemeal way that people have integrated technologies into their homes. For those that do use automation for their energy management, in advance of important household events, such as visiting guests or upcoming holidays, people override the automated settings related to the smart charging of their electric vehicles, household batteries and any appliances which they usually allow direct load control of. In doing so, their goal is to prepare for unexpected or additional needs that they feel the automated systems will not be able to account for, as they are deviating from the patterns of typical behaviour that automated systems anticipate.

**Affected network businesses:** All, but more likely to affect areas with large detached homes in **outer suburbs, seachange** and **holiday destinations**, and **rural areas**.



**Peak demand forecast:** Localised high demand during summer evening periods and particularly in advance of public holidays.

**Demand management opportunities:** Programs/initiatives targeted towards ensuring smart technologies and automation settings integrate energy price signals.



# Recreation and play

As a result of the ongoing COVID-19 pandemic and increased cost-of-living pressures, households are spending more time at home. Consequently, there is greater focus on household comfort, as well as investments in home improvements and digital devices that provide further opportunities for entertainment and recreation. This is an anticipated growth area for electricity demand.





## EMERGING TRENDS

### *Trend 1: Expanding Expectations for the Home are Encouraging Increasingly Luxurious Upgrades (By People's Own Standards)*

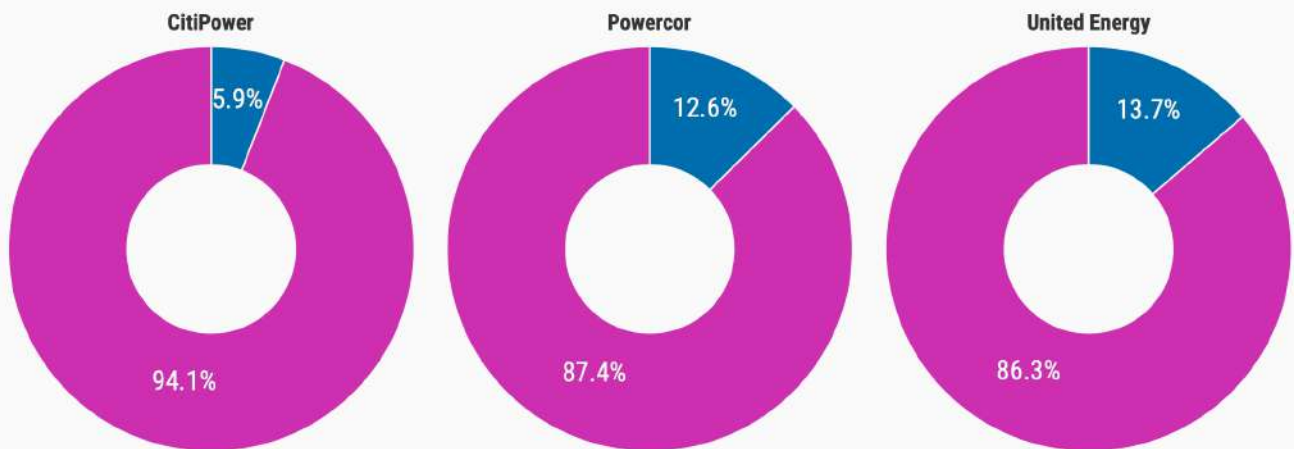


Households are spending increased time at home, and as a result are investing in home upgrades and renovations to meet their growing leisure and entertainment needs. These home investments include interest in upgrades deemed luxurious by people's own standards, such as swimming pools, saunas and hot tubs. Such investments often consume significant amounts of energy to operate and maintain. These are concentrated in areas with larger homes and lot sizes, such as in outer suburbs, seachange and holiday destinations, and rural areas.

10.7% of all households already have a swimming pool, or spa pool.



Pool and spa ownership across providers



- Have a Pool / Spa
- Do not have a Pool / Spa

Baseline: All households (n=1325) grouped by provider: CitiPower (n=439), Powercor (n=477), United Energy, (n=409)





## CASE STUDY | ABBY | POWERCOR

Abby is a university student who lives in a recently built townhouse in Ballarat with her mother and step-father. Soon after moving in, the family renovated their only outdoor space, a small courtyard into a high-tech and luxurious outdoor entertaining area. Abby described it as “a bit of a luxury”.

It includes a smart automated roof which automatically closes if it detects rain, two electric outdoor heaters, a hot tub and a video projector with a screen for watching movies from the hottub. The projector's screen is attached to a rolling door behind which sits a fully stocked bar, which includes three beverage refrigerators.





## *Trend 2: Multiplication of Screens and Increasing Simultaneous Use of Devices*

Where family viewing of TV shows or other media in a shared living space used to be commonplace, there is a growing trend towards individuals watching content on their own devices in separate spaces of the home. As people spread out, more areas of the home may require heating and cooling. People are also increasingly using multiple devices or screens at the same time, such as using a phone while watching TV.

*“But realistically, like the TV’s useful, but I think we could both sort of live without. It’s nice, brings the room together, but we’ve found that we’re moving more and more away from using the big screen.” Chloe (Powercor)*

*“I’d have to say, [laughs] and this is a bit gross really, but [my wife] and I both have iPads, so there might be times when there’s something running on free-to-air [TV] and there’s something else streaming simultaneously.” David (CitiPower)*







### *Trend 3: Gaming is an Increasingly Common Form of Entertainment*

Computer and console gaming are key forms of recreation, with gaming often an important social activity. The pandemic encouraged greater use of gaming for social interactions, with parents increasingly supportive of children's gaming, and adults doing more gaming themselves. Gaming is also associated with increasing computing needs, and the normalisation of an array of gaming technologies and accessories including additional monitors, larger screens, virtual reality headsets, speciality headphones, gaming keyboards and mice, and speciality lighting setups. All of these devices involve increased energy consumption.

*"I did monitor [the gaming computer's consumption] in the Powerpal. It wasn't necessarily as bad as I perhaps expected. That home theatre PC which was running older hardware, six, seven, eight years old, was actually worse than this. Probably having the three monitors running isn't always great. But I've usually got them on, because I've usually got something on each thing, and I've become accustomed to it."*  
*Jake (Powercor)*





#### *Trend 4: Electric Vehicles are Increasingly Used for Recreation*

In addition to using electric vehicles for transport and mobility, there is growing interest in using EVs for recreational purposes. The recreational use of EVs was apparent in a variety of circumstances, and illustrates the varied potential consequences of the shift to electric vehicles with potentially different charging patterns and behaviours. Uses of EVs for recreation included:

- E-scooters being used for enjoyment rather than transport

*“[I use the electric scooter] Just for fun. Mainly on the bicycle track. ...[not for] Going to places. If I going to ... Shopping Centre, I cannot park.. I have to hold it. It’s not convenient” Pat (United Energy)*

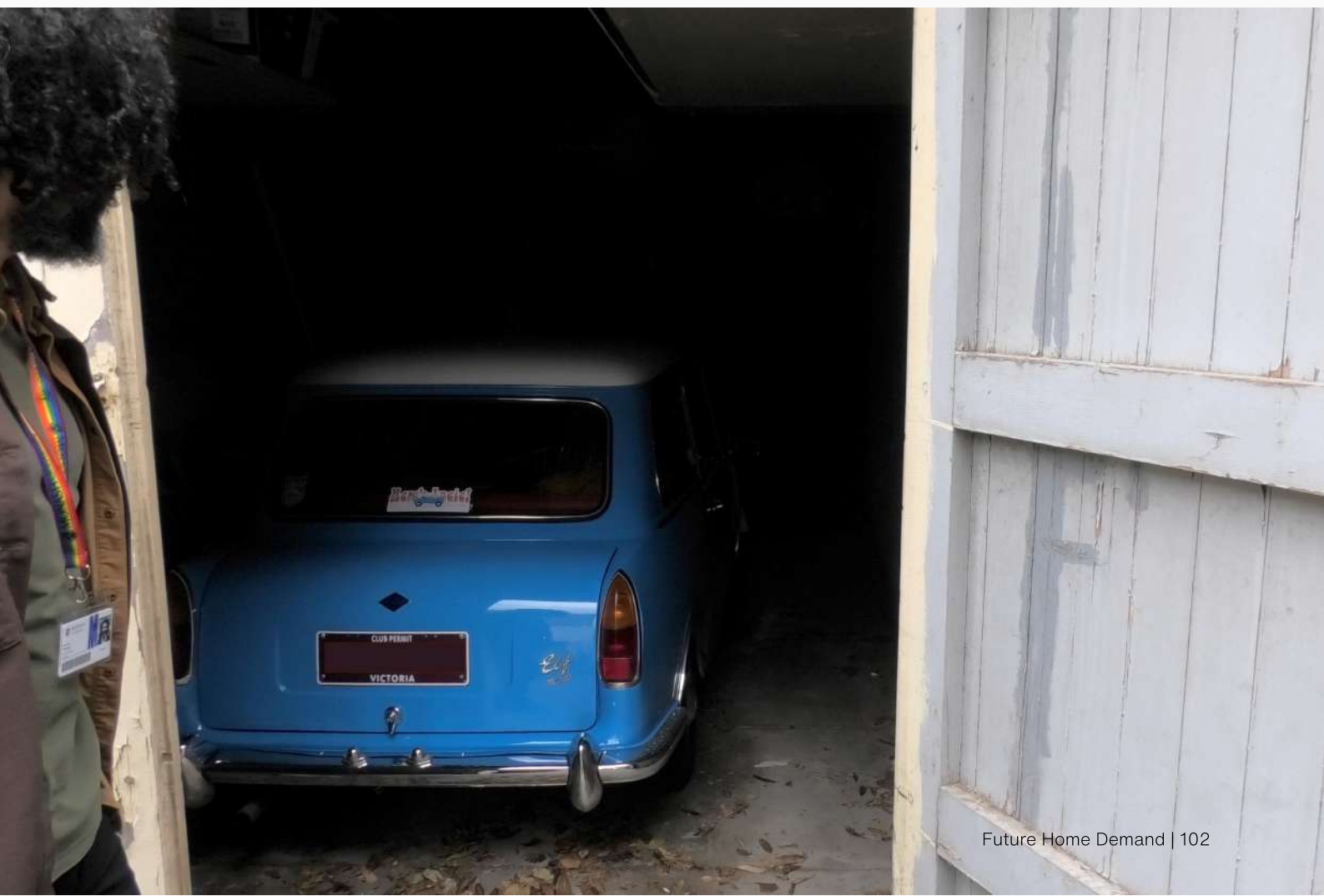
- Electric boats, which are ideal for fishing



*“The electric outboards are... very popular with people who fish in lakes, rivers, estuaries where the water is calm and they’ll have a device with GPS on it... they’ll pick a spot and you can hook it up to the electric motor and it will hold you there... so the fish are not disturbed.” Martin (United Energy)*

- Electrifying classic cars as a hobby

*“Probably the reason that I thought about it [converting a classic car into an electric car], there’s a blog, a guy actually blogged the whole process of turning one of his classics into an EV. ” Dee (CitiPower)*





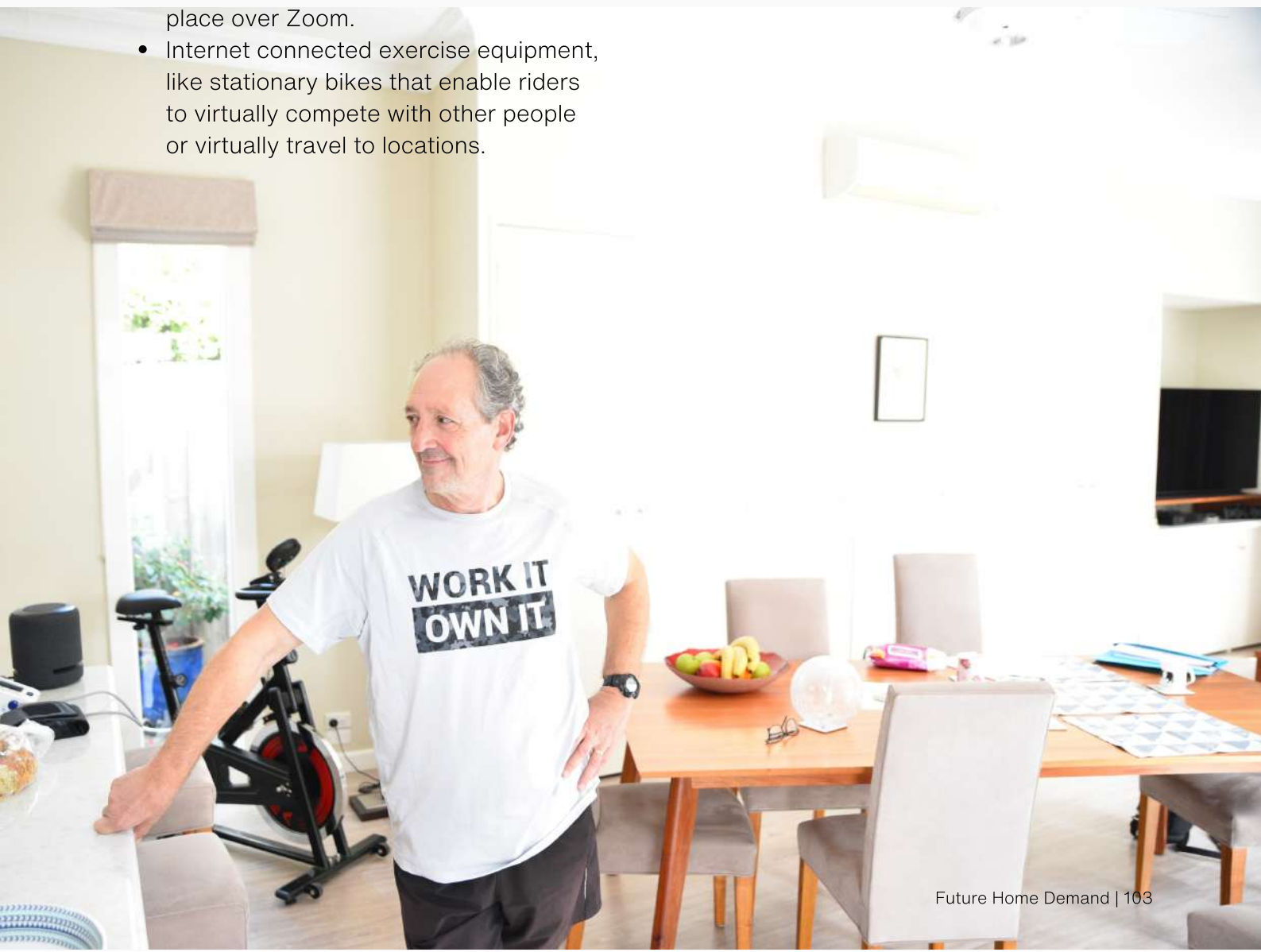
### *Trend 5: Increasing Technology-Use for Exercise at Home*

Technologies are an increasingly central part of health and exercise routines, enabling more exercise at home. As a result, the consumption of energy is increasing both through electricity used by exercise technologies, but also increased cooling needs during and immediately after exercise, as well as increased hot water needs for showering after exercising. Examples of such fitness technologies and practices that are increasingly common include:

- Fitness wearables, like smart watches which track a range of indicators of both fitness and general health. People often have specific charging routines for these devices.
- Online fitness and health classes, including those on YouTube or taking place over Zoom.
- Internet connected exercise equipment, like stationary bikes that enable riders to virtually compete with other people or virtually travel to locations.

*“Yeah, it’s just the bike on the stand, going round. But he does hook his laptop up and puts it in front [of the stationary bike].”  
Alison (United Energy).*

*“The laptop pretty much at the moment is only there because I do exercise, like, a Pilates class once a week, ... and that’s all virtual, so we use the laptop for that because I don’t have a camera for the TV.” Dee (CitiPower)*







## Recreation and Play: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Increasing expectations for the home are likely to increase the energy used at home. Even as the cost of energy rises, other cost of living increases outside the home may encourage greater energy consumption in the home as people invest more in the growing purposes the home is expected to serve.

The use of more spaces in the home for recreation and exercise comes with increased heating and cooling needs, including outdoor heating.

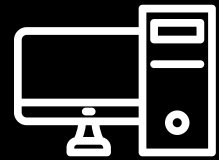
While EVs that are used for recreation are likely to have more flexible charging practices, they also may add to charging demand in advance of holidays, this may be particularly pronounced in seachange and holiday destinations.



Exercise at home will increase hot water needs for associated showers after exercising.

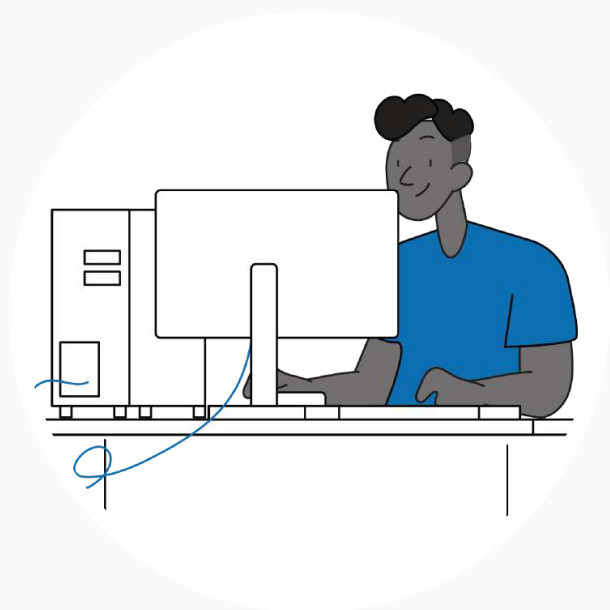
## Recreation and Play: Demand Management Opportunities

- Energy is an important facilitator of recreation and play, which is increasingly taking place in people's homes and in more energy-intensive ways that often entail further forms of energy consumption, such as heating and cooling. Encourage households to (re)engage with recreation outside the home during peak periods or peak events, including through incentives to visit cinemas, playgrounds, shopping centres or pools.
- Promote 'log out and switch off' messages that encourage recreation and play devices to be switched off or powered down when not in use, beginning by targeting energy-intensive activities or devices including high-end gaming computers, spa baths, home saunas or additional screens.



**Example: 'Cool Ways to Have Fun': An incentivised peak alert activity program' as discussed in the Future Grid Report (Engaging Households Towards the Future Grid (Strengers et al 2019, p. 29 [View Link](#)):**

"The Cool Ways to Have Fun" program is an incentivised peak alert demand response program for households that are willing and able to temporarily reduce their residential electricity use by doing an activity outside the home during periods of grid stress (tailored to specific jurisdictions/ regions). It involves partnering with local businesses in a network constrained area to offer a range of discounted or free local entertainment options in cool spaces on hot days."



## School Holiday Peak

*Staying at home with more technology and comfort during winter school holidays creates new peaks on cold overcast days.*

During the winter school holidays children are at home, when parents are working remotely in order to keep an eye on their children. The high cost of living means that many are unable to afford a vacation away and instead choose to stay home and continue working remotely. However, many have invested in home upgrades to provide more recreation and comfort. Many homes have replaced gas with electric heating throughout the house as part of the electrification of their properties. While some work as usual from a regular home office, for others, especially mothers, having the children home while they are trying to work is difficult. In response, many use makeshift work spaces such as sheds or garages to separate themselves from the activity in the house. These often uninsulated spaces are warmed by inefficient portable electric heaters.

Although this consumes lots of energy, because it only happens during school holidays it is considered a temporary issue. More significant energy saving renovations, such as installing insulation in garages and sheds, are not deemed priorities. While parent/s work, children are occupied by various activities around the home, meaning that each occupied space has its own heating and other miscellaneous energy needs. Some children may be playing video games with multiple monitors, powerful gaming computers and accessory lights. Others have visiting friends and are playing in outdoor household recreation spaces, some of which have recently been electrified including with outdoor heating. Some are exercising in home gyms, such as in garages with televisions, stereo systems and heaters on. The cumulative impact of heating and other energy needs within the home during the winter school holidays causes a significant peak – particularly during cold, overcast days which coincide with reduced solar PV production.

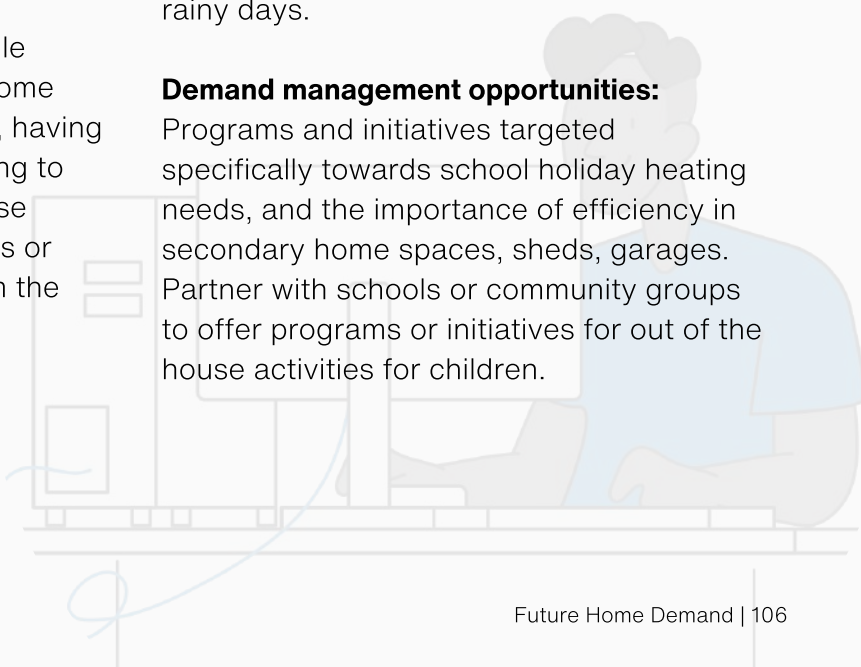
**Affected network businesses:** All, but especially prevalent in areas with large detached homes in outer suburbs, seachange and holiday destinations, and rural areas.



**Peak demand forecast:** High demand during school winter holiday periods and particularly during cold and overcast or rainy days.

### **Demand management opportunities:**

Programs and initiatives targeted specifically towards school holiday heating needs, and the importance of efficiency in secondary home spaces, sheds, garages. Partner with schools or community groups to offer programs or initiatives for out of the house activities for children.



# Working and studying from home

The COVID-19 pandemic saw many working and studying from home. People purchased new digital technologies and adapted their homes to accommodate these new working arrangements. Even as lockdowns have ended, many continue working from home in a hybrid manner that typically involves working remotely two to three days per week. Post-lockdown schools have returned to in-person learning. However, more hybrid forms of learning continue, particularly at the tertiary level.





## EMERGING TRENDS

### *Trend 1: Working from Home Continues in a Hybrid Model*

For those in industries able to do so, working from home for two to three days per week continues to be a common practice, and is expected to continue in future. The implications for energy demand are apparent as people both increase their general demand for services (like heating, cooling and lighting), and shift certain practices to occur during the day (like laundry and dishwashing).

*“Since Covid, I’ve been working a lot at home which is fantastic. I love it. But now we are at a point where they are asking us to go back to the office. So in terms of energy that would definitely lower my expenses, but I quite enjoy working from home as well for the convenience. And yeah, that’s what might happen in the future, a bit of a more mixed hybrid type of work in the house and at work with colleagues.” Florence (United Energy)*

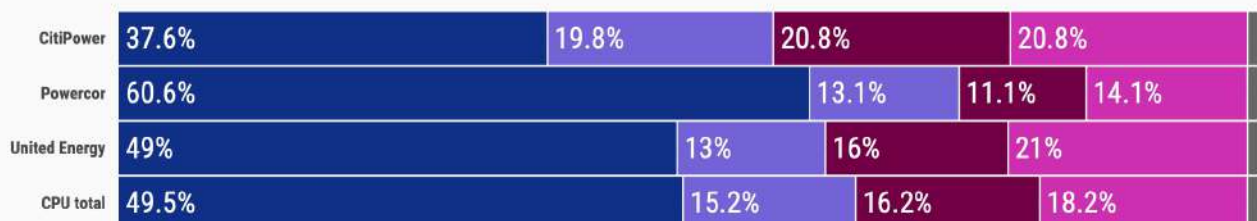
*“My studio is my office where I work from home, and then on the days that I am not working from home, which is about once to twice a week at this stage, I usually get properly dressed and head to the bus stop and then go to a co-working space in the centre of Geelong.” Chloe (Powercor)*



49.5% of all respondents do paid work from home at least one day per week. This is highest in the CitiPower network.

In a usual week, how many days per week is your home occupied by someone 'working from home' (staying home while doing paid work)?

Days: ■ None ■ 1-2 ■ 3-4 ■ 5+ ■ Unsure



Future Home Demand Survey, Question 6.  
All households (n=1325) grouped by provider: Powercor (n=477), CitiPower (n=439), United Energy (n=409). Row % displayed



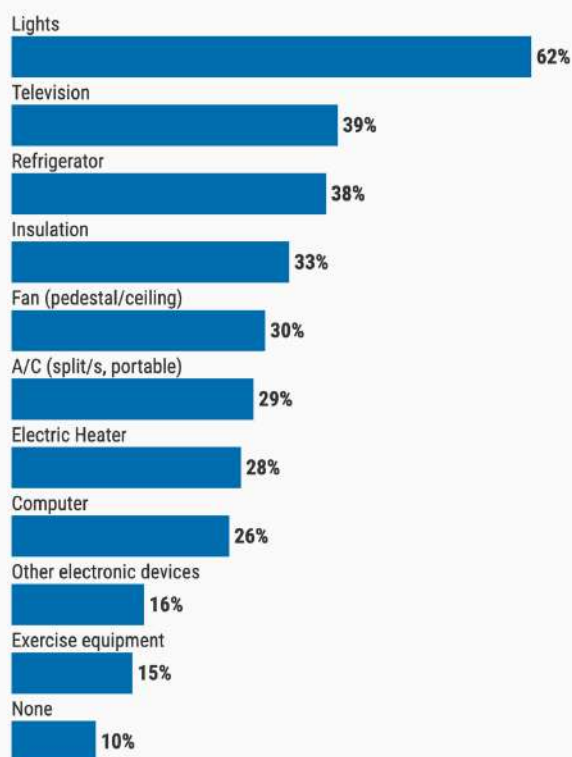


## *Trend 2: The Home is Changing to Respond to Increased Working and Studying from Home*

With working and studying from home continuing, along with expectations that the home will remain an important site of these activities for the foreseeable future, people are altering the way they use their homes and thereby consume energy through:

- Using new spaces of the home during the daytime to accommodate multiple people working or studying from home simultaneously, or to create a division between work and home life.
- Renovating in order to create more rooms and spaces specifically intended for work and study.
- Adding spaces for work and study on the edges of properties or electrifying existing exterior spaces, such as sheds being converted into office space. As they are often poorly insulated, these spaces may include heating and cooling.

69 households had converted an additional area on their property (eg. shed or garage) into a living or recreational space in the last five years. These respondents added the following appliances, equipment or features to that converted space:



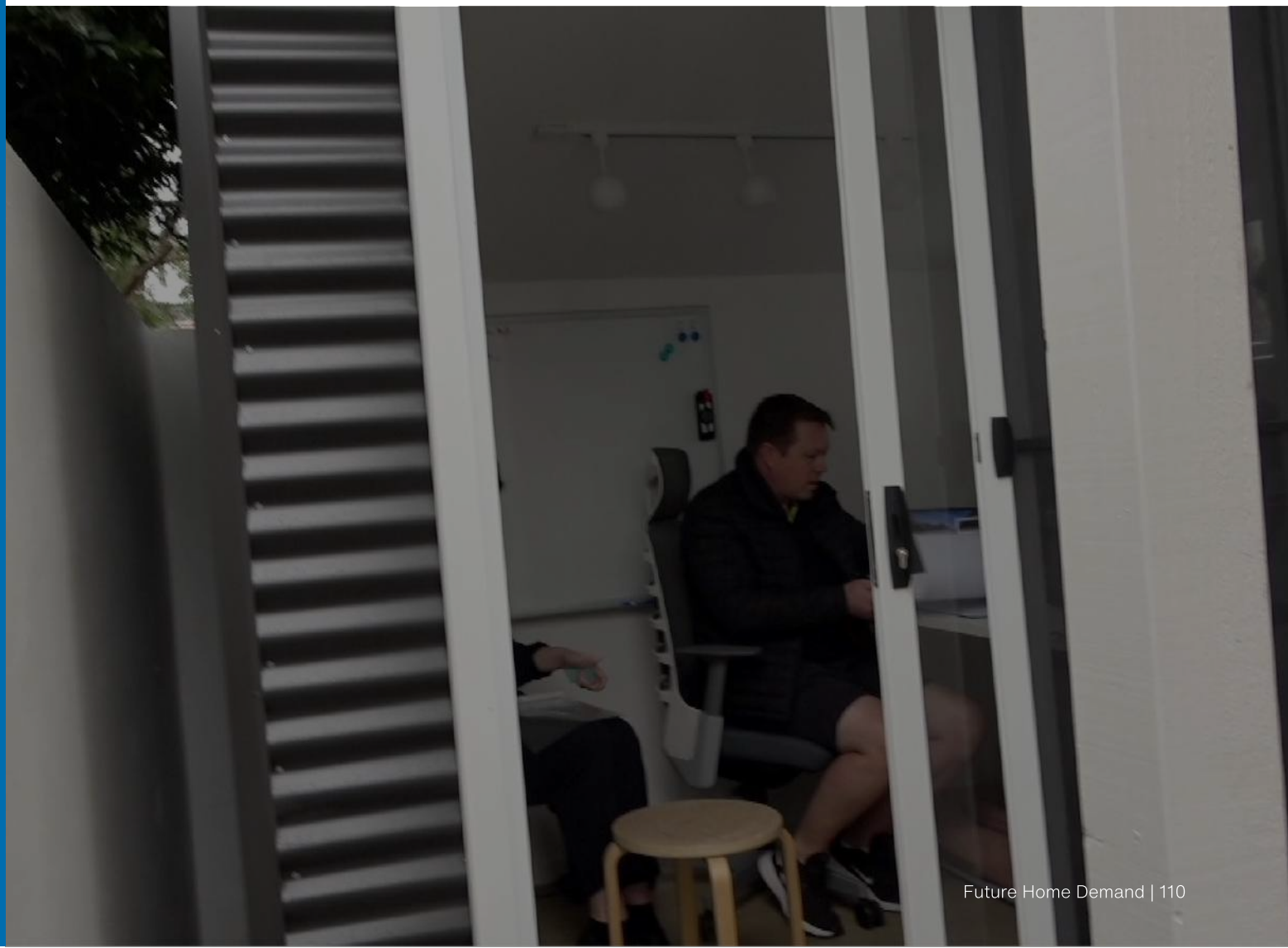
Future Home Demand Survey, Question 21.  
Baseline: Households that have converted an additional area on their property (n=69)



## CASE STUDY | EATON

Eaton lives with his wife and three children in a newly renovated home in United Energy's distribution area. The COVID-19 pandemic precipitated the decision to build a dedicated workspace adjacent to the house so that Eaton's wife could continue running her home business in peace. The shed is fully electric, with an extension cord connected to an outlet on the home's facade. The shed is equipped with a small electric heater for winter, but it is fully insulated, including thick plasterboard for soundproofing. Eaton and his wife also renovated existing spaces within the home to create a dedicated study area for the couple's three children.

This room, which housed three high-end desktop computers, was also designed to be open to the rest of the house so that the children's computer and internet use could be more easily monitored. Discussing the use of computers for both education and entertainment, Eaton recognised that the children's "needs are huge". Adapting the home to help accommodate the various work and study needs of the family, including in a safe manner, was thus paramount in Eaton's household.



### *Trend 3: Working and Studying from home is Increasing Computer Power Needs*

The computing power required in a number of professions and industries is increasing significantly, with potential consequences for household energy demand. Examples include those running complex algorithms, editing videos or other graphics and using virtual reality headsets. In some cases the heat generated by these substantial computing needs may require additional cooling, but could also replace heating in workspaces (as hot air from computers warms the room).

### *Trend 4: Working from Home Increasingly Facilitates Afternoon Load Shifting*

Working from home allows people greater opportunity to undertake light housework during the day when they would otherwise be out of the home, including tasks like laundry, light cleaning and running the dishwasher. The performance of these tasks during the day may lessen energy demand at other times, such as during evening peak periods.

***“So this is the good thing that I'm doing now since we work from home. In some mornings while I'm actually cleaning, if there's washing to put on, I will do this. And then when it beeps, I will actually go outside and [hang it out].” Florence (United Energy)***

14.3% of respondents currently have a high performance PC or server (e.g. for gaming, crypto-mining, running algorithms).



For survey respondents that said it was either 'very difficult' or 'quite difficult' to shift the time of their usual routines (n=876), the top three reasons they identified for shifting being difficult were:

1. I need to do these tasks when it's convenient for me (50%)
2. Not at home at those times (e.g. at work, study) (43%)
3. It's hard to plan when I need to use these appliances (27%)







### *Trend 5: The Particularities of Working from Home Are Increasingly Important in Generating Heating and Cooling Needs*

The generally sedentary nature of working and studying from home can contribute to increased heating demand in winter. As noted in Trend 2, work is often undertaken in rooms that may lack insulation or more efficient forms of heating, such as spare rooms or converted sheds. Heavy computing needs or lights can also heat up rooms, thereby increasing cooling needs in summer. The attire worn while working from home also shapes heating and cooling needs.

*“When I was working from home, I was using the spare room as the office, and I’d have a little microheater at my feet going pretty much all day, and so that bothered me in the sense of, oh man, this is not good when it’s on 24/7.” Laura (Powercor)*

*“If I’m having customer facing meetings, I’ll try and dress up a bit, but today, for example, I’ve only had internal meetings, so a hoodie is okay. I will wear a dressing gown when it’s really cold and then when someone calls, strip it down so that you only see the top half, but it depends on what my day looks like for work... There’s only so many layers you can put on under a blazer before you look like the Michelin Man.” Jasmina (United Energy)*





## Working and Studying at Home: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

When combining the increased heating and cooling needs of work and study spaces (including in poorly insulated office shed conversions), along with increased computing needs, energy impacts of working from home become significant.

Continued working from home likely to increase daytime energy demand, but also creates opportunities for flexibility in cleaning practices and greater use of afternoon solar electricity.



## Working and Studying at Home: Demand Management Opportunities

- The normalisation of working and studying from home offers opportunities to promote self-consumption of solar energy generated during the day. Increased solar self-consumption would provide a benefit both to consumers (through lower energy costs) and energy networks (via reduced needs to upgrade infrastructure).
- Working and studying from home is associated with higher heating and cooling demand, including through daytime occupation of the home's edges (spaces like garages, offices or studios). There is scope to promote lower-consumption forms of comfort while working and studying from home; examples include information campaigns or incentives that support the use of low-energy devices like fans and heated blankets, encouraging improved insulation, or promoting zoned heating and cooling.



**Example: ‘At home’ approaches for weekday occupied households as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 35, [View Link](#)):**

“Respond to household concerns about higher energy use by offering incentives, concessions or bonuses for electricity use in the middle of the day to position demand management as a positive, rather than punitive, strategy.”



## Friday Work From Home Peak

*Increased working from home on Friday, alongside EV charging in preparation for the weekend, creates demand peaks on Friday.*

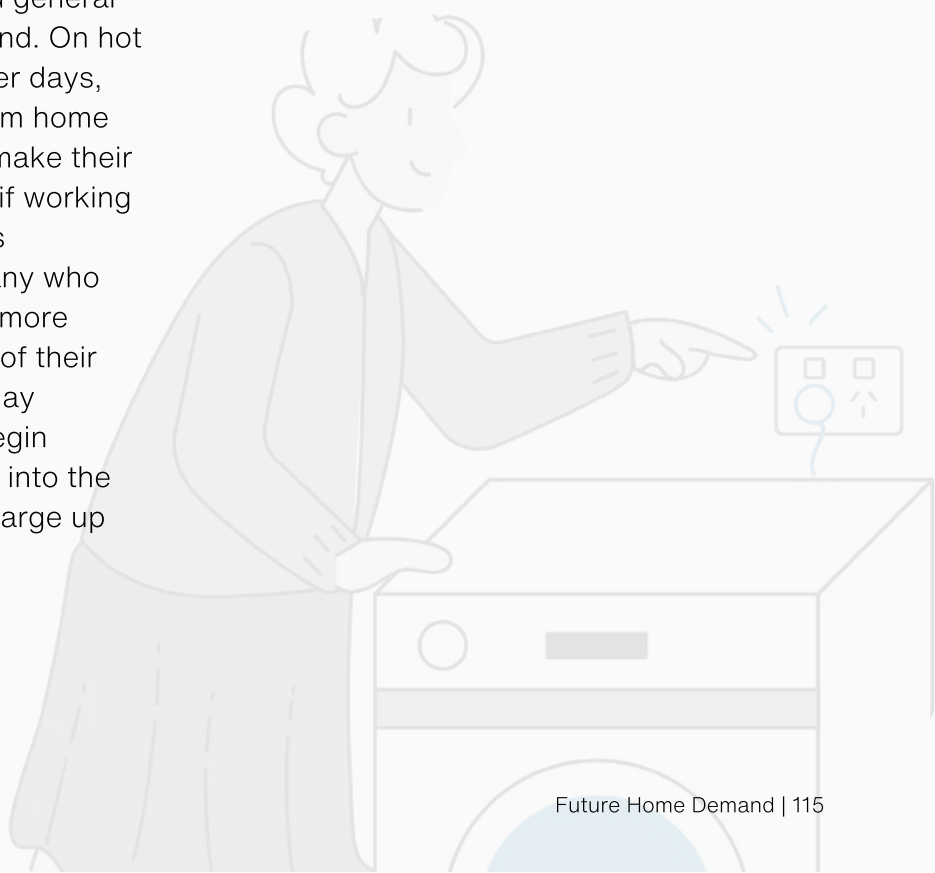
Fridays continue to be the most common day that people work from home. As people work from home on Fridays, they also do household chores like laundry and general cleaning to prepare for the weekend. On hot summer afternoons and cold winter days, the energy used while working from home increases significantly as people make their spaces comfortable – particularly if working in poorly insulated spaces such as converted sheds and garages. Many who work in IT, research, or who have more intense computing needs, as part of their work, will finish the project on Friday afternoon and set a program to begin running and to continue overnight into the weekend. Many also choose to charge up their electric vehicles.

Although people also occasionally charge during the week, Friday evening is considered the most important time to make sure the car battery is full so that the car can be ready for all of the activities that take place over the weekend, including short journeys, day trips and longer drives.

**Affected network businesses:** All, but especially areas with high EV uptake.

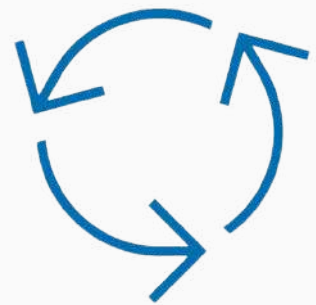
**Peak demand forecast:** Increased demand on cold winter or hot summer Friday evenings.

**Demand management opportunities:** Initiatives and/or incentives that specifically target Fridays.



# Healthy indoor air and thermal comfort

Household comfort is expanding beyond heating and cooling to include a growing interest in managing air quality in the home, including protecting the home and its occupants from bushfire smoke, allergens, mould and unpleasant odours. This means that the management of household air is becoming a household priority linked to health and safety, making it increasingly essential and therefore less flexible.





## EMERGING TRENDS

### *Trend 1: More Rooms and Spaces in (and on the Edges of) the Home are Being Heated and Cooled*

There is an increasing trend towards heating and cooling more spaces of the home, including spaces on the periphery of the house as a result of various other trends occurring in households, including:

- Working from home: Increased working from home, and in additional spaces of the home, has encouraged greater heating and cooling needs. Largely sedentary work at computers particularly encourages greater heating needs in winter. Office-to-shed conversions are also often without usual insulation: ([see Working and Studying at Home Trend 2](#)). Increased computing power can provide office heating, but also presents new challenges for home cooling ([see Working and Studying at Home Trend 3](#)).
- Increasing luxury upgrades of home: Upgrades often include heating and cooling needs, such as cooling in at-home gyms or outdoor heating of entertaining areas ([see Recreation and Play Trend 1](#)).

- Spread of activity throughout the house: The multiplication of screens and spaces for entertainment encourages greater occupation of separate rooms, each with their own heating and cooling needs ([see Recreation and Play Trend 2](#)).

84.6% of respondents currently have an operational air conditioner in their home.



### *Trend 2: Increasing Concerns about Indoor Air Quality*

Households show a growing interest in managing the air quality in their homes, including beyond the usual focus on temperature. The maintenance of air is now not only about household comfort, but increasingly about protecting the health and safety of household members. This increasing interest has significant energy implications as people attempt to manage the air quality through various means, discussed in trends 3-6.







#### Allergens (e.g. dust, pollen etc)



#### Mould



#### Cooking pollutants (e.g. odours or gases)



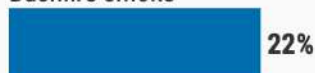
#### Odours (e.g. from a pet or cooking)



#### Viruses/germs



#### Bushfire smoke



#### Other



Households are concerned about the following air quality issues in their homes:

*(Most common 'other' responses include: pollution from road traffic, and smoke from wood fireplaces)*

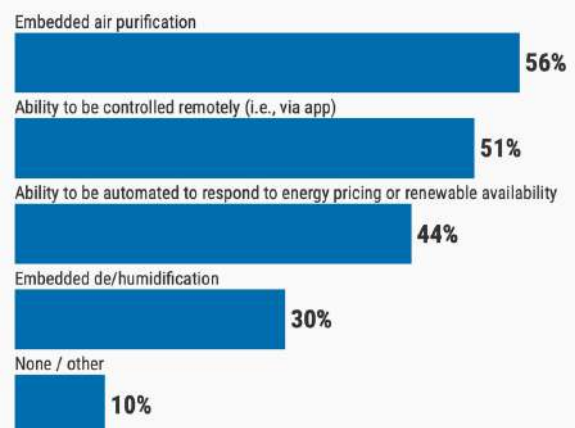
Future Home Demand Survey, Question 22.  
Baseline: Households concerned about air quality in their homes (n=642)

### Trend 3: Households Increasingly Looking to Technology such as Air Purifiers and Dehumidifiers to Manage Air Quality

Households show a growing interest in managing the air quality in their homes through adopting air technologies in the home. These increasing expectations around household air quality are generally accompanied by increased energy demand, as technological solutions are used to manage indoor air. Dehumidifiers are also adopted to deal with mould, particularly among renters and those living in older homes. People are continuing to purchase stand alone air purifiers to manage air quality, and there is growing interest in combining air purification with heating and cooling systems which may shift heating and cooling practices and make them less flexible.

*"Last time we had an [rental] inspection we were just given it [a dehumidifier] and said, "Use this to fix the mould problem... Whenever we have a shower or whenever we run the washing machine or the dryer or whenever we use this room, whenever we used this room in general, that's when the dehumidifier goes on. And then on the days that I'm not doing any laundry or my partner's not doing any laundry or we're not actively having a shower, then we unplug it from the power-board, we take it into the bedroom and plug it in there to go all day." Chloe (Powercor)*

What features will you want in your next air-conditioning unit that you might purchase in the next 10 years?



Future Home Demand Survey, Question 27.  
Baseline: All households intending to purchase an air-conditioning unit in the next 10 years (n=41)





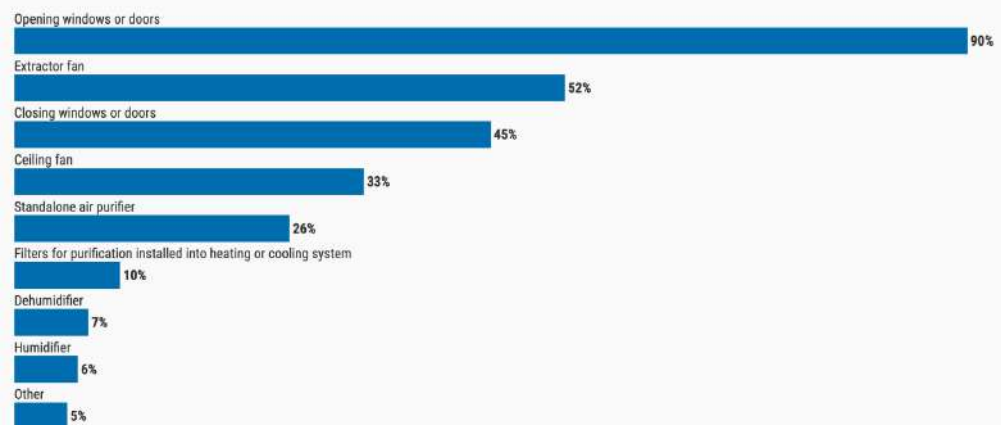
#### *Trend 4: Growing Interest in Improving Indoor Air Quality through both Increasing and Decreasing Natural Ventilation*

In addition to technology, managing air quality also often relies on manual methods like airing the home by opening windows and doors. Some prefer opening the house to improve air quality inside over using technologies such as air purifiers. The opening up of the house can be accompanied by continued use of heating and cooling. In other circumstances, such as during bushfire season or when seeking to avoid outdoor odours, some prefer to reduce natural ventilation by closing up the house. This has led some to consider replacing evaporative cooling with refrigerated systems, and others to install air filtration into new evaporative cooling systems.

*“I love heating the whole house... everyone is going, “Oh the window is open and the heater’s on”, and you are just going, “Oh shut up everyone”.... Normally I’d keep the windows open a little bit. .... Just to get the air through.”*  
*Anthea (United Energy)*

*“There’s a cow farm not far out of town, and when the wind’s pushing the wrong direction, we’re right in the line of it, and we actually need to shut the house, and it does drift a lot worse in the summer. And the same thing, even shutting our windows and stuff. So we might have had natural ventilation, [but] we can’t even do that.”* *Jake (Powercor)*

**How do you manage the air quality in your home?**



Future Home Demand Survey, Question 24.  
 Baseline: All households that manage the air quality in their home (n=536)



### *Trend 5: Increasing Interest in Improving Indoor Air Quality through the Electrification of Gas Cooking*

The electrification of cooking is often a result of increased concerns about the air pollution caused by gas cooking. Other motivations for electrification, including the resulting cost savings or wider environmental benefits, tend to be limited by the financial and resource implications of replacing appliances – particularly when gas appliances are still functioning. However, health concerns are a strong motivation for adopting electric cooking appliances beyond price or environmental concerns.

### *Trend 6: Increasing Interest in Improving Indoor Air Quality through Electrification of Wood Fired Heating*



There is a growing interest in replacing wood heaters in rural areas. This interest is arising for a number of reasons, including the rising price of wood, the labour involved in sourcing, transporting and chopping timber, and the implications of wood fired heating for both indoor and outdoor air quality. The replacement of wood heating with electricity would likely increase the energy demand of these households substantially.

*“Every winter, I cough, and then I cough for two months...I put a [induction cooktop] board on top of the existing [gas] cooktop. I used it for two months. I found it’s very helpful for my [coughing]” Pat (United Energy)*

*“One thing here is it’s a wood heater, which is our only source of heating other than that electric heater I pointed out that we’ve got on the smart switch. This is a royal pain in the backside. There was no way we were getting a wood heater [in our new house]... And our clothesline is just out there too. If you’ve got washing out there on the line, it covers it in smoke.” Jake (Powercor)*

*“[the fire]s dusty, like it's dusty....You've got all the little negatives - there's some negatives to having a fire, as well as the positives.” Robert (Powercor)*



## Healthy Indoor Air and Thermal Comfort: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Increased concern about air quality shifts management of indoor air from being about comfort to also being about health and safety, making it more essential and therefore less flexible.

Air purification is likely to become integrated into heating and cooling systems. Split systems with integrated air purifiers are already on the market. This is likely to change usage patterns and create more 'always on' systems, or create patterns that are responsive to air quality in addition to temperature variations.

Opening and closing the house and preferences for natural ventilation may shift in relation to outdoor air quality, leading to changing heating and cooling practices.

## Healthy Indoor Air and Thermal Comfort: Demand Management Opportunities

- Promote less-energy intensive heating and cooling by encouraging low-consumption adaptations that heat/cool the person as a first step towards improving comfort, rather than heating/cooling space. Examples could include changing clothing, consuming warming/cooling beverages and food, and using fans or hot water bottles to improve comfort.
- The electrification of services like gas cooking and wood heating offer opportunities to avoid or mitigate associated energy consumption through increased needs for air purification.



**Example: Zoned and personal temperature options as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 31-32 [View Link](#)):**

“Explore ways to support household access to and use of affordable and efficient zoned heating (and cooling), including via partnerships involving utilities, government, the housing construction sector, and air conditioning and appliance manufacturers and industry bodies. [Demand management programs could also] promote and enable access to devices that warm (or cool) the person rather than the room, e.g. heated foot mats and blankets.”



## Thunderstorm Asthma Peak

*Serious health and air quality concerns during asthma thunderstorms encourage closing up the home, running A/C and air purification which coincide with reduced solar production.*

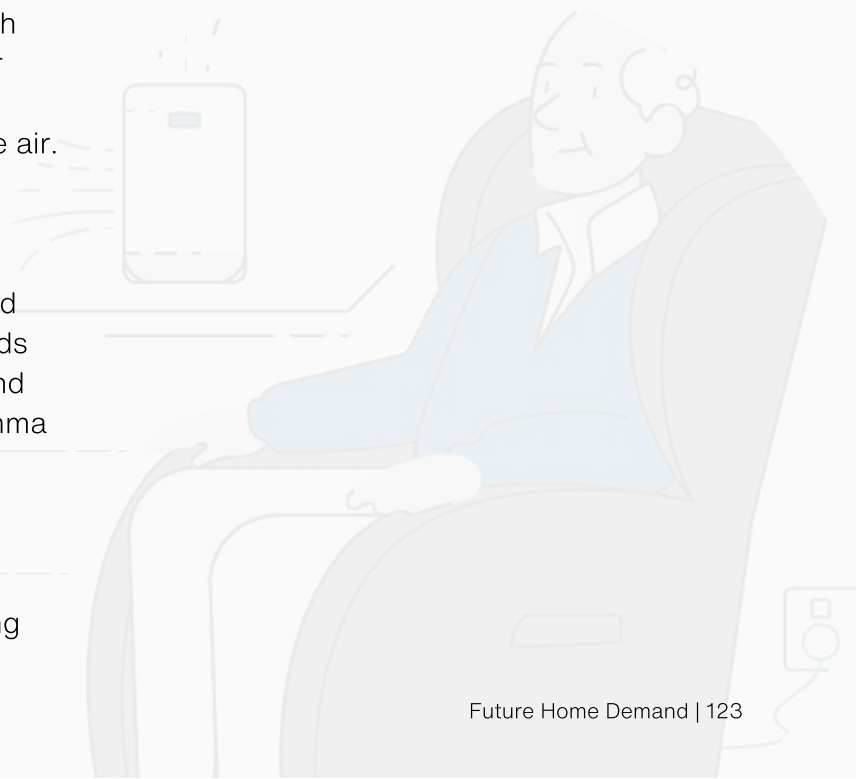
From October to December during grass pollen season, Victoria is at risk of epidemic thunderstorm asthma events triggered by thunderstorms. Vic Emergency alerts go out with instructions to stay inside, close doors and windows of the house, and set air conditioning to recirculate air. Those with evaporative cooling switch to using their refrigerated cooling, and people turn on their air purifiers to clean pollen from the air. Those with hay fever or who have experienced asthma attacks previously have purchased multiple powerful air purifiers, and had air purification installed into their A/C systems. At risk households run their A/C on high to purify the air, and reduce the chances of a dangerous asthma attack. Smart air purifiers, which people have acquired and use for a range of reasons, are always plugged in and now automatically turn themselves on in response to air quality monitors detecting an increased pollen count.

This may also happen when no one is home, or occupants are not directly concerned about pollen and asthma. As thunderstorm asthma events occur during extreme weather, they also correspond with weather warnings from the Bureau of Meteorology. In turn these warnings could contribute further to the thunderstorm asthma peak by triggering a storm charging peak ([see Storm Charging Peak scenario](#)), as household batteries collectively draw from the grid in advance of bad weather. Moreover, this peak in consumption is exacerbated by a decrease in solar production during inclement weather.

**Affected network businesses:** All

**Peak demand forecast:** Localised peaks during asthma thunderstorm conditions in October to December.

**Demand management opportunities:** Work with manufacturers, builders and consumers to privilege devices which separate air purification from heating and cooling functions. Partner with VIC Emergency to develop and support low energy-intensive ways of dealing with asthma thunderstorms.





# Cleaning, showering and laundering

Maintaining cleanliness is considered essential for household health and well-being. While emerging energy and digital technologies present new possibilities, many households have strong routines and preferences around maintaining cleanliness and hygiene. Therefore these practices may be inflexible and the availability of hot water for such practices is considered necessary.





## EMERGING TRENDS

### *Trend 1: Showering Continues to be Embedded in Other Routines, and is Increasingly Important for Maintaining Structure for the Day*

Showering or bathing at a particular time of the day is important to many households, as these practices are embedded in or help to structure other activities, such as bedtime for children, exercise, or setting a morning routine. People with less externally-defined schedules – such as retirees, or those working and studying from home – also noted the importance of showering or bathing as an act of self-care, or marker of activity in one's day. Consequently, the energy used in hot water heating may only be flexible insofar as hot water is available during key bathing times.

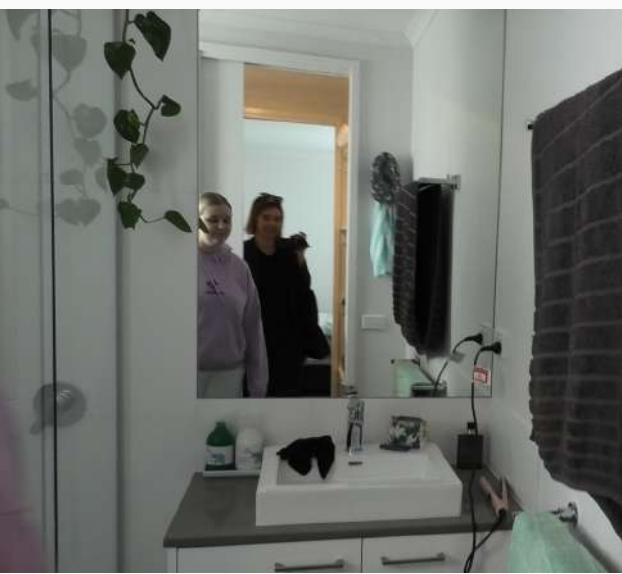
*“Well the morning routine is not strong but often I haven't had a shower by now. Things happen, gardening, walking, whatever, stuff goes on. [but]... if it hasn't happened by 3[pm], I start to think well really Anthea, either get a job or tidy yourself up. But the night time one happens before I go to bed and it's part of the sleep hygiene. So I'm wedded to it and I'm pretty wedded to two showers a day.” Anthea (United Energy)*

### *Trend 2: Concerns with Air Quality are Encouraging Dryer Use*

While a substantial number of households own a clothes dryer, most households continue to only use dryers when it is considered necessary, such as during an extended period of rainy weather. However, concerns about poor outdoor air quality, including smoke or other pollutants, are causing some to use the dryer more frequently. Air quality concerns around increasing moisture inside the home are also a concern for households dealing with mould problems. With increasingly frequent and extreme weather events and bushfires, use of clothes dryers may become more regular and widespread.

*“I try to avoid drying clothes inside although sometimes it just has to happen, because I'm just conscious of the moisture.” Maria (CitiPower)*

*“We have to be careful what we put outside in the winter time, because the fire's going, because the chimney's just there, and the clothes line's on that wall.” Robert (Powercor)*





### ***Trend 3: Continued Mismatch Between Energy Management and Household Cleaning Priorities***

The person in a household who takes over the majority of the energy management of the house, such as understanding and managing CER, is often not the same person who uses the majority of the energy undertaking housework. This is often divided along traditional gender roles in heterosexual households, where the man engages in energy management while the woman performs and manages the domestic labour. This division of labour can complicate (sometimes competing) priorities around energy and household management.

*“My wife just completely ignores it [ember pulse-an energy feedback portal]. She’ll put the washing on when she wants, she’ll set the dishwasher when she wants, that’s fine.... you know the timing of the dishwasher isn’t top of her priority list.... the kids have got various appointments, or something needs to be done for the school, that’s sort of, she generally handles most of that. Or even just like, generally maintaining the house, it’s more her than me to be fair.” Sean (Powercor)*



#### **CASE STUDY | DOLORES & ALAN | CITIPOWER**

Dolores and Alan, along with their two kids, reside in an inner-city home. They converted the house to run entirely on electricity due to a shared desire to lower their greenhouse gas emissions. Alan, a retired electrical engineer, recently invested in rooftop solar and a Tesla powerwall as part of a plan to change how they use electricity, and reduce their dependence on the grid.

Dolores is primarily in charge of the children, cooking, cleaning and other housework, despite having a number of ongoing health issues and experiencing fatigue. Because of how busy her life is she does things when they are convenient. So, if Dolores has the energy to do laundry, she will. "I do things when they are convenient because life is so hectic, so if I get a chance, I'll just have to use it[the dryer] quickly," she said.

During our conversation with them, Alan explained to Dolores that since they are not purchasing power from the utility at night, using the dryer during the day makes more sense as they could use their own solar production. This surprised Dolores as she thought it was the other way around, and had been mostly using the dryer in the early evening.



#### **CASE STUDY | LUKE AND ASHLEIGH | UNITED**

In another household in United Energy’s distribution area, we spoke with partners Luke and Ashleigh. They had solar panels on the roof, which Luke was aware of. However, when we asked Ashleigh if she ever considered moving her power consumption to take better advantage of the solar production, she didn’t realise the household had solar panels, “Solar Power? [laughing]...Oh we do [have it], do we? [laughing]”





#### *Trend 4: Inherited Cleaning Advice Continues to Affect Appliance Usage*

People often draw on inherited wisdom that guides how and when they clean. This advice generally comes from parents – and in particular mothers – and regards cleaning norms or techniques, such as the frequency with which one should wash bed linen or vacuum, reputable appliance brands or the appropriate settings for appliances like washing machines. Inherited cleaning advice may not always align with goals like energy efficiency, and can make practices less flexible or price responsive if embedded in other routines and preferences.

*“She told us to always use cold. I really didn’t question it. I was like ‘My mum genuinely knows what’s best.’” Jasmina (United Energy)*

*“[Mum] said something, I think about 60 degrees and [that] nobody washes anything below 60 degrees.” Simone (Powercor)*





## Cleaning, Showering and Laundering: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

Traditional gender divisions around an 'energy manager' (commonly a man) and household labour, especially cleaning (more commonly done by women) can limit the adoption and utilisation of CER if not addressed.

Shifting the heating of controlled load hot water must account for the importance of showering's embeddedness in other household routines.

Dryer usage is still low in households, but may increase in relation to air quality concerns outdoors and indoors.



## Cleaning, Showering and Laundering: Demand Management Opportunities

- Messaging around shifting controlled load hot water to afternoon heating should account for the importance of showering and bathing in relation to other important routines, such as preparing children for bed. In order to maintain the general acceptance of controlled load hot water, communications should use accessible terminology, and directly respond to householders' concerns (such as those around a general lack of hot water or a reduced morning hot water service). There is also scope to frame hot water as a form of (thermal) storage, thereby illustrating to householders the wider importance of shifting controlled load hot water.
- Worsening air quality, extended periods of poor weather or intensifying standards of cleanliness may contribute to high-consumption forms of washing and drying; messaging could reassert the continued effectiveness of lower-consumption forms of cleaning, such as using a cold wash cycle or hanging clothes up to dry.



**Example: Hot water as a lead 'solar sponge charging' concept as discussed in the Demand Management Opportunities report (Nicholls et al 2021, p. 40, [View Link](#)):**

“As automation of hot water heating has been widely accepted, linking the desired shift towards daytime operation of hot water units with charging of other devices could support acceptance of automation more widely, particularly if the sector adopts more consumer-friendly language for associated products (e.g. shifts ‘controlled load’ terminology towards the advantages instead of prompting household concerns about who has control of their home appliances and whether they trust that organisation).”



## Bushfire Peak

*Increasingly common bushfires create prolonged smoky conditions, limiting solar production while people stay home and increase their energy use to create safe and healthy air at home.*

Increased extreme weather causes more frequent and extreme bushfires, which in addition to causing significant local damage also create prolonged smoky conditions across a wide area. In order to protect themselves from bushfire smoke, where able, people choose to work from home to avoid exposure to harmful conditions. Some schools also switch to remote learning and children stay home. Because of the poor air quality outdoors, people close up their homes. For example, those who normally rely on natural breezes to cool the home, or who use evaporative cooling, shut windows and doors. Refrigerated cooling becomes more important for keeping the house comfortable. Households also turn on existing air purifiers, or purchase additional devices, in order to deal with smoky conditions.

Air purifiers on automated settings also run at a higher level to deal with any pollution that seeps into the house. Because they do not want to leave the house, people also use more energy cooking, exercising and entertaining themselves at home, with associated energy costs and consequences for the system. People who normally dry their laundry outside also switch to using a clothes dryer to avoid laundry smelling like smoke. Solar production is also reduced due to the smoky conditions.

**Affected network businesses:** All, but particularly in more bushfire prone rural areas



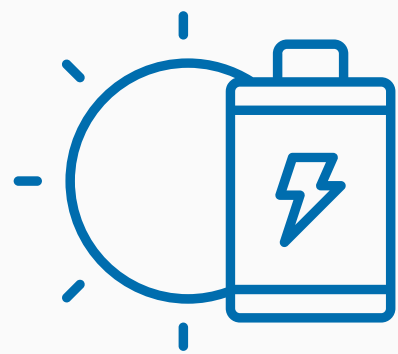
**Peak demand forecast:** Increased demand during and in the immediate aftermath of bushfires in localised regions affected by smoky conditions.

**Demand management opportunities:** Work with emergency services to encourage low energy ways to protect indoor air quality during smoky conditions, and target demand management to lower discretionary energy usage during smoky conditions.



# Making, saving, sharing, and storing energy

Households have considerable interest in the opportunities that new energy technologies give them to engage in the transitioning energy system, especially opportunities to contribute to decarbonisation and to resourcefully share solar energy. However, many household activities remain inflexible and some resist the adoption of smart technologies for energy management, preferring instead to maintain more hands-on control.





## EMERGING TRENDS

### *Trend 1: Interest in Smart Home Technology is a Precursor to Energy Technology Interest*

The higher upfront costs, longer payback periods and relative immobility of energy technologies means they are more accessible for homeowners, who tend to stay in properties for longer periods of time and are better placed to financially benefit from any investments in the property. However, smart home technologies that can be installed and uninstalled relatively easily are popular among technology-interested renters and those who intend to move more often. These technologies sometimes serve as a way of engaging in energy management, or as a first step towards engaging more substantially with CER like solar, batteries and electric vehicles at a later date.

### *Trend 2: Households Continue to Show Little Knowledge of or Engagement with their Tariff*

Many households are unaware of their tariff, in particular whether or not they are on a time-of-use or flat tariff, or what time the electricity price changes if they are on time-of-use tariffs. Even when people are aware of their tariff, most do not actively shift their behaviour in response to tariffs.

*“I can't remember. There was, we did have like a three tier tariff thing where it was one time during the day, one time in the afternoon..., and I think it's just down to either a flat rate now, I don't know. The power changed, I haven't really looked at it properly since they updated it.” Luke (United Energy)*



### **CASE STUDY | JAKE | POWERCOR**

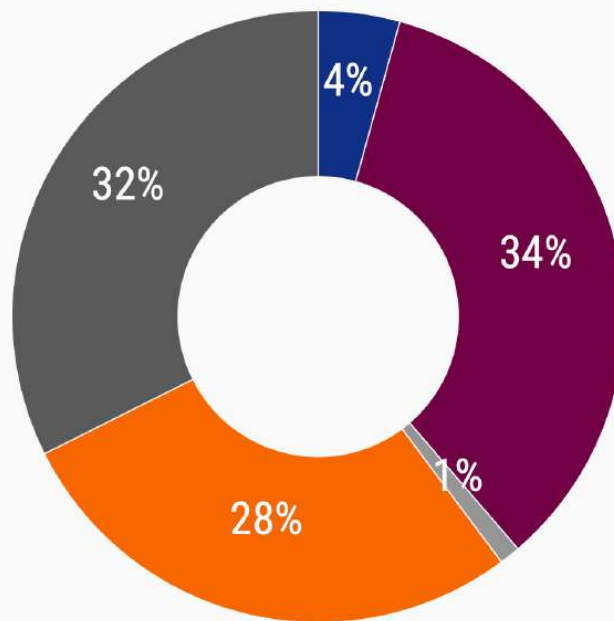
Jake works in a small rural town as the technology teacher in the local school, and is very interested in smart home technology. Jake currently lives in poor quality housing provided by his employer. Jake has installed a number of smart home technologies throughout the house. These devices are smaller piecemeal investments and did not require substantial installation into his temporary home. For example, although the house's only installed heating is a wood stove, Jake has purchased an electric heater that he has on a smart plug, voice assistants with routines, smart doorbell and security cameras, and smart lights that are on sensors but are also set up with geofencing to turn on when he nears home. Jake is also in the process of designing and planning for building his own home. Because of his interest in digital and energy technologies he hopes to have an integrated and all-electric smart home, but he also wants to ensure the house is designed for energy efficiency: “In the new house, we've double-glazed everything, insulated everything further. ...We've got a reverse-cycle ducted system, ...which can be fully controlled remotely, hooks in with Google Home...we made sure we've got plenty of zones, so we're not heating or cooling areas where people aren't going to be in.” Jake is excited about the possibility to more fully participate in the transitioning energy system, and is currently looking into options for adding CER including solar panels, a battery and joining a VPP.





#### Type of electricity pricing

- Controlled Load
- Flat Tariff
- Other
- TOU
- Unsure



Future Home Demand Survey, Question 39.  
Baseline: All households (n=1325)

### *Trend 3: Solar Self-Consumption is Increasingly Appealing to Households*

Although few are engaged closely with their tariffs, consuming solar power from one's own system is of interest for many households with solar PV. The appeal of self-consuming solar generates positive feelings of productivity and self-reliance. Shifting energy use in relation to more tangible experiences, such as when the sun is shining, makes more intuitive sense to people than responding to quarterly energy bills.

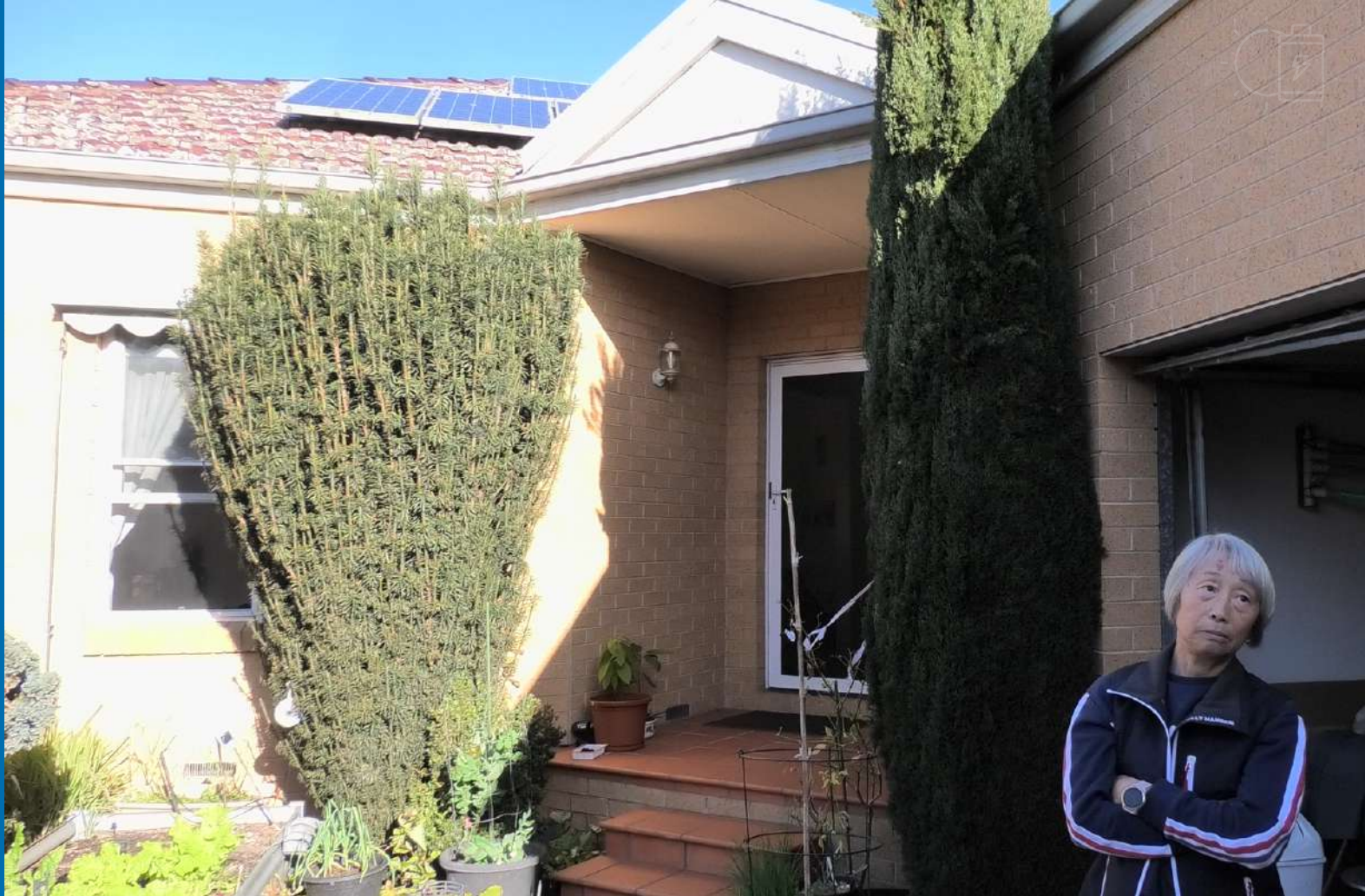
26.3% of the survey respondents (348 people) had energy monitors or feedback portals, but of these respondents 21% did not know their tariff.



32.4% of survey respondents were unsure of their energy tariff.



*"I don't pay attention to [the solar system] other than when I walk outside and I hear the inverter thrumming, I think, "Ah, that's making me electricity", which is nice. But I've never been one to watch the dials and work out the bills and things like that." Liz (Powercor)*



## CASE STUDY | CHLOE | POWERCOR

Chloe and her partner work from home and have very flexible schedules. They rent their home and do not have access to solar PV. However, they imagined that if they did have solar panels they would shift their entire schedules to make the most of their solar production, moving to a “Spanish model...where the lunchtime would become our more dinner; where me and my partner would sit down, we’d eat together, we’d cook each other meals, like most of the energy-intensive stuff in the middle of the day, and then we would reduce... the amount of power that we would use outside of those hours”. Instead of making minor shifts, they imagined making fundamental changes to their schedules to accommodate solar self consumption.

Chloe compared this to how they currently do some shifting in relation to peak and off-peak energy prices, but it would be much more significant if they could consume their own solar energy: “We would make the routine work for us as opposed to trying to force our routine that we currently have, where off-peak and on-peak does factor in, but it’s not much of a factor compared to something like a solar smoothing future where if that was the case, then we would definitely change our routine.” Not having children and both running their own businesses and primarily working from home meant that they had far more flexibility than most households.



#### ***Trend 4: People Increasingly Interested in Sharing and Resourcefully Using Renewable Energy***

Acceptance of low feed-in tariffs, especially for those who only recently installed solar PV, is shifting expectations of financial returns from exporting to the grid. People increasingly want to share excess solar production with neighbours and community organisations, and are less focused on the financial return from selling their excess solar.

*“We’re getting so little solar feed in tariff now, and they’re actually saying that the grid can no longer cope... I’ve heard that they have been talking about maybe – they cut off people once they get to a point and maybe even charging people for feeding in. Well I will not pay to feed my extra solar in... but I think as a community initiative, there must be some way you can set up a system where people can actually share the power.” Yvonne (CitiPower)*

*“For instance, if a company is in need of electricity they have to pay, but if it's a neighbour or a friend or even someone who is really in need of electricity ...it's okay if they want to use [my excess solar for free].” Qianfan (United Energy)*



#### **CASE STUDY | JAKE | POWERCOR**

The idea of giving away one’s spare resources, even at a small cost, is not considered unreasonable or without precedent. For example, Jake is very tech savvy and he has a large and powerful computer at home. He explained how he had an app on his computer called Folding@home, “where you can lend your computing power to research projects”. When he isn’t using the computer he can turn this program on, and it uses his computer’s computing power to perform calculations for research projects. Jake realises that this costs him a little bit of money in terms of the energy costs, but he is happy to donate that small amount to the effort, even without knowing directly what it’s contributing to. He also linked this to how he might similarly share his excess solar, “if we had excess solar, it wouldn’t worry me much where that went to. Which again, if that was charging a community battery or something, well great, [I’d] be more than happy for something like that.”





### Trend 5: Increasing Solar-Self Consumption is Motivated by a Desire to be Resourceful

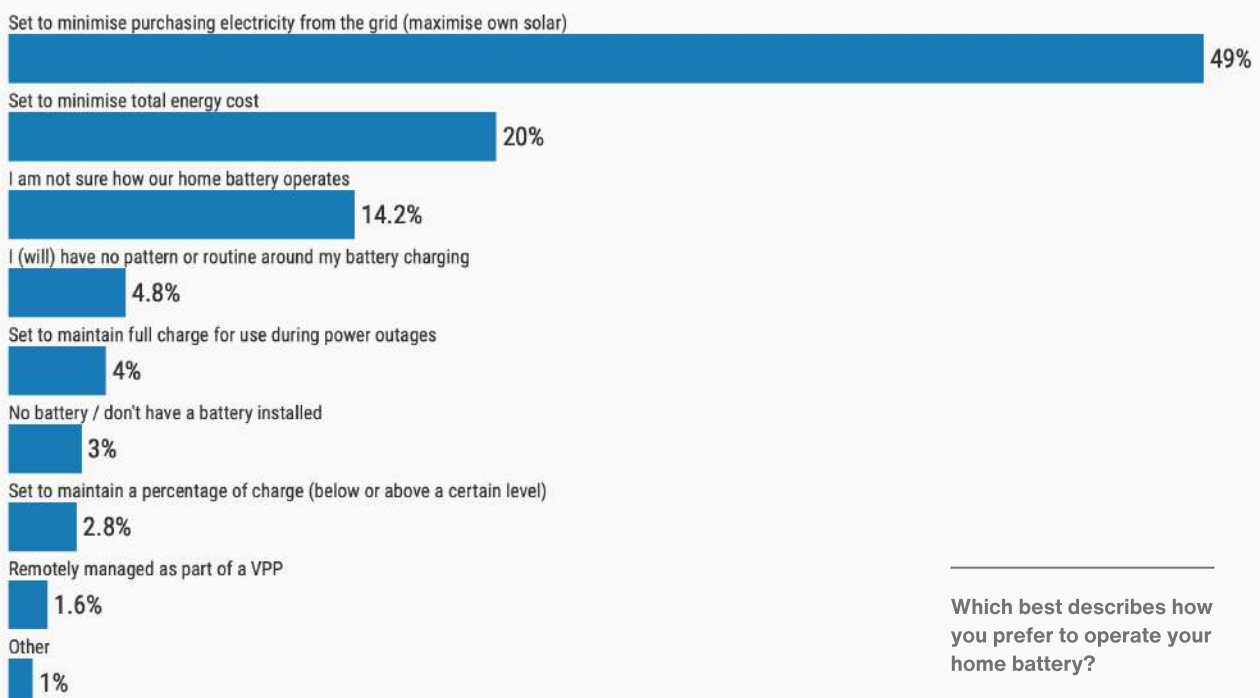
Solar self-consumption is appealing, but not always possible for households. In the context of expected low feed-in tariffs, the desire to export to the grid is not only about financial benefit that can be derived from feeding solar into the grid, but increasingly about not wasting renewable electricity. Wasting renewable electricity is incompatible with the reason many continue to install solar, which is not only about the financial payoff, but also about doing their part in decarbonisation efforts and increasing their own energy independence. Batteries offer a means of solar self-consumption for those otherwise unable to use afternoon power.

*“There doesn’t always need to be a financial thing [for exporting excess solar]. It might be a once a year thing. You get a gift voucher once a year at the time or whatever, as a thank you for doing that. Not a financial incentive in terms of you get six cents back or whatever ...At the end of the day, if you’re not using it, what does it matter?” Rowan (CitiPower)*

*“not wasting money...not wasting resources, time, that’s a big thing I think for our family or for my own personal values as well.” Maria (CitiPower)*



Of people who own or intend to purchase a household battery in the next five years (n=422), 49% preferred to maximise the use of their own solar, whereas only 20% preferred the lowest cost option for charging their batteries. Solar self consumption is privileged by 29% more households than reducing energy cost.



Future Home Demand Survey, Question 8.  
Baseline: Households that currently own or intend to purchase a battery in the next five years (n=422)





### *Trend 6: Responding to Demand Management is Increasingly Not Motivated by Financial Incentives Alone*

Reasons for demand management programs are not often clear to households. However, once grid challenges are explained, many are interested and eager to participate as a way to contribute to the grid as a community resource.

*“I can’t even remember what it was, but when it popped up, they said, ‘If you can do this [reduce your energy use] at this time, then you’ll be rewarded.’... For me, it would have been sufficient just to say, ‘This will allow everybody’s electricity to stay on if you do it this way.’ That, for me, was enough incentive... I guess I have a level of optimism that if, with our smart devices, we can modify our behaviours in certain ways that can allow the grid not to fail, that in itself is a good enough incentive that not having it fail [laughs] is I think a great incentive.” David (CitiPower)*



### **CASE STUDY | ANTHEA | UNITED ENERGY**

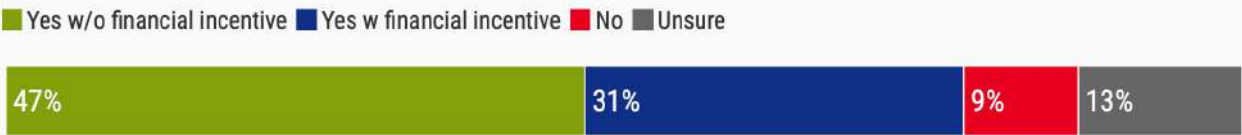
We asked Anthea if she had ever been asked to reduce her energy use during a peak demand time for a financial incentive, and explained that this would be something like if you use less energy for the next few hours, we’ll give you \$50 off your energy bill. She replied, “that would mean nothing to me”. We followed up, but what if they told you “if you reduce your energy you will help to support the grid so they don’t have blackouts”. She instantly changed, and said “That would mean a lot to me. I would do it absolutely. If the energy company said on the evening news, turn the TV off and go and sit in a cold bath, I would go and do that so that people didn’t have to be roaming around. I mean I can’t imagine anything worse than on a cold or a hot day to have to leave your home.” Although Anthea said she’s not a typical charity volunteer type, meaning she would never go out of her way to go and volunteer at a charity, if she’s given direct directions of what to do, she’s willing to do it for the good of the community.

Of the survey respondents, 47% said that they would respond to a demand management program to reduce their energy usage *even without a financial incentive*.



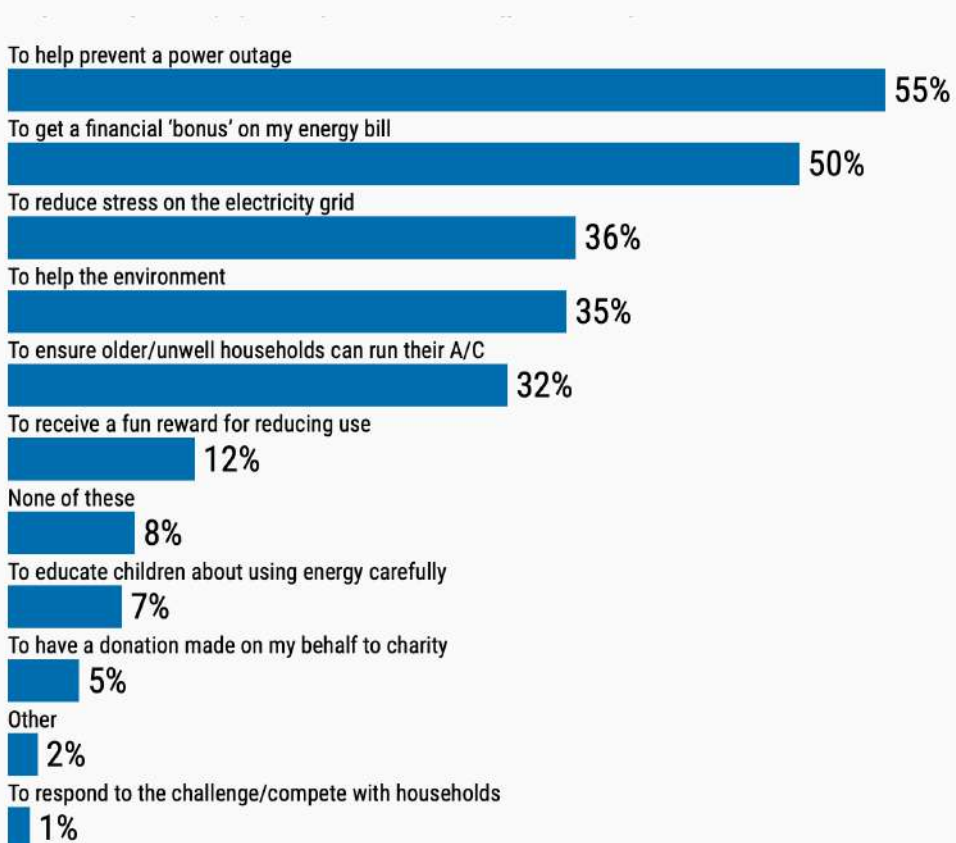
They were given the following background to explain: “During periods of very high energy demand (such as when many people use their air conditioning during very hot periods), energy companies, government agencies or respected community groups sometimes run campaigns asking people to reduce their energy use for a short period.”

**If, during a very hot period, there was such a campaign asking people to reduce their energy use, would you be willing to reduce your energy use?**



Future Home Demand Survey, Question 16.  
All households (n=1325)

People were also motivated by a diverse set of reasons for participating in a demand management program.



Future Home Demand Survey, Question 15.

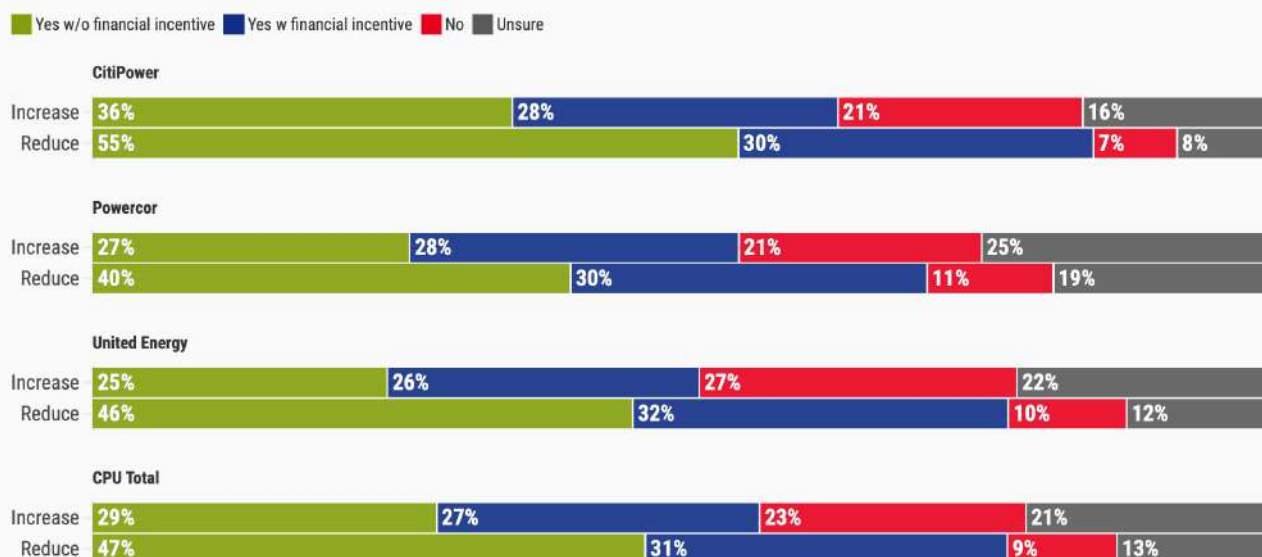
## Trend 7: Demand Management to Increase Demand is Creating Greater Confusion for Households



The aims and challenges of demand management are increasing. As variable renewable generation increases, households may be asked to increase their energy consumption during key periods as a way of consuming excess electricity. This is a complicating and potentially confusing prospect, as it runs counter to norms regarding resource conservation and long-established sector messages about reducing consumption. Interventions targeted at addressing the issue of demand troughs may prove difficult, and will likely need concerted and sustained attention and messaging as demand troughs and the need to address them become more frequent and acute.

When asked if they would reduce electricity use during a peak demand period, 77.4% of survey respondents answered affirmatively (either with or without a financial incentive). When asked if they would be willing to increase their energy use when there is abundant energy available, 56.4% of respondents answered affirmatively (either with or without a financial incentive). Notably, there were more people who would either not increase their consumption, or were unsure.

### Willingness to reduce and increase use to help stabilise the grid



Future Home Demand Survey, Question 16 and 17.

Base: All households (n=1325) grouped by provider: CitiPower (n=439), Powercor (n=477), United Energy (n=409)





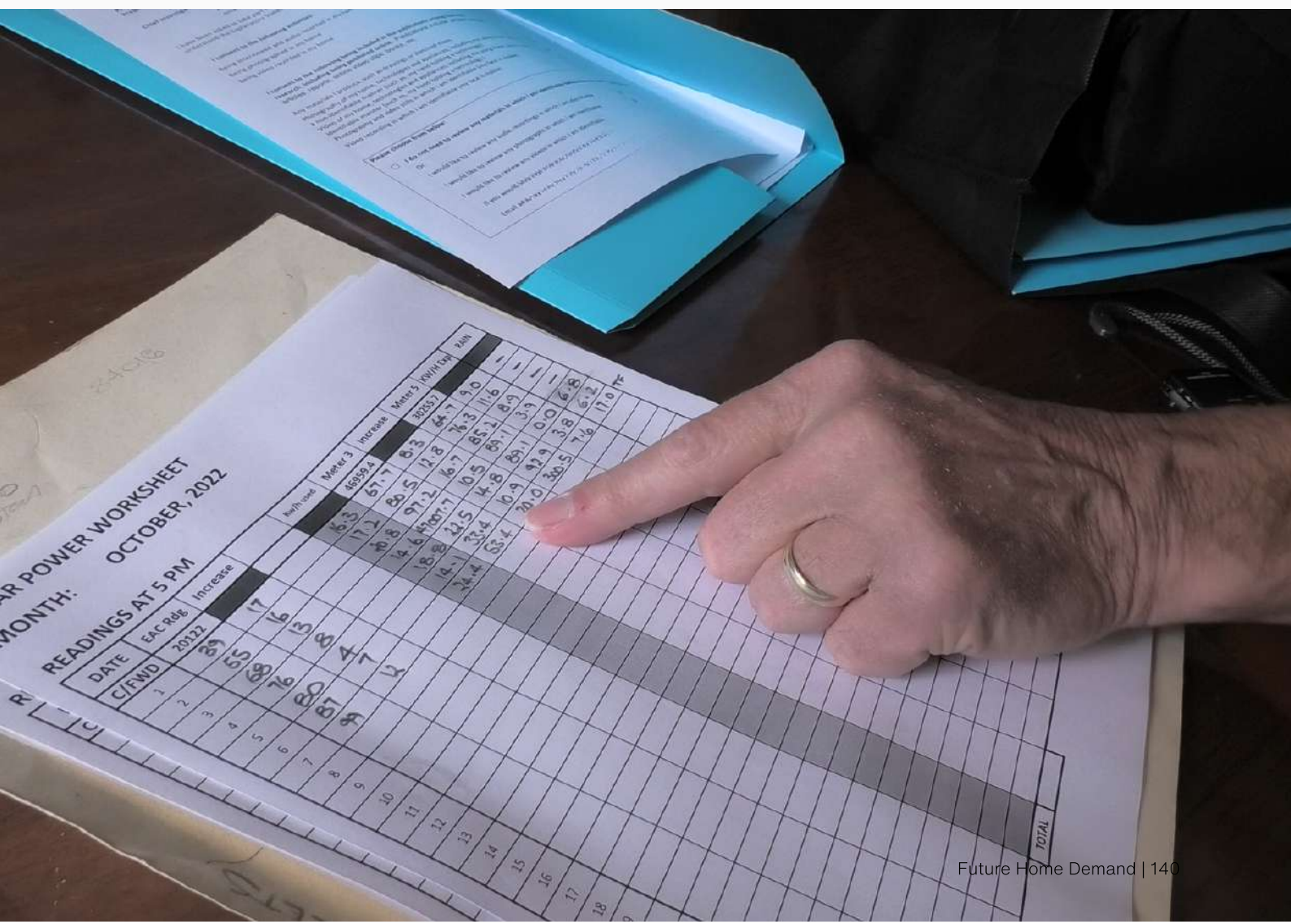
## Trend 8: Differential Access to CER is Accelerating Inequitable Participation in the Energy Transition



Tenants and homeowners have different motivations and face different challenges for building upgrades, installing efficient appliances and accessing CER. Beyond affordability, renters must negotiate building upgrades and the adoption of CER through their landlords, and often have to use more electricity inflexibly due to building and appliance inefficiencies. They also have significantly less access to installed CER such as solar PV and home batteries. While relevant across the state, this is especially important in locations with a higher percentage of renters, such as in urban and inner suburbs.

*“Even though the landlord promised a gas heater here, that’s never eventuated, so I’ve been using the heat pump, and I was heating the whole place and that was a big mistake [financially].” Dee (CitiPower)*

*“So, about two weeks ago we had someone coming around the neighbourhood with the showerheads, like the replacements, all I could do was say, “I can’t, we rent,” and the person interjected and said, “Yeah, I’m hearing that a lot.” I’m like, “I’m sorry.” Like, we just can’t do stuff. We can’t do really simple stuff like that.” Chloe (Powercor)*



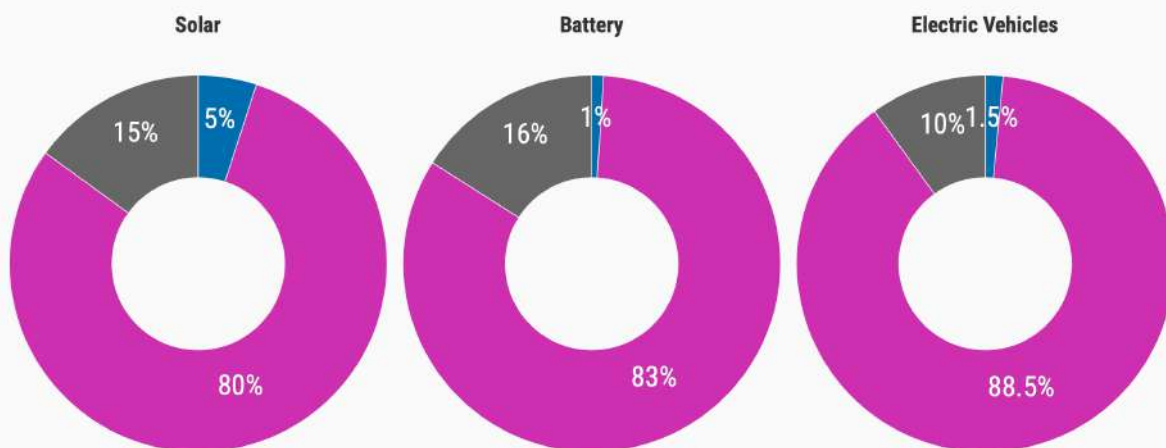




CER ownership (11 participant responses excluded due to "other" housing tenure)

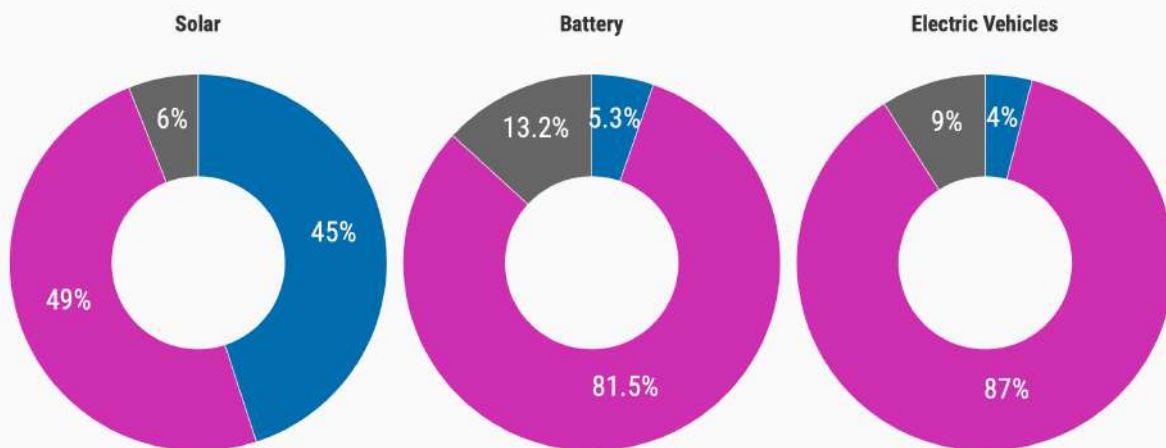
Renters (n=267)

- Have
- Do not Have
- Unsure



Home owners (n=1047)

- Have
- Do not Have
- Unsure





## Making, Saving, Sharing, Shifting and Storing Energy: Implications for Energy and Forecasting

Implications for energy and forecasting are ranked via their likely material impact, with **red** representing high impact, **orange** representing medium impact, and **green** representing low impact.

A continued focus on market-based and tariff incentives to realise demand management objectives is likely to result in limited engagement and desired outcomes from households.

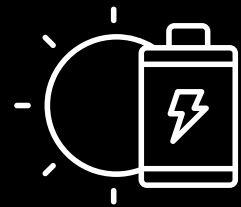
Households' increasing interest in self-consuming or resourcefully using (e.g. donating, locally sharing) their own solar power offers new demand management opportunities.

If not addressed, differentiated access to CER will further entrench inequalities in consumers' access, and exclude groups like renters from the direct benefits of the energy transition.



## Making, Saving, Sharing, Shifting and Storing Energy: Demand Management Opportunities

- Demand management programs need to engage householders beyond financial terms, as people show interest in participating in managing energy for a wide variety of reasons, including out of generosity, from a sense of community, or through a desire to be resourceful.
- The high uptake of CER – which is occurring at the same time as working and studying from home are both being normalised and facilitated by new technologies – represents an opportunity to encourage greater self-consumption of solar power. Promoting the use of self-generated energy need not follow conventional demand management paths into automation or targeted messaging about peak times, but could instead draw on the existing strategies, capacities and desires people draw on to make the most of their solar generation.



**Example: ‘Vari-Grid’: A national communication campaign to engage households in grid issues and raise awareness of electricity’s variability as discussed in the Future Grid Report (Engaging Households Towards the Future Grid (Strengers et al 2019, p. 18, [View Link](#)):**

“The Vari-Grid campaign is a long-term, persistent initiative to gradually introduce new understandings and ways of supporting the grid and system health to households. It highlights the value of the grid as a shared asset, raises visibility of the grid and demand-related issues, and repositions electricity as a flexible and variable resource in the Future Grid. It introduces households to ideas about using energy responsibly and productively (e.g. times to moderate energy consumption to relieve pressure on the grid, and times to actively consume when high renewable energy production creates potential load troughs).”



## Diversifying Demand Troughs

*More CER alongside changes in household practices and increasingly efficient appliances increase the frequency and intensity of demand troughs.*

Installations of CER are increasing at the same time as patterns of household activity are diversifying. 'Demand troughs', whereby energy supply significantly outweighs energy demand, are increasingly common. The current solar peak often occurs on autumn or spring weekdays – a time when significant energy is generated from rooftop solar systems, but people are generally away from the home and less likely to use heating or cooling. In the future, more diverse patterns of household activity alongside other complications may create more frequent but less predictable demand troughs. During prolonged periods of mild, sunny weather during weekdays, home batteries and EVs are fully charged and therefore unable to act as 'solar sponges' and the continued normalisation of working from home results in reduced charging of EVs as people drive less.

There are also ongoing improvements in the energy efficiency of household appliances, which decreases energy demand, including standby consumption. There is also reduced use of air purification outside narrow periods of hazard reduction burning (generally occurring over five to eight weeks during spring and autumn in Victoria). The continued rollout of household batteries also results in reduced evening demand in areas of high uptake as those with access to storage do not draw from the grid as the sun goes down. Long-standing habits and sector messaging around energy conservation complicate efforts to encourage consumption during solar peaks or periods of low prices. In short, the spread of CER, alongside changing ways of living facilitated through new technologies, contribute to a rise in the incidence and intensity of demand troughs, which occur across a wider range of the day and night.

**Affected network businesses:** All, but more likely in city and inner suburb areas with high solar uptake, good transport options and higher rates of working from home (meaning EVs are charged less frequently).

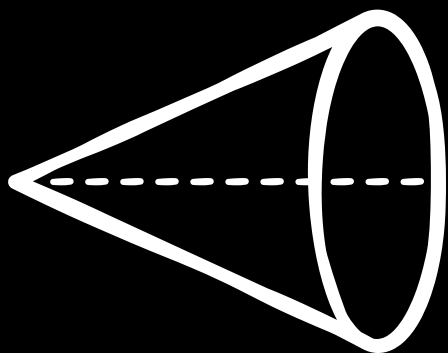


**Peak demand forecast:** Mildweather weekday late mornings and early afternoons in spring and autumn.

**Demand management opportunities:** Initiatives and/or incentives that specifically target increasing energy usage such as through free or negative pricing energy offers.



# **PART 4: FORESIGHTS FOR ENERGY FUTURES**



# Exploring Energy Futures

Exploring futures with households can help to probe deeper into and crystallise people's explicit and implicit expectations for managing their own energy, even if some ideas are not always viable or technically feasible. This process can also reveal unspoken contradictions, misconceptions or assumptions about how energy technology or systems work, and identify knowledge gaps that shape how these technologies are adopted and adapted into homes.

Importantly, exploring futures with households does not directly predict what people will do, but it can provide foresight into what will be most important for different households, and how lifestyle and routine trends are more likely to unfold.

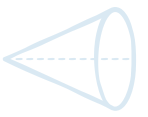
This can be helpful for policymakers and energy companies to design and implement energy systems that meet the current and future needs and preferences of households.



## Reactions to Future Scenarios

As part of the household research, participants were asked to imagine how their current routines might shift in different future scenarios. At least one future scenario card was discussed with each household, but many did more if time allowed. The card was generally chosen based on the researchers' previously established understanding of the household. For example, for those who knew little about the energy system researchers might introduce the 'Solar Smoothing Future' card, which described the basics of load shifting to use solar electricity.

For those with greater technical and energy knowledge, researchers would introduce a more complicated future scenario such as the "Vehicle to Grid Future". Participants were given an opportunity to read the card, ask any questions, and think through how their routines would or would not change in relation to the proposed future scenario ([See Part 2: Research Process and Methodology for more details](#)).



## Solar Smoothing Future



### IN A SOLAR SMOOTHING FUTURE

Solar panels are pervasive and they produce abundant and cheap energy in the late morning and early afternoon on most days. To balance electricity supply and demand, **it is important that more electricity is used when the sun is shining in the middle of the day and afternoon** than in the evening or early morning.

People's willingness to load shift in response to solar energy availability depended heavily on whether one or more members could be home during the day (e.g. working from home, caregiving from home, or retired). Participants who had to work during the day often did not think they could shift these practices significantly, and found that doing so was too inconvenient to be worth any financial gain.

*"[The dishwasher is] costing me probably a lot—like my bill—but it's the convenience of emptying it in the morning versus having it go during the day" Elisabeth (Powercor).*

Retired participants were not always flexible about the timing of their routines. Though not tied to rigid work schedules, participants expressed limits about when certain household tasks could be performed based on their peak mental alertness, travel for health appointments and social or recreational

activities. Even when someone was home in the afternoon, the following practices were considered significantly more flexible than others.

### Laundry and Dishwashing

The most common practices that participants thought they could shift in this scenario were laundry and dishwashing. Most participants currently run their dishwashers overnight, but thought they could change this practice to take place between 10-4pm. For some, however, the financial incentive was not always worth the inconvenience of running an appliance during the day.

*"We try and sort of time it [laundry] with the day, so we try and get it done...before lunchtime, so it's got the afternoon to dry. Or, if it's not quite dry, we'll bring it in and put it on the clothes airer, or [if] it's towels and that, we might chuck it in the dryer for five minutes, just to dry it off. But yeah, we try and sort of get the most out of the sun more. But also we just do things around our day, because most times we're always out in the morning, so then we do things when we get home." Susan (Powercor)*

### Cooking and Showering

Regardless of work schedule, the least flexible practices were those related to comfort and relaxation, such as warming the kettle for a cup of tea, baking bread overnight for the morning and the timing of showers or saunas.

### Cooling and Heating

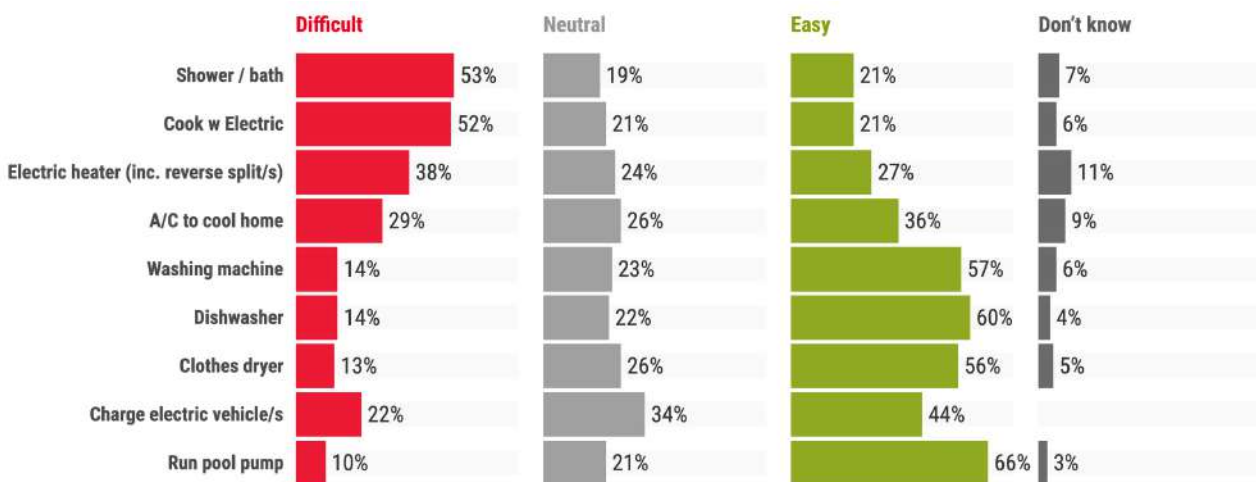
Participants who currently have solar panels were open to load shift during times of energy abundance, such as using more air conditioning in the summer. Participants who were not at home during the day struggled to visualise changes to pre-heating or pre-cooling their homes, even those which could be automated or remotely controlled.



The findings from the household research were generally supported by survey results, which revealed that the most difficult practices to shift to the middle of the day were cooking, and showering or bathing. Whereas, using the washing machine, dishwasher and clothes dryer were more easily moved to the middle of the day.

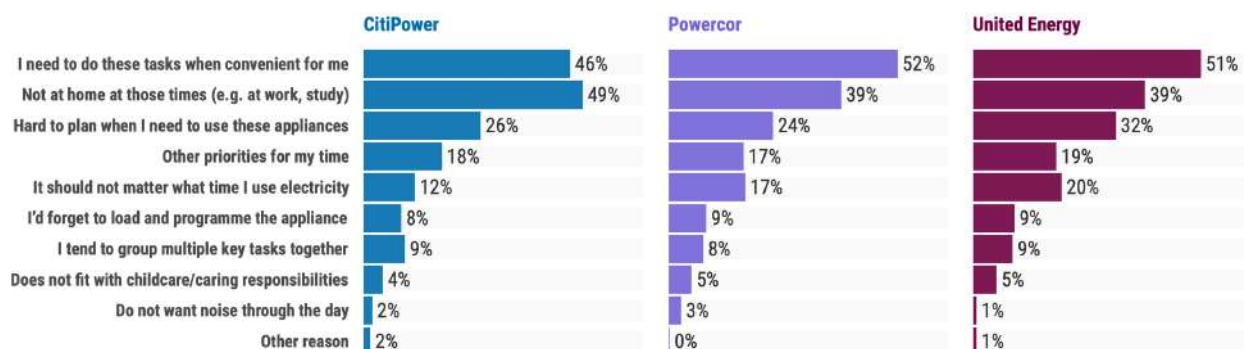
Not being home during the day was also identified as a key reason for not shifting the timing of practices, but needing to do things when convenient was the top reason people were prevented from load shifting to the middle of the day.

#### Difficultly shifting use to the middle of the day when solar electricity is abundant



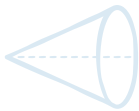
Future Home Demand Survey, Question 13.  
Percent of row (activity) total displayed

#### If asked to move some activities to the middle of the day when there may be excess solar electricity available, what would prevent you from doing this? (Respondents selected up to 3 options)



Future Home Demand Survey, Question 14.  
Baseline: Households that selected difficult to Q13 (n=876), percentage of household from total of provider displayed. CitiPower (n=323), Powercor (n=307), United Energy, (n=246)





## Implications for Demand Management and Forecasting

Certain practices are more amenable to shifting than others, targeting more flexible practices for demand management will offer better results than targeting less flexible practices. Different demand management programs should offer specific suggestions and guidance and directly target flexible practices such as when to run the dishwasher and do the laundry rather than asking for general load shifting. Messaging can also target the opportunities offered by increased working from home to accomplish these chores in the middle of the day even without smart or automated appliances.



Of survey respondents with dishwashers, 60% said that moving the dishwasher to the middle of the day would be “quite easy” or “very easy”.

However, the main time that the dishwasher is run is still overnight between the hours of 8pm to 6am. There is considerable opportunity to encourage shifting dishwashing to the middle of the day.

On a typical day, at what time does your household do the following activities?



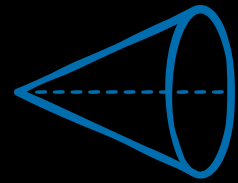
Future Home Demand Survey, Question 12.



IN AN  
**ALL ELECTRIC**  
FUTURE

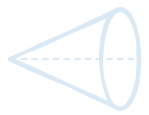
Gas is no longer available or is prohibitively expensive. You have been strongly encouraged or incentivised to **switch all of your gas appliances and gas heating to electric.**

When asked about going all electric, most participants focused on changing their gas stove tops, while some spoke about changing the way they heated their homes. There was some preference towards cooking on gas, but experience with induction cooktops and more positive reviews from friends and family made the difference less significant. Many also considered the air quality and environmental benefits of switching to electric cooking. While they were flexible about the kind of cooktop they would use, participants were not flexible about the timing of cooking. Future routines did not change significantly in response to electrification; while some imagined possible changes, most expected that their heating or cooking practices would stay the same regardless of the energy source.



*“If I could get permission to get rid of them and to de-connect completely from the gas, I would do it in a hot second. I would love to do that. I hate the idea that I'm stuck burning freaking 19th century fossil fuels...I've never cooked on anything except gas my whole entire life but, you know, it's a learnable skill.” Ricky (CitiPower)*

*“I'm not a fan of the electric stoves to be honest. I feel like they take longer to heat up food, but if it will help the environment a bit more, then I'd make that change to you know, help out as much as I can... because most of the things I use already are electric and stuff, it's kind of leaning more towards that way now.” Abby (Powercor)*



# Implications for Demand Management and Forecasting

Cooking will be increasingly electric in the near future. However, this is likely to be an inflexible practice, and therefore highly likely to add to evening peak demand unless offset by increased efficiency and smaller appliances. Forecasters should prepare for potential increased load from electric cooking. Electric heating is more flexible and likely to be a slower transition, which will first happen in new builds, such as in new estate and high growth areas in outer suburbs.



Survey results supported these findings; 20.2% of respondents already had induction cooktops (installed or plug-in), and more people intend to purchase an induction cooktop than any other technology in the next 12 months (n=91).



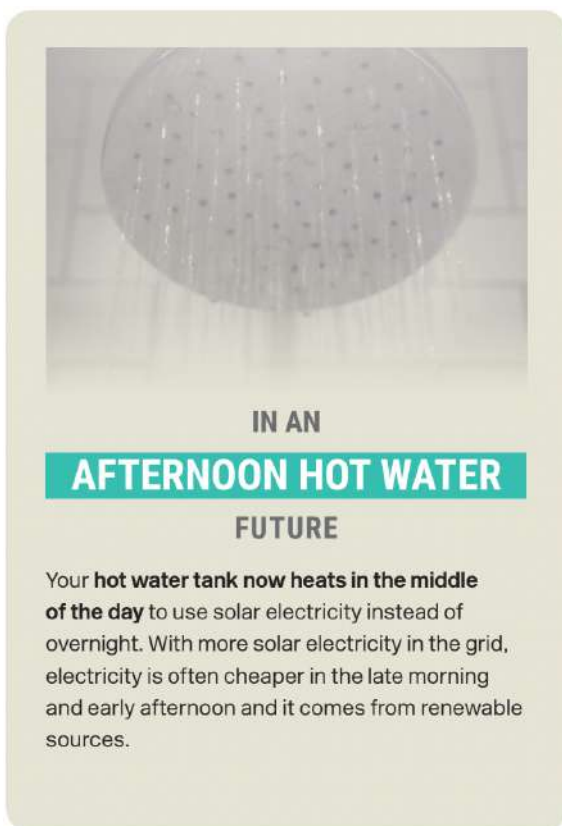
Cooking was the second least flexible practice, with 52.4% of respondents saying that cooking with electrical appliances, stovetop, or oven was either “Quite difficult” or “Very difficult”.

64.8% of respondents primarily do their cooking in the evening between 3pm-8pm.

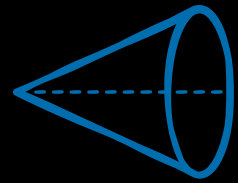
On a typical day, at what time does your household do the following activities?



Future Home Demand Survey, Question 12.



Changing the time of controlled load hot water to heat in the afternoon rather than overnight was viewed with significant scepticism. Those more familiar with their current hot water system tended to be less worried about the change, expecting that regardless of the time it was heated, they would have sufficient hot water for their needs. However, most people are largely unaware of their hot water system, and are generally happy with what they have now. They are hesitant to switch anything in relation to it, because of how significant hot water is to other everyday routines. People were very unwilling to shift the time that they used hot water, particularly for bathing and showering. Bathing and showering are deeply embedded in other routines and are highly inflexible. Concerns about not having sufficient hot water at the exact times needed was worrying to many.

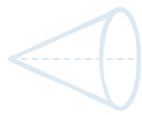


*“So long as it could maintain the heat, I think that would be fine.”*  
Wendy (Powercor)

*“Obviously you want to have a shower and be ready for the day and you want to have a shower after the gym, so that feels pretty set. You wouldn't necessarily have a shower in the middle of the day instead.”* Jasmina (United Energy)

*“Then I may end up switching to having a shower at the end of the day, rather than the beginning. That's just problematic because I actually don't like that. So, yeah that would definitely be... I'd have to think twice about that.”* Dee (CitiPower)





# Implications for Demand Management and Forecasting

The greater prominence of the morning shower, will require careful messaging if controlled load hot water heating is moved to the afternoon. It is crucial that any messaging around shifting the time of heating hot water be carefully explained, and households be informed that any changes would not impact on the availability of hot water for existing showering and bathing routines.



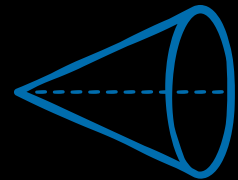
Survey results supported the ethnographic research showing that showering/bathing was the least flexible household practice, with 51.9% of households saying that changing the time of their shower or bath would be either “very difficult” or “quite difficult”.

Showering and bathing primarily takes place in the morning, with 49.6% of respondents showering between 6am-10am.

On a typical day, at what time does your household do the following activities?



Future Home Demand Survey, Question 12.



IN AN

## EXTREME WEATHER

FUTURE

Climate change has caused **more frequent extreme weather** throughout Australia. Bushfires, drought, and floods are all common. Temperatures soar in summer and are colder in winter. Blackouts are common as storms regularly knock out powerlines. Solar panels are also affected and produce less on smoky days.

Recent experiences with changing weather and disasters such as bushfires enabled people to envision significant shifts to their future routines from increased extreme weather events. Since many had already experienced interruptions to their daily life from extreme weather events, they expected these events to happen more often in the future and were open to imagining that they will shift their lives in response.

Participants shared expectations for how their lives would shift in response to extreme weather.

### More Air Cooling and Purification

People anticipated spending more time inside, and using more air purification and more advanced air conditioning systems for their household health during more extreme temperatures and bushfire smoke.

*Describing a future of more extreme weather, Kristine worried about the future air quality. She would want “better sealing” for her apartment and “probably an air purifier maybe”. She doesn’t have one now, but would consider it for the future. She also thought about what changes she would need to make to keep her cat safe in extreme weather. Her cat hates it when she runs the air conditioning, but she would have to adjust in the future: “I would be putting the air conditioning on even though I know that it would make my cat panic, it would be for her benefit as well.” She described that, “there is a level of heat that it [air conditioner]’s just got to go on. It’s just that I kind of avoid it as much as possible till we get to that point. We’re talking extreme heat, then yes, I would turn the air conditioning on.” Kristine (CitiPower)*

### Changed Timing of Routines

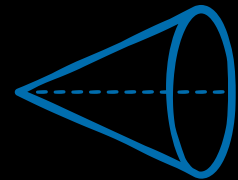
Many imagined shifting their outdoor recreational activity (like a daily walk) to earlier and/or later in the day. Similarly, they also expected work schedules to shift to accommodate more regular extreme weather.

### Decreased Electricity Reliability

Increased incidences of extreme weather also raised concerns about electricity grid reliability. Some were concerned that blackouts from storms might be more common in the future, which with increased electrification of the home caused some to think they would want back up power in the form of petrol generators, gas, or batteries including in bi-directional EVs.

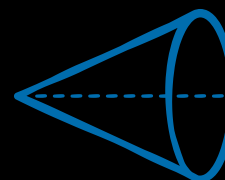
### Implications for Demand Management and Forecasting

Increasing summer temperatures and extreme weather events may create significant changes to household routines in the future. Energy forecasting should incorporate climate projections into more than supply forecasts and recognise that demand is also likely to be significantly affected by a changing climate.



*“So recently the power did go out in Kyneton and I arrived home from somewhere and there was no power, but I could heat up water on my gas rings. And I thought then, if this was an all electric house, what would I do? Well if I had a car parked in the driveway that I could plug into, that would be very nice.” Lucy (Powercor)*

*Simone (Powercor) would postpone her daily walk to “wait until it cools down a bit in the evening or so”. Yvonne and Joe (CitiPower) would also shift their exercise routines “We’d bike ride earlier or later; it really depends. Qianfan (United Energy) expects that we might also start to see longer workdays, with a break in the middle to accommodate higher temperatures into usual work routines, describing how “if you are thinking about the future, the whole routine will change.” Philippe (United Energy), retired, would also either start his day earlier or shift outdoor activities to later in the day: “I would wait until it’s cooler. Very early in the morning or late in the evening.” During the hottest time of the day, he would stay home with the air conditioning on “Yeah, having a nap probably.”*



IN A

## VEHICLE-TO-GRID

FUTURE

Electric car batteries are 5x the size of a home battery and have a 400km range. You can charge at home from solar panels or from the grid when electricity is cheap or renewable. **You can also use a car's battery to power your home** when electricity is more expensive and solar is not available. If you own an electric car, you can choose to allow the grid operator to remotely manage your battery to help balance supply and demand on the grid.

The 'vehicle-to-grid' (V2G) future scenario provided foresights about how households will want to use V2G technologies and the challenges they might face to manage electric vehicle charging as part of their everyday routines. Many were concerned about third party management of their batteries. Yet most participants were very interested in V2G technologies, the ability to use their EV battery as energy storage, and could imagine many positive benefits of this technology including:

### Enabling Existing Routines

V2G was seen as a technology that would generally fit with existing routines and allow people to continue their current routines during the evening, while still enabling energy self-sufficiency. In all areas, most households imagined that on a typical day they would want to draw from their EV battery in the evening.



*Laura in Geelong would like to use a V2G enabled car for commuting to work and then as a battery in the evening to power her home after dark. She liked the idea of being able to power her home off the EV battery in the evening. "Usually, when I come home from work, if I'm going to be really productive, I'll do a lot of stuff then, and then before I go to bed, I'll get off technology, try to. So I feel like that post-dinner few hours is, if I wasn't able to power stuff then, that's when it would affect me the most." However, she didn't imagine she would be completely off-grid and only reliant on her car's battery, and so she would still "prioritise being able to use it [EV] to get to and from work... the other stuff's just added benefits, I suppose." Laura (Powercor)*



## Expanding Opportunities to Participate in Energy

While most imagined V2G as fitting into a traditional commuter's schedule, some participants also imagined that this technology could be incorporated into many mobility patterns and therefore could allow a broader range of participation in CER, such as through fleet vehicles with V2G capability.

## Increasing Resilience

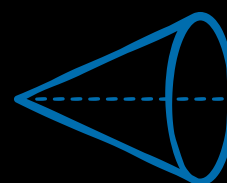
The ways that participants imagined using V2G varied across city and **inner suburbs** and **rural areas**, reflecting slightly different motivations for adopting this technology. Whereas in the city and inner suburbs EVs with V2G were a positive integration of mobility and energy needs,  in **rural areas** V2G technology was seen as a potential backup resource during blackouts – both for individual households, as well as a potential shared resource to enhance community resilience. 

## Concerns with Third Party Management

Almost all participants had at least minor concerns about allowing a third party to manage automated charging of their electric vehicle battery.

### (a) Concerns with Ability to Deal with Contingencies

The most common concern was the possibility of not having enough battery power when they might need it (especially due to unexpected variations in routines). While people could imagine an automated system or third party management to be able to take into account their usual patterns of use, they worried about how such a system would manage deviations and irregularities in their lives. Most people wanted to manage their own vehicle charging.



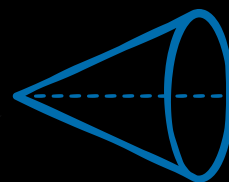
*Ricky, from an inner Melbourne suburb, does not drive or own a car but spoke about the potential for careworkers to help with ‘balancing’ the grid as they travel to visit clients in their homes. In this case, homes would need to be equipped with V2G charging capabilities even if the cars being charged are fleet vehicles or not owned by a member of the household. She stressed the need for V2G charging to work for more people: “If it's going to be everyone they want driving them it has to work for everyone, Uber drivers, pizza delivery people and care workers and everyone else as well.” Ricky (CitiPower).*

*Jake from a small rural town thought EV batteries would likely become a shared resource in rural areas. “Yeah, I suppose it’s not unexpected for the whole town to potentially lose power in a bushfire”. He imagined that with V2G, people could bring their EVs to the evacuation point for the town: “people could bring, here’s your electric car over here, we could at least have some things running, could be an intriguing idea”. Jake (Powercor)*

However, for some people who imagined still having a backup vehicle such as an ICE vehicle or with easy access to public transport, these concerns were somewhat lessened.

### **(b) Concerns with Control and Trust**

People also felt uncomfortable with the idea of having to trust a third party, and were concerned about trusting that management of the battery would actually be in their interests as the owners, or whether it would serve the interests of the operator. Some thought that more information and transparency would improve this, but others had concerns around the trustworthiness of the energy sector or the potential for technologies to be hacked.



*“Well, no, I don’t like it. If he has, if the grid operator has access to my power he’ll obviously, there’ll be times when he’ll want to take some out obviously, now that reduces the range that’s available to me. So I’m planning to drive up to Baringhup or Castlemaine or Bendigo or wherever and when I go to use my car I find that half the power’s been taken out... to put on the grid, and I don’t want that. I want a full charge available when I want it.” Brian (United Energy)*

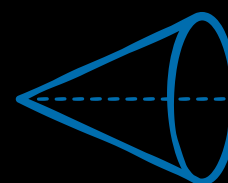
*“Sometimes on the weekend if the weather’s good we’d go Saturday morning, for example, and you wouldn’t decide until Friday but I wouldn’t want someone taking all my battery power overnight and me having to charge. ...I wouldn’t like to give someone else any type of authority to look over that car battery at all, to use it ... because I want it.” Elisabeth (Powercor)*

*Laura welcomed the idea of automated charging of an EV by a third party: “I think, just in terms of how lazy, forgetful, disorganised, uninformed I am, that I would probably prefer to have someone else manage it and deal with it.” She also wasn’t concerned about the vehicle not having charge when she might need it unexpectedly, describing how “If it was something [not important], I could probably just be like, I’ll just cancel and not drive anywhere. “ However, if it was important and “ I really have to get here, I live down the road from a train station.” Laura (Powercor)*

## Implications for Demand Management and Forecasting

V2G was highly appealing to households, as this technology becomes more widely available it is likely to increase uptake of EVs, including in rural areas where the appeal of the EV as a backup battery is high. This may create unexpected patterns of high EV uptake in rural areas [🔗](#).

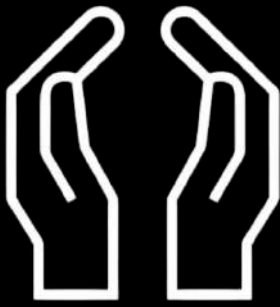
However, people are hesitant about direct load control of EV charging, even more so as the importance of the vehicle becomes both about mobility as well as the home's back up battery. This is likely to limit the ability of V2G technology to serve energy management objectives of balancing the grid and may create new charging peaks ([see Storm Charging Peak](#)).



*“There's far too much stuff out there at the moment which doesn't give you any information about what you're doing. So I'd want information about the power flow...So that I'd know that is the power that I'm using in the house, is it actually coming from the car battery?...Or is it you know, at what point does it switch over onto the car battery off the grid and all that kind of stuff.”*  
Robert (Powercor)

*“I've got no logical reason but I feel just uncomfortable with the whole concept of their power network controlling batteries in your vehicle. This may be something I could overcome with the passage of time and actually see what's happening, but I don't know.”* Gerard (Powercor)

*“So if a hacker is going to hack into your system, you don't really have any option to stop it... But you do wonder about that, though, if a grid operator has the option to remotely manage your battery, and they can remotely do that, well, what else can they do?”* Alison (United Energy)

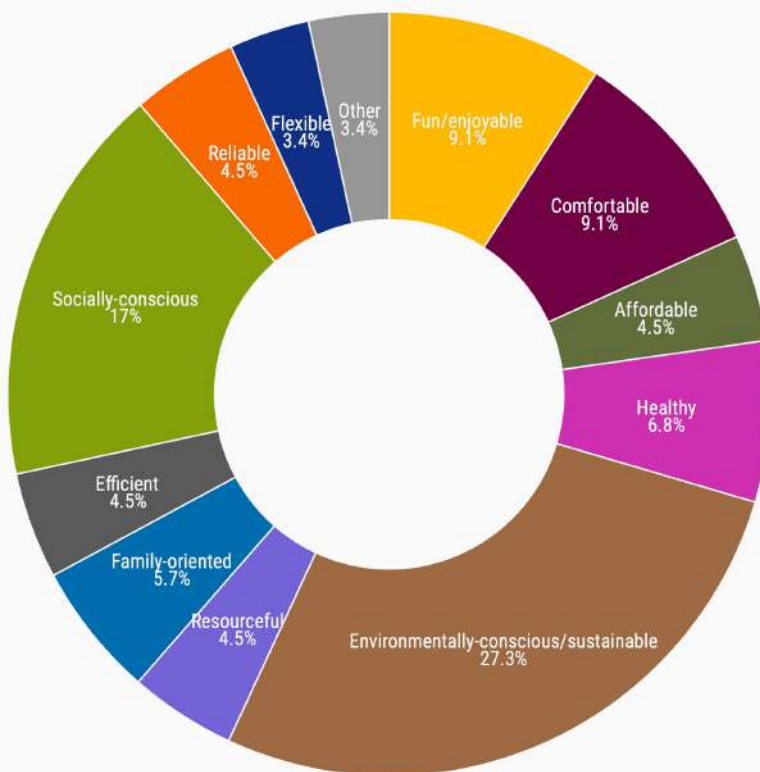


# Guiding Household Values

As part of the design activity stage of the research visit, households were asked to choose a few key values that are important to their household and to fill out the card below.

The key values that households nominated as important to them illustrate the importance of environmental sustainability and values of social consciousness which came out in relation to discussions about the transitioning energy system. The pie chart below shows the distribution of values across 12 categories. Open responses were organised based on which of these broad categories they best fit into.

Households were then encouraged to design future demand management technologies, incentives, or services that would help a household like theirs manage their energy, and which were aligned with their household values.



The distribution of household defined values organised across 12 categories

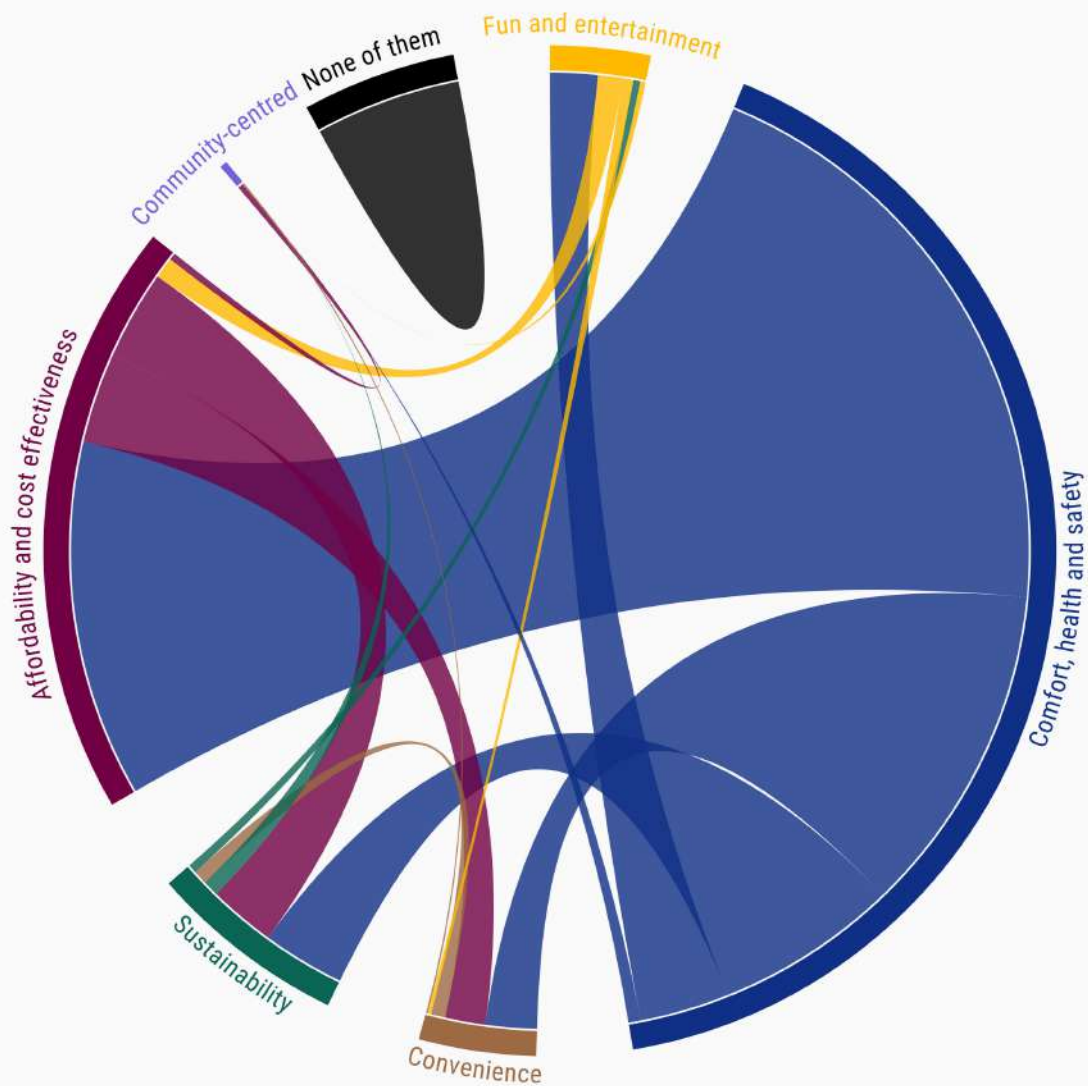




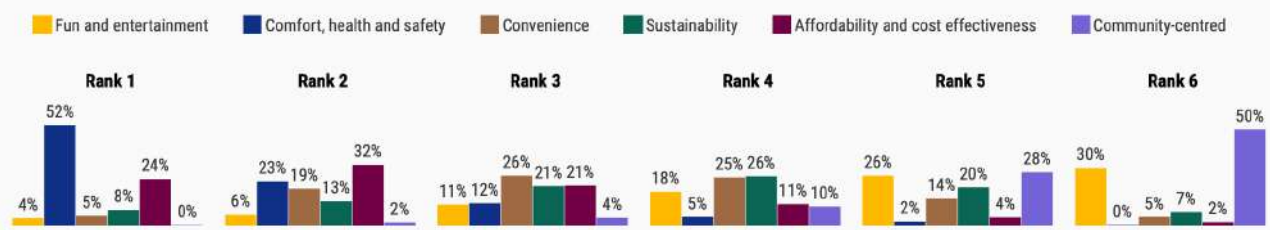
We also asked households about their values in the survey, they were asked to rank their household values. The graph below represents the flow from participants' first selection to their second.

"Comfort, health and safety" was most respondents' first and primary household value in survey results (52.3%), with affordability and cost-effectiveness a common secondary value (31.7%).

"Sustainability" was the top-ranked value for only 8.1% of people surveyed, but it was ranked in the top three values by 41.2% of households.



Future Home Demand Survey, Question 29.  
All households (n=1325)





## Implications for Demand Management and Forecasting

- A continuing focus on cost-reflective pricing or financial rewards and penalties will likely undermine demand management potential in CPU's customer base, particularly if economic measures are perceived to compromise comfort, health and safety.
- “Sustainability” and appeals to the environmental benefits of demand management are powerful, but they must similarly account for the importance of values like comfort, health, safety and affordability.
- Values commonly overlap; for example comfort, health and safety are directly linked to a better environment for many, evidenced in the rise of greater concerns about air quality in the context of bushfires and health concerns ([see Healthy Indoor Air and Thermal Comfort Trend 2](#)).
- Comfort, health and safety values also include concerns with community health and safety, as evidenced by survey responses on why people would respond to demand management, which emphasised preventing outages in the community and protecting vulnerable customers ([see Making, Saving, Sharing and Storing Energy Trend 6](#)).
- The prevalence of values around being socially conscious discovered in the household research reflect this complexity, and represent opportunities to frame demand management in ways that appeal to these varied values. Ideas suggested by participants are presented in the next section.

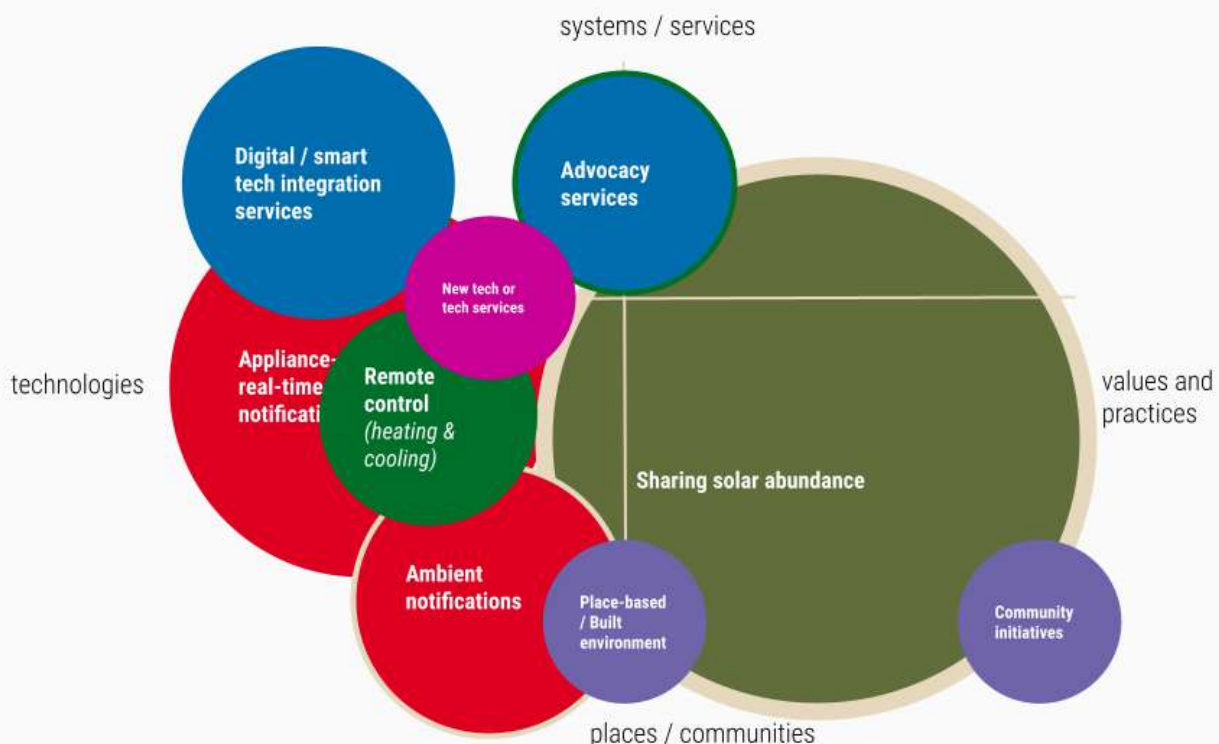
# Values-Based Demand Management Designs

With their key values in mind, participants were asked to design demand management programs or technologies using a card game technique. (See Part 2: Research Process and Methodology for more details).

Some of the designed objects and services are included below, but rather than seeing these ideas as solid suggestions for the energy sector to implement, the research team analysed them for what they say about household desires and aspirations for energy management.

They were also analysed for ways that energy management can better align with existing priorities and values, and household desires for future and more diverse engagement with the energy sector. The variety of responses represent differing roles expected for technology, systems, practices and place-based initiatives. The graph below depicts the categories of design ideas mapped against their relation to:

- Technology-led (e.g. devices, apps, CER)
- Place-based (e.g. built environment, community initiatives)
- Systems-led (e.g. services, policies, advocacy)
- Practice-led (e.g. routines, habits, customs, social norms/etiquette)



Categories of participants' design ideas.



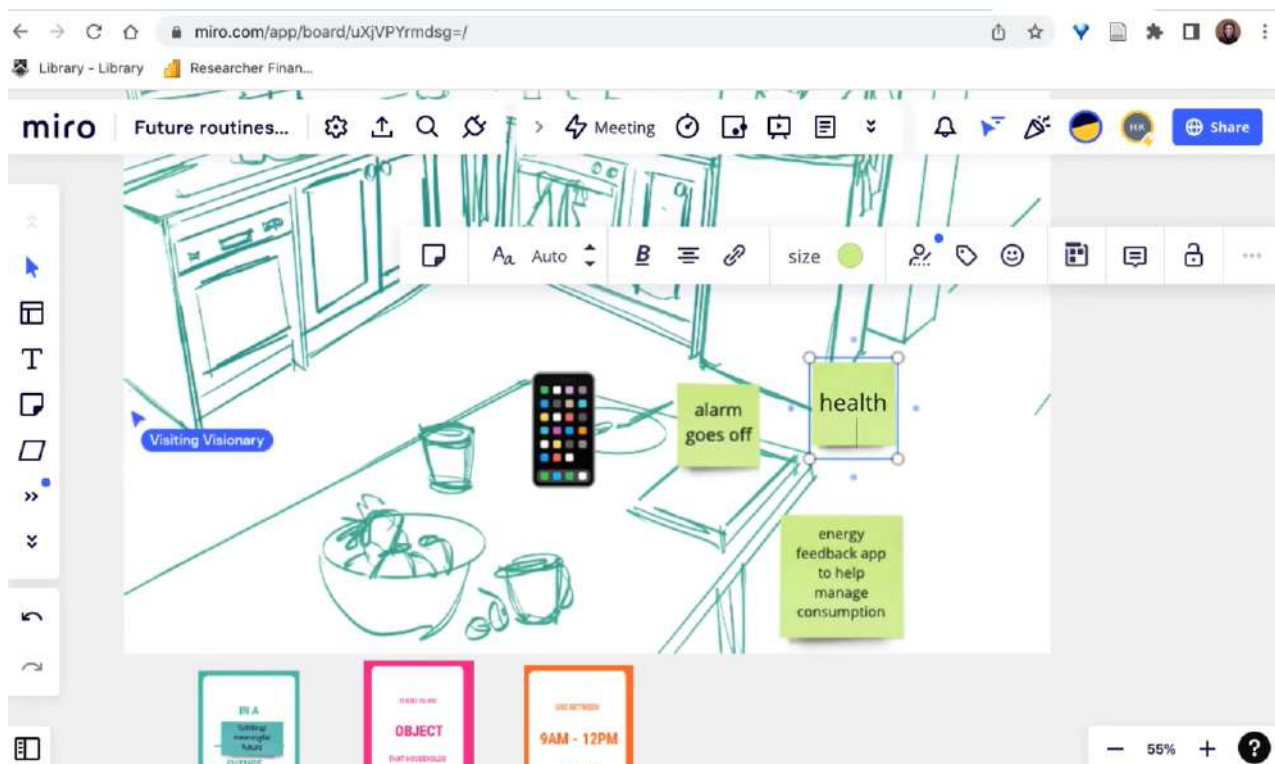
## Appliance-Specific, Real-Time Data and Notifications

Some want the option to get real-time feedback on detailed household energy consumption via notifications.

- Some want access to household energy data, but most want more certainty about exactly which appliances or systems are using the most energy, versus overall household consumption.
- Some are also interested in, and motivated by knowing more about, the source of their energy and would be motivated to use more renewable energy.

*"It would be much better if you could see it for each appliance in real time. So, if I knew that right now I was using quite a lot of energy but also that half of it was used by the oven, like, it would be so much more easy to know where the money was going. .... especially if someone would come and set it up for them."*  
Ricky (CitiPower)

*"I would like to have a display on the wall here showing what fraction of my daily energy consumption was green, was generated without harming the atmosphere.... That would be a very nice thing to have, and I would be prepared to change my habits to try and get the needle to point in the right direction"* Brian (United Energy).







## Ambient Feedback

For some, in-depth quantitative data using digital apps and/or portals were not effective. They instead wanted a more ambient notification (e.g. a chime or glowing lamp placed in the home).

- Some imagined ambient notifications, such as chimes or glowing lamps, which could be easily consulted and which translated energy data into simple signals.
- This was envisioned to encourage making energy management a shared responsibility with other members of the household (such as children and those less interested in energy management and traditional data), and created a more intuitive way to understand the relationship between household practices and energy consumption.

- Connecting energy feedback with other, more general forms of data offers different ways of providing ambient feedback. Previous research has explored how energy feedback could be incorporated into weather forecasts in a way that encourages understanding of renewable energy as a weather-dependent and variable resource, while also building on people's general interest in weather. (See: Engaging Households Towards the Future Grid (Strengers et al 2019, p. 22, [View Link](#))

*“Maybe you could have some kind of audio, sort of an alarm if your power consumption goes up over a certain level...nothing too alarming, maybe just a bell or something, just to let you know that you’re using more power than you had wanted to. You set it at a certain level.” Lucy (Powercor).*





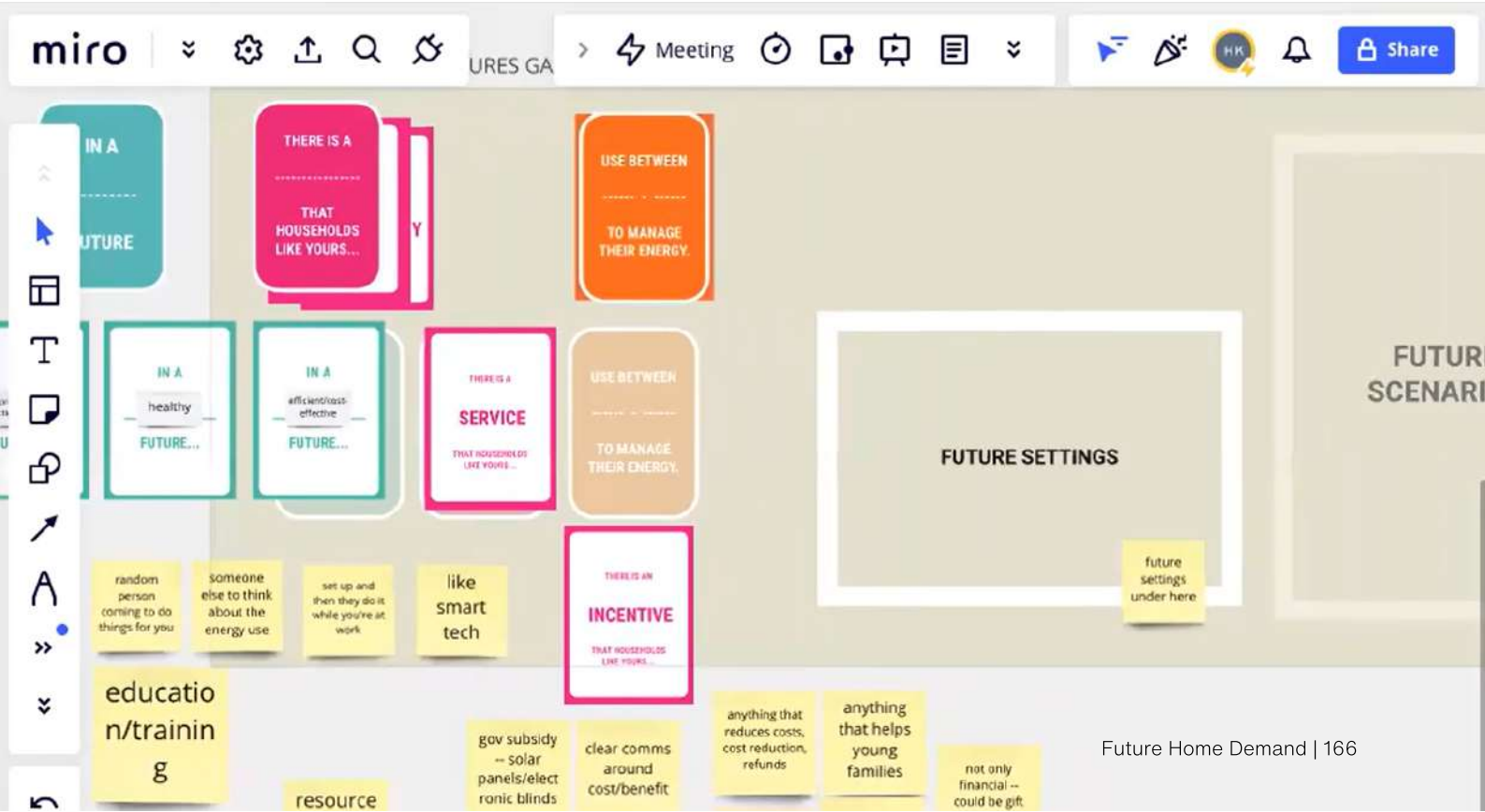
## Digital and Energy Technology Integration Services

People sought solutions to the everyday challenges of trying to integrate smart technology, especially where digital technology and energy technology are not integrated and they largely envisioned services that could enable this.

- Some wanted services where a knowledgeable person comes to the home to install, educate and help manage technologies in the house.
- These services offered integrative advice across appliances and energy technologies and offered bespoke advice that also included advice on managing energy through non-technical means (e.g. building upgrades such as improving insulation, plants for shade, or adding drapes in certain areas of the home).



*“I think if it was individual [service] and they could come to your house and give you suggestions. And I know there’s people that do that, but it’s more being able to make it understandable for people so that they realise, you know, that they can start with small steps and work towards something.” Wendy (Powercor)*





## Advocacy Services

People envisioned advocacy to be a form of service or community initiative that would help them to manage their energy and participate in the transitioning energy system.

- Households anticipated challenges with inequitable access to smart, efficient technologies and CER, and envisioned advocacy services such as for renters to address this.

*“I want them to set up and go around so that they can negotiate with owners’ corporations for units like ours and set up solar panels to start with and then maybe later on also, like, batteries, so that all of us can have access to a share of them.” Ricky (Citipower)*

- Some imagined advocating for work and school schedules, facilities and expectations that would better allow households to load shift in response to renewable energy, such as having laundry facilities at work, or encouraging employees to do household chores while they were working from home.

*“I guess if it was a more formalised thing to be “Hey, yeah, go for it”. I know you’re sneakily doing your laundry, just have 15-minutes and go do it. I think that would work as well...Just [to] feel a little less guilty about doing it on work time.” Jasmina (United Energy)*

*“I’d do my washing at work if there were washing machines at work.” Laura (Powercor)*







## New Energy Technologies and Technology Services

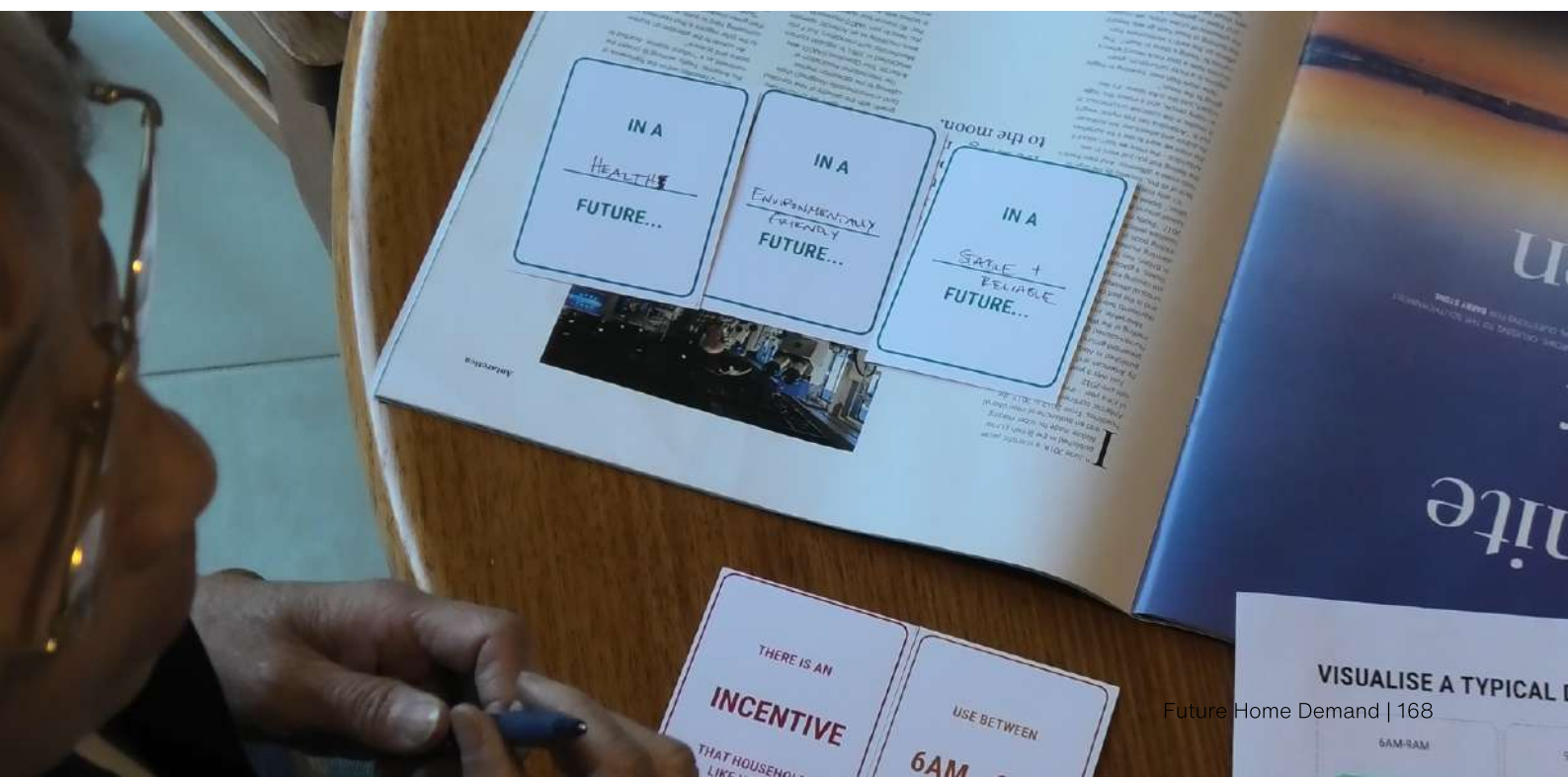
People imagined alternative energy resources like mobile or rentable batteries that would enable more diverse forms of participation, while also avoiding the high upfront costs associated with current CER.

- Some people imagined making use of several, smaller, appliance-specific batteries which could serve as a contingency for essential appliances during blackouts, for loads that cannot be shifted, or for always on technologies. These batteries would function in a more affordable way than larger household batteries.

*“So I might not be able to afford a \$10,000 battery but maybe for \$30 I can have the freezer working overnight. I’d probably buy that...like if I could just get little batteries for that... like the cordless battery I can plug it into an outlet during the day or maybe it’s even smarter and it’s actually just already attached to the freezer and somehow miraculously charges when there’s excess solar.” Maria (Citipower)*

- Some imagined battery rental services or mobile batteries that would allow energy storage to be adapted in relation to changing energy needs, such as during holidays.

*“What I would realistically see is a situation where people would hire an extra battery or two or three to, you know, to be able to power the house while you have family over for the breakfast, for the lunch, for the dinner, for the weekend, whatever you need it for, and they would be taken away again, you know, the next day or something like that. Or, something like people being able to bring their own batteries...to come to the family get-together...so then you could help power the home that you’re all staying at.” Chloe (Powercor)*





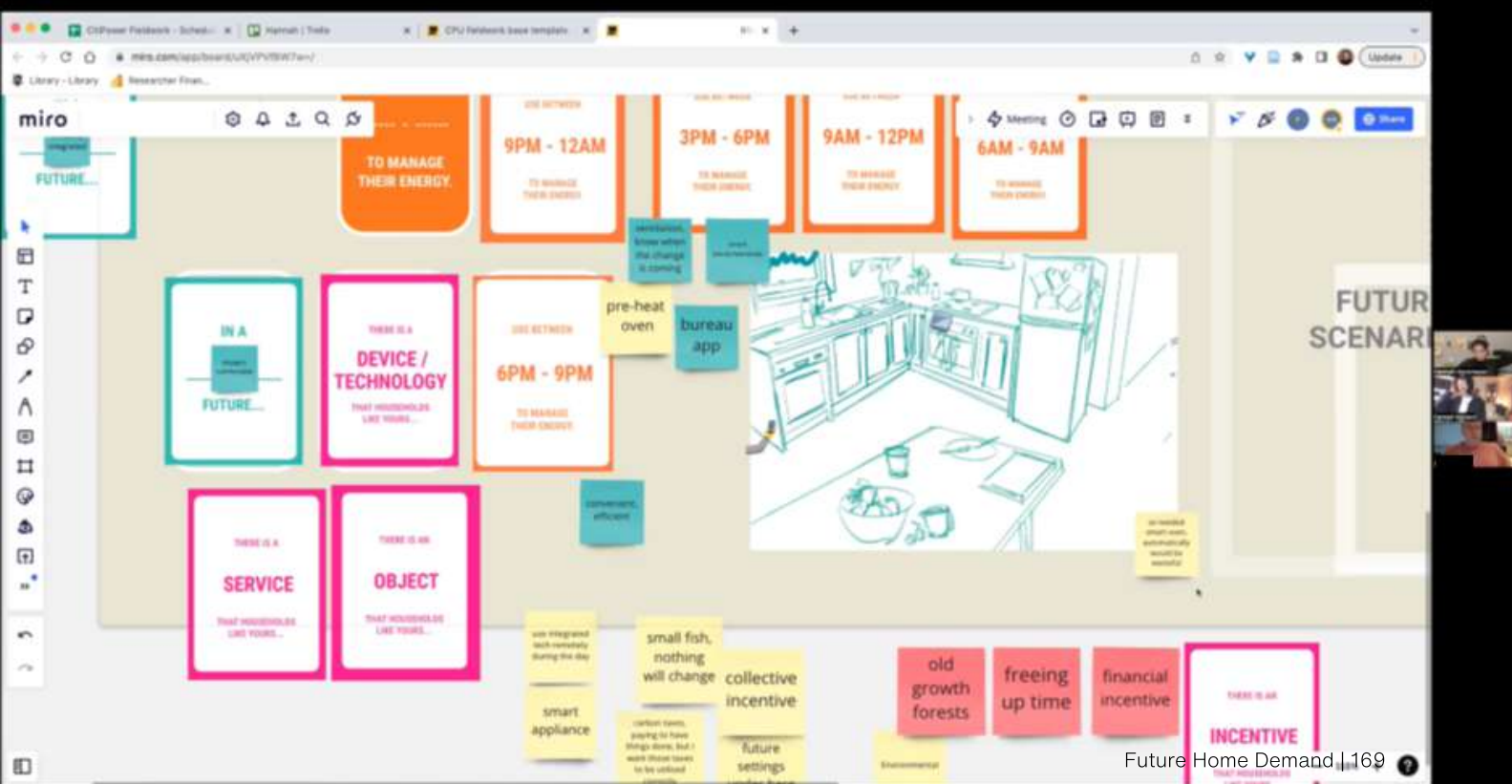


## Smart Devices for Remote Control

When participants imagined smart technologies, they were largely intended to increase remote control over appliances, rather than enable automation or third party management of devices.

- Some imagined turning on heating and cooling and opening and closing blinds or windows remotely to use solar energy while away from home.
- Controlling these technologies was nearly always envisioned to still be initiated by the householder via remote control (usually an app), and was not envisioned to be fully automated or controlled by a third party.

*“Like if you were at work, and it’s more efficient for you to do the washing at 3[pm], you could have an app to say turn my washing machine on at 3[pm]... Because that’s going to be more efficient for me. Yeah. And so then you could still get that on-the-spot, ‘I feel like doing my washing right now,’ versus like having to plan and set the timer for this time. Like it can still be as you go, flexible, throughout the day.” Susan (Powercor)*





### *Place-Based, Built Environment and Renewables Initiatives*

Deep knowledge of place and weather patterns influences what solutions householders design for their homes in particular environments.

- People envision building design improvements that would enable energy savings and which take direct account of their local environmental conditions such as sun positioning, breezes and seasonal changes.

*“Is there a thing ... like a pergola, that wouldn’t have to be there all year?... Because [in] this weather, the seasons are so dramatically different.” Anthea (United Energy)*

- Local conditions also encourage people to imagine more opportunities for renewable generation in their neighbourhoods and homes.

*“Can you imagine even being next to the ocean that the roof above here and all that winds coming from the ocean would be amazing. Solar panel great, but what about others?” David (CitiPower)*

*“If you can get me a wind turbine that’s a sunflower and that would be great.” Wendy (Powercor)*





## Community Initiatives

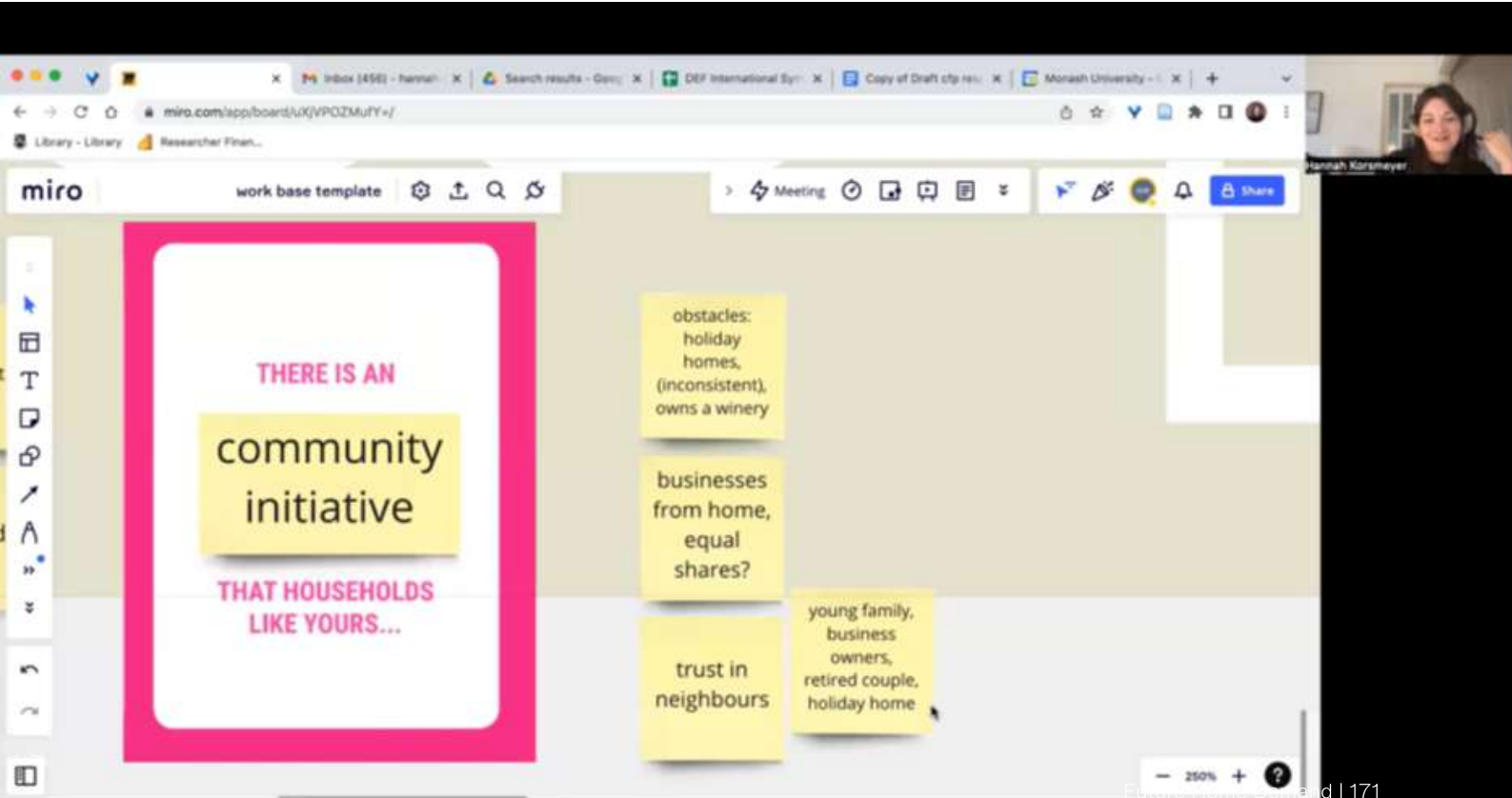
People want their energy practices to be more integrated with their local place and saw the dual possibilities to encourage community building while addressing energy challenges.

- Energy was commonly viewed as a shared resource, and energy management that included acknowledgement of this sharing was envisioned by some, such as through communal initiatives like shared swimming pools to help keep cool or to reduce energy use with shared meals.

*“[In other cultures] most of the cooking isn’t actually all inside somebody’s own home, it’s community, downstairs and they share. I don’t see why we can’t. We’ve got such a diverse, ethnic background that is used to a lot of that. I don’t see why we can’t look at doing more of that within Australia.” Yvonne (CitiPower)*

- Others imagined forms of sharing access to CER with neighbours, and preferred this to owning their own CER.

*“If I install a fast charger in our garage, then that’s fine for me to fast charge when I want to, but ... there’s my fast charger sitting in my garage for a lot of the time not charging it, yet there are other people out there who might want to fast charge.... That’s why I like it when fast chargers are installed in shopping centre car parks and so on; I like the idea of a shared model of some of those resources.” David (CitiPower)*







## Sharing Solar Abundance

People are very interested in sharing the energy they produce via CER, especially excess solar PV production that they cannot self-consume.

- With reduced solar feed-in tariffs, and expectations that the financial rewards from exporting solar decrease, people are increasingly interested in sharing their excess production.
- While people did not need or want to know exactly where their energy goes, they would like it to support something they feel is important (e.g. a local hospital, someone experiencing energy poverty, etc.)

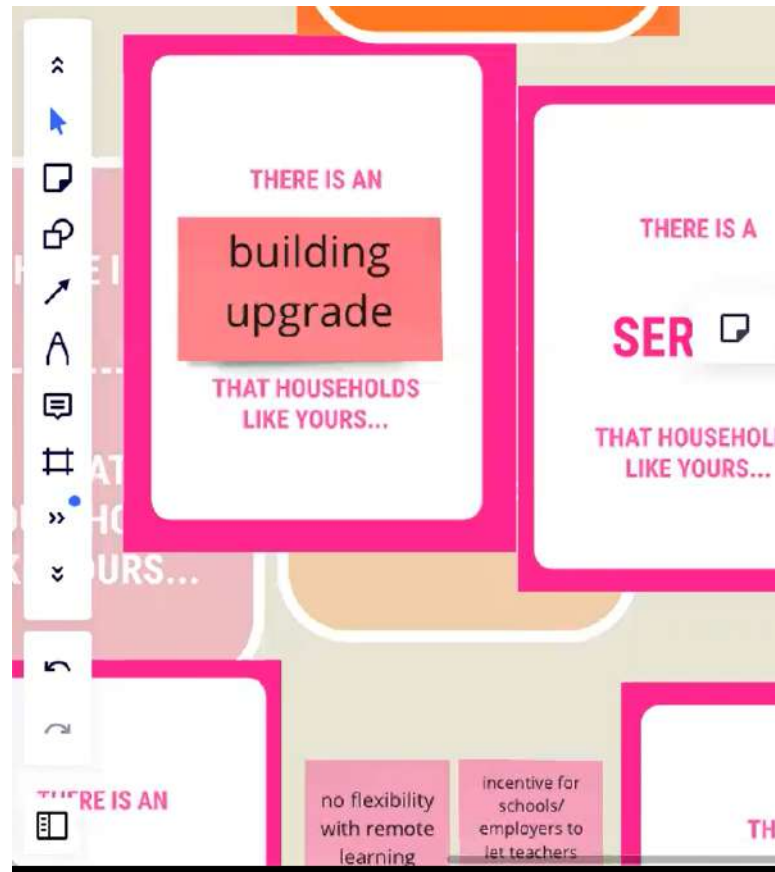
*“I don’t need to know where [donated solar power would go] specifically... But I just like to be sure that it goes somewhere where it’s needed.” Simone (Powercor)*

- Some were interested in alternatives to traditional financial compensation, such as trading and bartering energy for other goods, or incentives like vouchers.

*“Yes. I’m not sure whether this makes any sense in terms of energy use again, but again I like the idea about not exchanging money, so some other trade off that is about your skills or something... let’s say if they were growing vegetables for example ...I would be happy to have it in return for [my electricity].” Simone (Powercor)*

- Not wanting to waste solar energy motivated many who would prefer donating or sharing their excess solar production.

*“I’d love to see shareable energy between households. It’s to have those sustainable ways to actually produce and then be smart with the neighbourhoods so that we’ve got a stronger sense of community as well.... So you wouldn’t see it really as a way of sort of making money. You would just see it as a way of kind of sharing and not wasting it.” David (CitiPower)*







## Implications for Demand Management and Forecasting

Many of the participant-suggested demand management programs, technologies or initiatives reflect the findings from the survey results and broader household research. They reinforce the importance of household practices, routines and values to the use and management of energy. Rather than relating to energy only as a commodity, these ideas also reveal that people value energy for what it enables them to achieve in their everyday lives, and for what they hope it will enable in the future. Often this means that emerging technologies and energy should be used to provide comfort, convenience and entertainment in order to enhance the everyday lives, health and safety of the household and community. Demand management programs will be most successful if they understand key household values and motivations, and seek to account for how these affect everyday routines and practices, as illustrated throughout this report.



## References

Candy, S. 2018. Gaming futures literacy: The thing from the future. *Transforming the future*, Routledge: 233-246.

Nicholls, L, Strengers, Y, Dahlgren, K, Pink, S, and Martin, R. 2021. *Digital Energy Futures: Demand management opportunities*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

Strengers, Y, Nicholls, L, Glover, A, Arcari, P, and Martin, R. 2019. *Engaging households towards the Future Grid: An engagement strategy for the energy sector*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University) and Centre for Urban Research (RMIT University). [Link](#)

Tesla. 2023. *Storm Watch*. [Link](#)

### **For more on the Digital Energy Futures Project see the previous five Reports:**

Dahlgren, K, Strengers, Y, Pink, S, Nicholls, L, and Sadowski, J. 2020. *Digital Energy Futures: Review of Industry Trends, Visions and Scenarios for the Home*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

Strengers, Y, Dahlgren, K, Nicholls, L, Pink, S, and Martin, R. 2021. *Digital Energy Futures: Future Home Life*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

Nicholls, L, Strengers, Y, Dahlgren, K, Pink, S, and Martin, R. 2021. *Digital Energy Futures: Demand management opportunities*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

Pink, S, Korsmeyer, H, Dahlgren, K, Strengers, Y, Martin, R, Kaviani, F, and Nicholls, L. 2022. *Digital Energy Futures: Foresights for Future Living*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

Strengers, Y, Kaviani, F, Dahlgren, K, Korsmeyer, H, Pink, S, Nicholls, L, and Martin, R. 2023. *Digital Energy Futures: Scenarios for Future Living 2030/2050*. Melbourne, Australia. Emerging Technologies Research Lab (Monash University). [Link](#)

## Appendix

CitiPower / Powercor / United Energy

Survey type: Online

Project consultants:	Sharon Morris, Meg Young
Total number of interviews to be completed:	Minimum n=400 per distributor (n=1200 in total)
Definition of target audience:	CitiPower / Powercor / United Energy customers
Emails distributed by (non-panel sample only):	Quantum
Fieldwork to close by:	April 16 <sup>th</sup> 2023
Data to be merged with a previous datafile?	No
Questionnaire has been reviewed by Sharon or Mary	Yes
Does this job require a representative screener sample? (Typically required for segmentation and market sizing)	No
Any quotas on the sample? If yes, specify below	Yes – minimum n=400 completes per distributor

Weights to be applied: None

**Introduction – Online**

Thank you for taking part in this survey.

This survey is about energy use in your home, and should take no more than 15 minutes to complete.

Please be reassured that this survey is anonymous, and we will never use your individual responses on their own. Quantum is an independent market research company and complies with the Australian Privacy Act 1988 and The Research Society's Code of Professional Behaviour. Our privacy policy can be found [here](#). If you have any queries or concerns, please contact us on [surveys@qmr.com.au](mailto:surveys@qmr.com.au)

Gift card prize draw:

All participants who complete this online survey go into a draw for the chance to win one of three prizes:

- First prize is an eGiftPay gift card ([www.giftpay.com.au](http://www.giftpay.com.au)) to the value of \$500
- Second prize is an eGiftPay gift card to the value of \$300
- Third prize is an eGiftPay gift card to the value of \$200.

All prizes will be delivered via email and can be used at all Australian retail stores (both online and in-store).

Please click [here](#) for the Terms and Conditions of this draw. We will contact successful participants of the draw to arrange the delivery of the eGiftcards. Gift cards are also provided as thanks in the next phases of this research program.



Quantum will conduct the prize draw, and personal details collected for the draw will be stored separately to the survey responses and will be deleted once all prizes have been claimed.

If you have any

I am 18 or over and consent to participate

Yes	1	
No	2	TERMINATE

ASK ALL

Q.1. Which of the following do you have at your home?

SINGLE RESPONSE PER ROW; RANDOMISE

		Yes	No	Unsure
1	Air purifier	1	2	3
2	Dehumidifier or humidifier	1	2	3
3	Refrigerated air conditioning (e.g. reverse cycle air conditioner)	1	2	3
4	More than 2 fridges or freezers	1	2	3
5	Swimming pool, or spa pool	1	2	3
6	High performance PC or server (e.g. for gaming, crypto-mining, running algorithms)	1	2	3
7	Induction cooktop (installed or plug-in)	1	2	3
8	Remotely controllable or smart heating or cooling (e.g. via an app or smart thermostat)	1	2	3
9	Energy feedback portal or app (e.g. Emberpulse, Powerpal)	1	2	3
10	Smart kitchen or laundry appliances (e.g. internet connected fridge, oven, washing machine or clothes dryer)	1	2	3

---

ASK ALL

**Q.2.** Do you intend to purchase or install these technologies in the next 12 months? ASK ONLY ITEMS FOR WHICH  
Q.1 = CODES 2 OR 3 (NO OR UNSURE)

SINGLE RESPONSE PER ROW; RANDOMISE

		Yes	No	Unsure
1	Air purifier	1	2	3
2	Dehumidifier or humidifier	1	2	3
3	Refrigerated air conditioning (e.g. reverse cycle air conditioner)	1	2	3
4	More than 2 fridges or freezers	1	2	3
5	Swimming pool, or spa pool	1	2	3
6	High performance PC or server (e.g. for gaming, crypto-mining, running algorithms)	1	2	3
7	Induction cooktop (installed or plug-in)	1	2	3
8	Remotely controllable or smart heating or cooling (e.g. via an app or smart thermostat)	1	2	3
9	Energy feedback portal or app (e.g. Emberpulse, Powerpal)	1	2	3
10	Smart kitchen or laundry appliances (e.g. internet connected fridge, oven, washing machine or clothes dryer)	1	2	3

---

ASK ALL

**Q.3.** Please indicate which of the following statements apply to your home:

MULTIPLE RESPONSE; RANDOMISE

- Apps (smartphone, tablet or computer-based) are used to control or automate some home appliances or devices 1
- A voice assistant (e.g. Alexa, Siri, Google Home) is used to control or automate some home appliances 2
- My home has been described as a 'smart home', 'connected home', or 'digital home' (by yourself or others) 3
- My home is connected to a micro-grid ..... 4
- My home is part of a community battery 5
- My home is part of a 'virtual power plant' (VPP) or 'peer-to-peer' electricity trading (e.g. via Reposit, Power Ledger, Evergen, Redback Technologies) 6
- None of these apply to my household 7

---

ASK ALL

**Q.4.** Are you considering replacing the gas appliances (eg gas heating, gas cooking, etc) in your home with electrical appliances in the next 5-10 years?

SINGLE RESPONSE

Yes	1
No	2
I already have replaced them	3
Unsure	4

---

ASK IF Q.4 = CODES 1 OR 3 (CONSIDERING REPLACING OR HAVE ALREADY REPLACED)

**Q.5.** What is the main reason you [IF Q.4 = 1: “are considering replacing”; IF Q.4 = 3: “have already replaced”] gas appliances with electrical appliances?

SINGLE RESPONSE

Environmental concerns	1
Cost of gas	2
Health concerns	3
Gas isn't available	4
Other (please specify): _____	5

---

ASK ALL

**Q.6.** In a usual week, how many days per week is your home occupied by someone 'working from home' (staying home while doing paid work)?

SINGLE RESPONSE

Typically 1-2 days per week at home	1
Typically 3-4 days per week at home	2
Typically work 5 or more days per week at home	3
None – no one works from home in my household	4
Unsure	5

ASK ALL

Q.7. Which of the following energy technologies are used at your home?

SINGLE RESPONSE PER ROW; RANDOMISE

		Yes	No, but intend to purchase in the next 5 years	No, and do NOT intend to purchase in the next 5 years	Unsure
1	Rooftop solar	1	2	3	4
2	Home battery	1	2	3	4
3	Electric vehicle (EV) or Plug-in Hybrid (not including bicycles)	1	2	3	4

ASK IF Q.7\_2 (HOME BATTERY) = CODES 1 OR 2 (YES OR NO BUT INTEND TO IN NEXT 5 YEARS)

Q.8. Which best describes how you [IF Q.7\_2 = CODE 2: would] prefer to operate your home battery?

SINGLE RESPONSE

- I am not sure how our home battery operates 1
- Set to minimise purchasing electricity from the grid (maximise own solar) 2
- Set to minimise total energy cost 3
- Set to maintain a percentage of charge (below or above a certain level) 4
- Remotely managed as part of a VPP 5
- Set to maintain full charge for use during power outages 6
- I [IF Q.7\_2 = CODE 2: will] have no pattern or routine around my battery  
charging 7
- Other (please specify): \_\_\_\_\_ 8

ASK IF Q.7\_3 (ELECTRIC VEHICLE OR HYBRID) = CODES 1 OR 2 (YES OR NO BUT INTEND TO IN NEXT 5 YEARS)

Q.9. IF Q.7\_3 = CODE 1: Why did you get an electric / plug-in hybrid vehicle? Please select up to 2 reasons.

IF Q.7\_3 = CODE 2: Why do you intend to get an electric / plug-in hybrid vehicle? Please select up to 2 reasons.

MULTIPLE RESPONSE; RANDOMISE; MAX TWO RESPONSES

- The environmental benefits 1
- The lower running costs 2
- The speed and acceleration 3
- The appeal of the new/cool technology 4
- Automated driving features 5
- Comfort and safety reasons 6



Other (please specify): _____	7
Don't know / I wasn't the decision maker	8

---

ASK IF Q.7\_3 (ELECTRIC VEHICLE OR HYBRID) = CODES 1 OR 2 (YES OR NO BUT INTEND TO IN NEXT 5 YEARS)

Q.10. How [IF Q.7\_3 = CODE 1: do; IF Q.7\_3 = CODE 2: would] you primarily charge your electric / plug-in hybrid vehicle?

SINGLE RESPONSE; RANDOMISE

Slow charge (standard three prong wall charger) at home	1
Smart wallbox charger at home (responds to price or solar availability)	2
Standard Wallbox charger at home (not automated to respond to price or solar availability)	3
Public fast chargers (for a price)	4
Public fast chargers (free)	5
Private fast charger in public place (e.g. dedicated charger at workplace, or fleet charging station)	6
Other (please specify): _____	7

---

ASK IF Q.7\_3 (ELECTRIC VEHICLE OR HYBRID) = CODES 1 OR 2 (YES OR NO BUT INTEND TO IN NEXT 5 YEARS)

Q.11. Which of the following best describes how you [IF Q.7\_3 = CODE 2: would] prefer to charge your electric / plug-in hybrid vehicle?

SINGLE RESPONSE; RANDOMISE

I [IF Q.7_2 = CODE 2: would] prefer to keep my EV fully charged when possible	1
I [IF Q.7_2 = CODE 2: would] prefer to charge my EV when it is most convenient for me	2
I [IF Q.7_2 = CODE 2: would] prefer to charge my EV in the least expensive way (own solar or cheap phase of a time-of-use tariff)	3
I [IF Q.7_2 = CODE 2: would] prefer to charge my EV using renewable electricity	4
I don't have a preference, or don't know, about how I [IF Q.7_2 = CODE 2: would] charge my EV	5
None of these	6

ASK ALL

Q.12. On a typical day, at what time does your household do the following activities? If the time varies, please select when they are done most often.

SINGLE RESPONSE PER ROW; RANDOMISE

		6am-10am	10am-3pm	3pm-8pm	8pm-6am	Varies too much to say	Nearly always on/charging	Not applicable in my household
1	If Q.1 = 3: Use the air conditioning to cool the home	1	2	3	4	5	6	7
2	If Q.1 = 5: Run the pool pump	1	2	3	4	5	6	7
3	If Q.7_3 = 1: Charge electric vehicle/s	1	2	3	4	5	6	7
4	Use the dishwasher	1	2	3	4	5	6	7
5	Use the washing machine	1	2	3	4	5	6	7
6	Use the clothes dryer	1	2	3	4	5	6	7
7	Use an electric heater (including reverse cycle split system air conditioner heating)	1	2	3	4	5	6	7
8	Shower or bathe	1	2	3	4	5	6	7
9	Cook using electric appliances, stovetop or oven	1	2	3	4	5	6	7

ASK ALL

Q.13. How easy or difficult would it be for your household to change when you do these things to the middle of the day when solar electricity is abundant? ONLY SHOW ITEMS FROM Q.12 FOR WHICH THE RESPONSE WAS NOT CODE 7 (NOT APPLICABLE IN MY HOUSEHOLD)

SINGLE RESPONSE PER ROW; RANDOMISE

		Very difficult	Quite difficult	Neither easy nor difficult	Quite easy	Very easy	Don't know
1	If Q.1 = 3: Use the air conditioning to cool the home	1	2	3	4	5	6
2	If Q.1 = 5: Run the pool pump	1	2	3	4	5	6
3	If Q.7_3 = 1: Charge electric vehicle/s	1	2	3	4	5	6
4	Use the dishwasher	1	2	3	4	5	6
5	Use the washing machine	1	2	3	4	5	6
6	Use the clothes dryer	1	2	3	4	5	6
8	Use an electric heater (including reverse cycle split system air conditioner heating)	1	2	3	4	5	6
10	Shower or bathe	1	2	3	4	5	6
11	Cook using electric appliances, stovetop or oven	1	2	3	4	5	6

ASK IF CODE 1 OR 2 (VERY OR QUITE DIFFICULT) FOR ANY ITEMS AT Q.13

Q.14. If asked to move some activities to the middle of the day when there may be excess solar electricity available, what would prevent you from doing this? Please select up to 3

MULTIPLE RESPONSE; RANDOMISE; MAX 3 RESPONSES

- Not at home at those times (e.g. at work, study) 1
- Does not fit with childcare/caring responsibilities (e.g. would wake the baby) 2
- Do not want noise through the day (e.g. would disturb shift workers) 3
- It's hard to plan when I need to use these appliances 4
- I'd forget to load and programme the appliance 5
- I need to do these tasks when it's convenient for me 6
- I tend to group multiple key tasks together at the same time 7
- Other priorities for my time 8
- I don't think it should matter what time I use electricity 9
- Other reason (specify) 10

---

ASK ALL

**Q.15.** During periods of very high energy demand (such as when many people use their air conditioning during very hot periods), energy companies, government agencies or respected community groups sometimes run campaigns asking people to reduce their energy use for a short period. During these times of high demand, would you reduce energy use in your home for any of the following reasons? Please select up to three.

**MULTIPLE RESPONSE; RANDOMISE; MAX 3 RESPONSES**

To get a financial 'bonus' on my energy bill for reducing use at that time	1
To receive a fun reward for reducing use at that time (e.g. movie ticket, meal, or pool voucher)	2
To help the environment	3
To reduce stress on the electricity grid	4
To educate children about using energy carefully	5
To help prevent a power outage (e.g. loss of electricity supply to my home or other parts of the community)	6
To ensure older or unwell households can run their air conditioning to keep cool	7
To respond to the challenge or compete with other households in the campaign	8
To have a donation made on my behalf to a charity or community organisation	9
Other (please specify): _____	10
None of these	11

---

ASK ALL

**Q.16.** If, during a very hot period, there was such a campaign asking people to reduce their energy use, would you be willing to reduce your energy use?

**SINGLE RESPONSE**

Yes, but only if I was offered a financial incentive	1
Yes, even if I was not offered a financial incentive	2
No, I would not reduce my energy use	3
Unsure	4

---

ASK ALL

Q.17. During an afternoon when there is abundant solar energy being produced in your neighbourhood, would you be willing to increase your energy use to help stabilise the grid?

SINGLE RESPONSE

Yes, but only if I was offered a financial incentive	1
Yes, even if I was not offered a financial incentive	2
No, I would not increase my energy use	3
Unsure	4

---

ASK ALL

Q.18. In the next few years, smart appliances may become more available and affordable. These could help reduce electricity bills by running at times when electricity is cheaper or when it comes from renewable sources.

Smart appliances such as dishwashers and electric vehicle chargers, hot water systems and pool pumps could be connected to an external company, such as your energy supplier. The external company would be able to monitor the cost of energy and remotely send signals to your appliances so they can run at times when electricity costs are lower and reduce usage when electricity costs are higher. Critical appliances such as life support equipment could not be switched off remotely.

Which of the following ways of using smart appliances would you prefer in your home?

SINGLE RESPONSE

I want to set the timings or control the settings on my smart appliances myself, so that I fully manage them myself	1
I am happy for the smart appliance to be automated provided I can override manually if I need to	2
I am happy for the smart appliance to be fully automated	3
I would not use smart appliances	4



---

ASK IF Q.18 = CODE 2 (HAPPY FOR SMART APPLIANCE TO BE AUTOMATED IF I CAN OVERRIDE MANUALLY)

Q.19. In what circumstances would you want to override smart or automated appliances? Please select all that apply

MULTIPLE RESPONSE

During hot weather	1
In the event of storms, flood, or bushfire	2
When I was travelling	3
If I was hosting (e.g. for guests or events at my home)	4
During holidays	5
If someone in my household had an illness or health concern	6
Other	7

---

ASK ALL

Q.20. Have you converted an additional area on your property (e.g. shed or garage) into a living or recreational space in the last 5 years?

SINGLE RESPONSE

Yes	1
No	2

---

ASK Q.20 = CODE 1 (YES)

Q.21. Which of the following appliances, equipment or features have you added to that converted space? Please select all that apply

MULTIPLE RESPONSE; RANDOMISE

Electric Heater	1
Fan (pedestal or ceiling)	2
A/C (split-system or portable cooler)	3
Television	4
Refrigerator	5
Computer	6
Exercise equipment	7
Lights	8
Insulation	9
Other electronic devices	10
None – I haven't added any appliances, equipment or features to the converted space	11

---

ASK ALL

Q.22. Are you concerned about any of the following in the air of your home?

MULTIPLE RESPONSE; RANDOMISE

I am not concerned about the air in my home [ANCHOR]	1
Allergens (e.g. dust, pollen etc)	2
Odours (e.g. from a pet or cooking)	3
Bushfire smoke	4
Cooking pollutants (e.g. odours or gases)	5
Mould	6
Viruses/germs	7
Other (please specify): _____	8

---

ASK ALL

Q.23. Do you do anything to manage the air quality in your home?

SINGLE RESPONSE

Yes	1
No	2

---

ASK IF Q.23 = CODE 1 (YES)

Q.24. How do you manage the air quality in your home?

MULTIPLE RESPONSE

Standalone air purifier	1
Filters for purification installed into heating or cooling system	2
Opening windows or doors	3
Closing windows or doors	4
Dehumidifier	5
Humidifier	6
Ceiling fan	7
Extractor fan	8
Other (please specify) [insert textbox]	9

---

ASK IF Q.1\_3 = CODES 2 OR 3 (DON'T HAVE OR UNSURE IF HAVE REFRIGERATED AIRCON); IF Q.1\_3 = CODE 1 AUTOCODE THIS QUESTION AS CODE 1 (YES)

Q.25. Do you have an operational air conditioner in your home?

SINGLE RESPONSE

Yes	1
No	2
Don't know	3

---

ASK IF Q.25 = CODE 1 (HAVE AIR CON);

Q.26. Do you intend to install or upgrade your current air conditioner in the next 10 years?

SINGLE RESPONSE

Yes	1
No	2
Don't know	3

---

ASK IF Q.26 = CODE 1 (YES)

Q.27. What features will you want in your next air-conditioning unit that you might purchase in the next 10 years? (select all that apply)

MULTIPLE RESPONSE; RANDOMISE

Ability to be controlled remotely (such as via an app)	2
Ability to be automated to respond to energy pricing or renewable energy availability	3
Have embedded air purification	4
Have embedded dehumidification or humidification	5
Other (please specify): _____	6
None of the above	7

---

ASK IF Q.26 = CODE 1 (YES)

Q.28. How often do you estimate you would use this air-conditioning unit?

SINGLE RESPONSE

- |   |   |
|---|---|
| More than I currently use my air-conditioning               | 1 |
| Less than I currently use my air-conditioning               | 2 |
| About the same as I currently use my air-conditioning       | 3 |
| At different times than I currently use my air-conditioning | 4 |
| Other (please specify) [insert textbox]                     | 5 |

---

ASK ALL

Q.29. Please rank the following according to how well it describes your household's priorities or values (drag/move the options into your preferred order):

- |                                      |   |
|--------------------------------------|---|
| Fun and entertainment                | 1 |
| Comfort, health and safety           | 2 |
| Convenience                          | 3 |
| Sustainability                       | 4 |
| Affordability and cost effectiveness | 5 |
| Community-centred                    | 6 |
| Don't know / can't say               | 7 |

## Demographic

Now we have some questions about you, to help us analyse this data. Please be assured your answers will be anonymous and confidential, and we will de-identify this data as soon as the project is complete.

ASK ALL

Q.30. Please select your gender:

SINGLE RESPONSE

- |                             |   |
|-----------------------------|---|
| Man                         | 1 |
| Woman                       | 2 |
| Non-binary / gender diverse | 3 |
| Prefer not to say           | 4 |
| Prefer to self-describe     | 5 |

---

ASK ALL

Q.31. What is your age?

SINGLE RESPONSE

18-24	1
25-34	2
35-44	3
45-54	4
55-64	5
65-74	6
75 or over	7
Prefer not to say	8

---

ASK ALL

Q.32. Which of the following best describes you:

SINGLE RESPONSE

Work full time		1
.....		
Work part time	2	
Work on Casual Basis	3	
Unemployed	4	
Household duties only .....		5
Retired (self-supporting)	6	
Pensioner	7	
Disability pensioner	8	
Full time student	9	
Other – please specify	10	
Prefer not to say	11	

---

ASK ALL

Q.33. With which ethnic group(s) does your household identify?

MULTIPLE RESPONSE

Australian	1
Indigenous Australian or Torres Strait Islander	2
New Zealander	3
Asian	4
Indian	5



Middle Eastern	6
European	7
North American	8
South American	9
African	10
Decline to Answer	11
Other, please specify	12

---

ASK ALL

Q.34. Is English the main language spoken in your household?

SINGLE RESPONSE

Yes	1
No	2
Prefer not to say	3

---

ASK IF Q.34 = CODE 1 (YES)

Q.35. What is the main language spoken in your household?

\_\_\_\_\_

---

ASK ALL

Q.36. What is your total annual household income (gross)? Please include all forms of income including wages and salary, investment income, government payments and superannuation income before taxes for all people who live in your household.

SINGLE RESPONSE

Less than \$40,000	1
Between \$41,000 - \$80,999	2
Between \$81,000 - \$120,999	3
Between \$121,000 - \$160,000	4
More than \$160,000	5
Prefer not to say	6
Unsure	7

---

ASK ALL

**Q.37.** In the last 12 months, did any of the following things happen for you? You may choose more than one answer.

MULTIPLE RESPONSE; RANDOMISE

Sought financial assistance from community/welfare organisation	1
Did not have enough money to pay electricity bill on time	2
Sought assistance from friends or family to pay electricity bill	3
Could not pay for other important things, ( e.g. food, other bills, rent or mortgage)	4
Could not afford to use heating when I/we needed it	5
Had electricity disconnected due to lack of money to pay	6
Was at risk of electricity being disconnected	7
Pawned or sold something to pay bills.....	8
Been on a 'hardship' program because of unpaid electricity bills	9
None of the above	10

---

ASK ALL

**Q.38.** About how much is your electricity bill typically each quarter (every 3 months)?

SINGLE RESPONSE

Less than \$300 per quarter (Less than \$100 per month)	1
\$300-\$600 per quarter (\$100-\$200 per month)	2
\$601-\$1200 per quarter (\$201-\$400 per month)	3
More than \$1200 per quarter (More than \$400 per month)	4
Unsure	5
Prefer not to say	6

---

ASK ALL

**Q.39.** What electricity pricing do you have with your energy retailer?

SINGLE RESPONSE

Flat tariff. e.g. same rate for electricity consumption at any time of the day or night)	1
Time of use tariff. e.g. peak, shoulder or off-peak rates differing by the time of day or day of the week	2
Controlled load tariff. e.g. hot water systems on an off peak tariff	3
Unsure / Don't know	4
Other, please specify	5

---

ASK ALL

Q.40. Please enter the postcode of your primary residence:

\_\_\_\_\_

Prefer not to say

2

---

Q.41. What type of dwelling do you live in?

SINGLE RESPONSE

Detached house

1

Semi-detached, row or terrace house, townhouse

2

Flat, unit or apartment

3

Other - please specify: \_\_\_\_\_

4

---

ASK ALL

Q.42. Do you currently have a place, where you could (or already) charge an electric vehicle (these can be charged from a regular powerpoint)?

SINGLE RESPONSE

Yes

1

No

2

Unsure

3

---

Q.43. Do you own your home or rent?

SINGLE RESPONSE

Own (outright)

1

Own (mortgage)

2

Rent

3

Other - please specify

4

---

ASK ALL

Q.44. How many bedrooms does your home have?

SINGLE RESPONSE

None (studio)	6
1	1
2	2
3	3
4	4
5 or more	5

---

ASK ALL

Q.45. Which of the following best describes your household?

SINGLE RESPONSE

Single person household	1
Couple without child(ren)	2
Couple with child(ren)	3
One parent/guardian with child(ren)	4
Extended family household (e.g. multigenerational)	5
Group or share household	6
Other (please specify): _____	7

---

ASK ALL

Q.46. Have you moved your primary residence from a metropolitan area (city) to a coastal or regional/country area in the past 5 years? (e.g. a 'sea-change' or 'tree-change')

SINGLE RESPONSE

Yes	1
No	2

---

ASK ALL

Q.47. Are you planning to move your primary residence from a metropolitan area (city) to a coastal or regional/country area in the next 5-10 years? (e.g. a 'sea-change' or 'tree-change')

SINGLE RESPONSE

Yes	1
No	2





---

ASK ALL

**Prize draw entry:**

Thank you for helping us with this survey. If you would like to be entered into the prize draw to win XXXXXXXX, please enter your name and a contact email address and phone number below. Winners will be drawn randomly on XX and notified by phone and/or email.

These details will only be used for the prize draw and will be deleted once all prizes have been claimed. Winners will be drawn randomly on XX and notified by phone and/or email. Terms and conditions can be viewed [here](#).

ENTER YOUR NAME:

ENTER YOUR EMAIL ADDRESS:

ENTER YOUR PHONE NUMBER:

Prefer not to enter the prize draw

1

---

End with thanks (all):

Thank you for assisting us today. Your response to this questionnaire will be have all identifying information removed prior to passing the data set on to Monash University, and the identified data set will be deleted. The information collected will only be used for research purposes. If you have any queries or concerns, please contact us on [surveys@qmr.com.au](mailto:surveys@qmr.com.au)

All data and information collected from the survey will be stored appropriately and in accordance with the Australian Privacy Act 1988 and the New Zealand Privacy Act 2020. Our Privacy policy can be found [here](#).



# MONASH University

## Authors

Dr Kari Dahlgren  
Dr Hannah Korsmeyer  
Dr Fareed Kaviani  
Dr Rex Martin  
Professor Yolande Strengers  
Professor Sarah Pink

## Published by

Emerging Technologies Research Lab  
Monash University Caulfield campus  
900 Dandenong Road  
Caulfield East VIC 3145

## Photography and participant materials

All ethnographic photographs and materials were created by the Emerging Technologies Research Lab team or by participants who granted copyright to the research team. ©Emerging Technologies Lab 2023. Where relevant, other image sources are acknowledged in the report.

## Funding acknowledgement

Funding acknowledgement The research was funded by CitiPower, United Energy and Powercor in partnership with Monash University. We gratefully acknowledge our partner organisations for their time and contribution.

## Participant acknowledgement

We thank the 36 households who participated in our household research. They kindly opened their homes to us, and shared the details of their lives as well as their hopes and goals for the future. All photos in this report come from our participants' homes and we are grateful for their willingness to share these images with us.

The views expressed herein are those of the authors and are not necessarily those of the project partners.