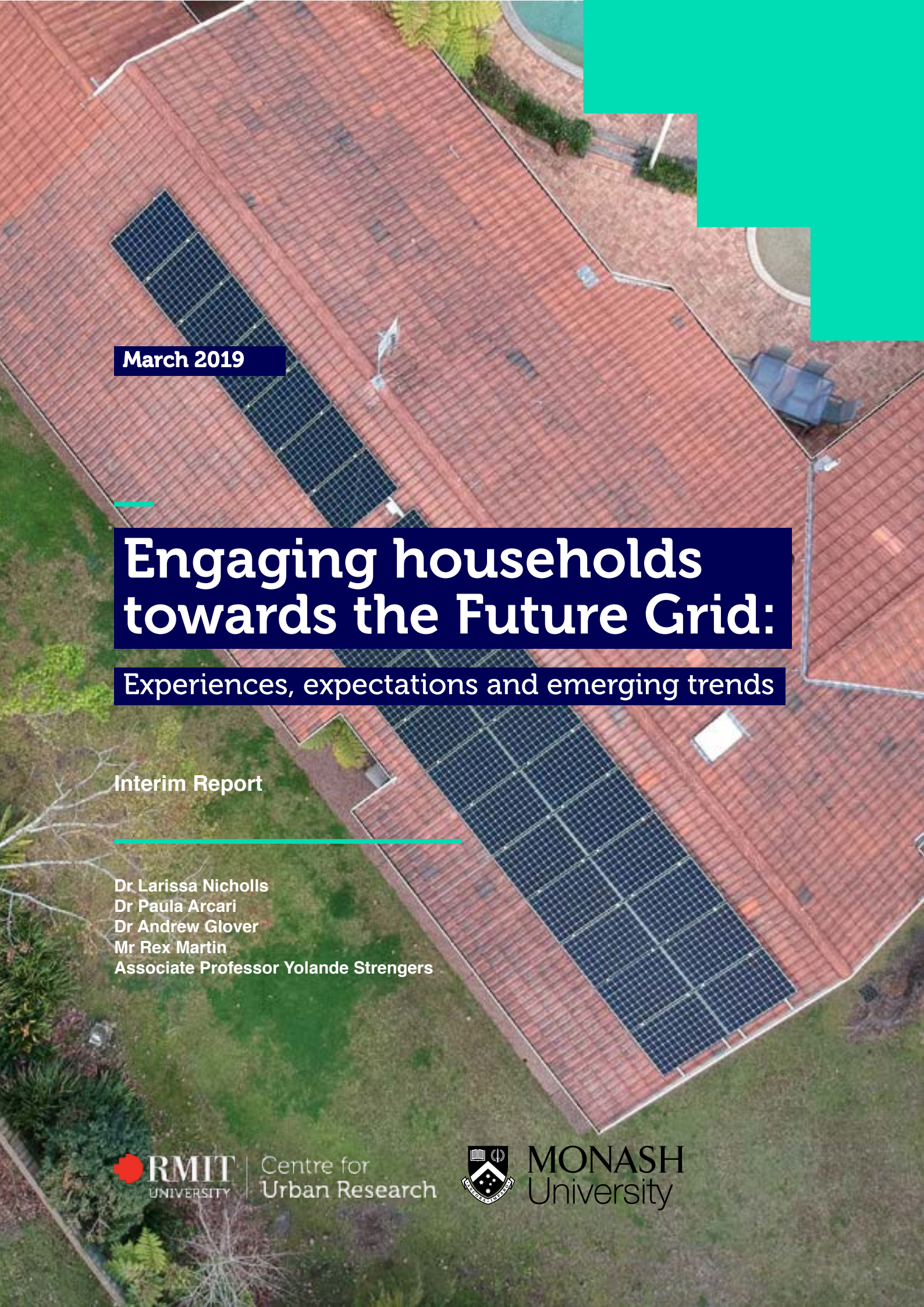

March 2019

Engaging households towards the Future Grid:

Experiences, expectations and emerging trends

Interim Report

Dr Larissa Nicholls
Dr Paula Arcari
Dr Andrew Glover
Mr Rex Martin
Associate Professor Yolande Strengers

RMIT UNIVERSITY | Centre for Urban Research
MONASH University

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SUMMARY

Residential consumers' relationships with the electricity grid and market are changing, and so are the types of engagement needed to navigate this complex environment. Scenarios proposed for the 'Future Grid' (CSIRO 2013, CSIRO and ENA 2017) provide opportunities for (and sometimes require) greater participation from householders to interact with electricity products, providers, services and technologies.

The Future Grid Homes project (2018-19) aims to identify best practice engagement strategies, concepts and relatioship models to improve residential consumers' trust, participation in demand management, and adoption of new energy tecnologies (e.g. solar PV and battery storage) intended to support affordability and reliability objectives for households.

The project is concerned with engagement around the use of emerging energy technologies and participation in demand management in relation to the Future Grid. The term 'engagement' is used to encompass both energy sector led and household initiated types.

Future Grid Homes adopts a qualitiative methodology and is being conducted in three stages:

Stage 1: Household research
Stage 2: Stakeholder interviews and analysis of consumer engagement materials
Stage 3: Development of an engagement strategy for the sector

This **interim report summarises findings from Stage 1**, which involved in-depth and at-home interviews with 51 Australian households in five National Energy Market states and territories (VIC, SA, NSW, ACT and QLD). The interviews were conducted between August and November 2018.

Recruitment focused on **3 overlapping household categories** which have experienced different types of engagement with the energy sector:

Early adopters: Have solar PV array combined with battery storage and/or electric vehicle, or are planning installation of battery storage for self-generated electricity
Demand management participants: Households participating in a demand management initiative (Peak Rewards program or Direct Load Control program)
Blackout experiences: Households who reported experiencing at least one memorable electricity outage in recent years

Although the research recruited households with specific experiences, other Future Grid topics relevant to the research (emerging technologies, demand management or blackouts) were raised and discussed with each household. The findings presented in this report provide:

- Thematically organised sections summarising the issues and priorities discussed by householders and illustrated by exemplary quotes
- Householder responses to emerging issues raised via five prepared statements (read to householders during the interview) on challenges and opportunities for the Future Grid
- Selected household case studies that highlight emerging issues and concerns in depth

Findings are generalised to the sample, which achieved thematic saturation for each of the three household categories. The research is not intended to be representative of all Australian households but is likely to reflect broader views and trends as more householders come into contact with aspects of the Future Grid. It also builds on the authors' past qualitative research with Australian households conducted over the last ten years.

FINDINGS: CHALLENGES

The report identifies three key challenges which impact household interest and capacity to engage with electricity sector priorities for the Future Grid. These challenges are significant for consumer outcomes in relation to householder interest in 'taking control' of their energy supply and participating in the Future Grid in ways which help manage network costs and reliability.

Reliability

- Most householders **do not expect the electricity grid to deliver a higher level of reliability** to their home. Blackouts are commonly accepted as unavoidable outcomes of weather and other events. However extended blackouts, like the 2016 statewide outage in South Australia, raise householder concerns about their own or others vulnerability.
- **Some householders would like more continuous access to electricity** due to growing dependence on information and communication technologies used to working from home and stay in touch during disruptive or unsettling events, and concerns about staying cool at home with air conditioning in hotter conditions arising through climate change.
- Households are interested in (or already using) home battery storage to secure access to electricity at home and increase reliability.

CASE STUDY: LEAH *"Reliability... it's a real gripe for us"*

Distrust

- **Distrust** in energy businesses, organisations or policymakers is widespread and related to a range of concerns such as high energy bills and perceived lack of justification for price rises or 'low' feed-in-tariff rates, lack of leadership or energy planning, unfairness and inequity in access to energy as an essential service, and dissatisfaction with privatisation of energy services.

CASE STUDY: ALAN *"I want to stick it to the energy companies"*

Disengagement from the energy market and Different Priorities

- The research found *two main types of disengagement*: householders who were 'unengaged', meaning they weren't particularly interested in tariffs, the energy market or grid technicalities; and those who were 'deliberately disengaged', which describes people who had decided to disengage due to dissatisfaction, frustration and disappointments with aspects of the energy market.
- Householders are mostly unsure about their own electricity tariff and dissatisfied with complexity in the energy market – an approach which requires substantial time, skills and interest to navigate, and which they doubt is serving their interests.
- Householders desire simplicity from the energy market and associated services. They find energy sector communications to be unengaging, unhelpful, confusing or discouraging.
- Despite widespread disengagement, **households are not disinterested in energy issues**. They are engaged in other ways such as adopting new technologies, improving their home's energy efficiency performance, ensuring health, comfort and productivity at home, or engaging with energy policy regarding affordability, reliability and environmental impacts.

CASE STUDY: EDDIE *"Australian citizens don't need to worry about poles and wires"*

FINDINGS: PATHWAYS TO ENGAGEMENT

The report identifies four pathways to engage householders through the programs, activities and interests that already engage them, or that they would like to engage in.

Participation

Most householders are interested in participating in energy initiatives which they perceive to be productive – not only for personal gain but to support the energy system.

The report identifies two forms of participation.

Participation via energy generation – to make their 'own' energy, respond to feelings of powerlessness or lack of control over energy costs and issues, and/or 'support' Future Grid initiatives.

- Early adopter households are already engaging in this form of participation. They often make significant modifications to their household routines and/or monitor their energy generation and consumption to improve financial outcomes from their investment and/or to assist with demand issues. Men are more interested in energy monitoring than women.
- Early adopters want their efforts and contribution of 'clean' energy to support the grid better acknowledged. Understandably, householders may not have a full understanding of the complexities of energy demand, networks, and costs. They view household installation of solar PV as highly beneficial to the electricity grid to both reduce carbon emissions and network electricity demand.
- Even households not already involved in early adoption (or demand management) want to participate via installation of solar PV and other renewable energy technologies – regardless of whether financial circumstances, tenure or other constraints exclude them from this desired form of participation.
- Modification of household routines to suit energy imperatives may not suit all households and battery adoption can also be a 'one-off' form of participation not linked to an interest in making energy use a frequent consideration in daily life.

CASE STUDY: DEON *"It takes the load off the infrastructure"*

EMERGING ISSUE: CONSUMER PROTECTIONS

Reduced consumer protections for householders with new energy technologies is a key concern that most people haven't thought about before. Consumer protections are likely to be central to maintaining and building trust in Australia's energy system.

Participation via demand management – householders participating in a peak rebate or Direct Load Control programs.

- Reasons to participate in a program vary (and may be influenced by program design), including receiving personal and community benefit rewards, engaging in an educational opportunity, and/or delivering collective action or benefit.
- Peak events facilitate participation because they are occasional and capture household attention for short periods of time via a notification system.
- Demand management programs improve householders' engagement with and understanding of the energy sector and grid/network constraints.
- When householders have little exposure to demand management initiatives, their reactions range from highly supportive of the concept through to distrust that demand management is necessary or productive.
- There are a range of opportunities to further improve participation, such as consistent messaging on the need for demand management in Australia, enhancing visibility of the overall benefit and impact of the programs, and

responding to concerns about who should be expected to respond to demand management, e.g. younger and healthy households instead of sick, elderly or vulnerable households.

CASE STUDY: VERA *"We need to co-operate, and we need to contribute"*

CASE STUDY: NADIA *"'If everyone's doing it together, that makes a difference"*

Sharing & Equity

The concept of **energy sharing appealed to most households** even if they had not heard of it prior to the interview (as long as it did not add further unwanted complexity in the energy market). Early adopter households had often already investigated and/or actively pursued options for peer-to-peer trading.

- The concept of sharing is appealing to householders as a response to widespread concern for more vulnerable others who may not be able to afford electricity or access renewable electricity in their homes.
- Current forms of sharing included feeding household-generated electricity into the grid (for 'collective' use), or sharing energy with other households who share the same property through alternative dwelling and housing arrangements.

CASE STUDY: ISAAC *"There's a risk in not having peer-to-peer"*

EMERGING ISSUE: PEER-TO-PEER ENERGY TRADING

Peer-to-peer trading is a highly engaging concept that some households are already exploring. It has the potential to build trust in the energy sector. However, delivery needs to be clearly communicated to minimise the potential for confusion, programs and platforms need to ensure that consumers are the primary beneficiaries, and rules and regulations need to address equity concerns.

Communication

Householders expressed **concern that the energy sector does not communicate well with them**, that they can't trust sector communications, and/or that they do not find communication materials engaging. As a result, they are often unsure whether they want more communication from the sector. However, once energy topics are raised with households (such as via the emerging issue statements) households show interest, express opinions, and are more inclined to engage.

Householders expressed their desire for clear, consistent and accessible communication for themselves and other households. They want to know why prices have gone up, limitations of the grid, how the Australian context compares with other countries, what the benefits of infrastructure upgrades have been and will be, and greater transparency and honesty from the sector.

EMERGING ISSUE: PEAK DEMAND

Awareness and understanding of peak demand have improved since earlier research conducted by the research team. However, the role of household air conditioning in contributing to peak demand and options to address this issue are less well understood or agreed. Relating peak electricity demand to household water restrictions can shift householders' position regarding their role in addressing peak demand, and result in more positivity towards participating in reducing peak demand.

EMERGING ISSUE: GOING OFF THE GRID AND SUSTAINING THE GRID

There is low awareness of the potential impact of widespread household disconnections on the financial viability of the grid and potential impact on costs to those who remain on the grid. 'Off-grid' is an appealing idea – particularly to gain a sense of control of electricity costs and issues – but use of the term 'off-grid' does not usually mean that households want to completely disconnect from the grid. When introduced to the emerging issue of sustaining the grid, most householders who thought that disconnecting from the grid was a good idea change their minds.

Leadership & Consultation

Householders are looking for **coordinated and effective leadership on energy issues**. They want to know that the energy sector understands and is responding to householder concerns and interests, and that there is a clear plan to ensure energy in Australia is not only affordable and reliable, but also becoming more environmentally sustainable.

Householders are willing to give their time to consultation processes that present an avenue to express their concerns in their own words, and enable them to learn about energy issues without having to navigate technical jargon. They view this research as a form of consultation.

CASE STUDY: CLARE *"An overall plan would be so lovely"*

EMERGING ISSUE: INTEGRATION OF DISTRIBUTED GENERATION INTO THE GRID

Householders are mostly unaware of the potential need to upgrade the electricity grid to accommodate increasing distributed energy generation, and some doubt whether this would be costly. However, accommodating additional household energy generation is considered a national priority and is likely to be important for building and maintaining trust in the energy sector. The issue of how to distribute the costs of any upgrades is a new idea to most householders and they recognise it is a complex issue.

IMPLICATIONS & CONCLUSIONS

The following summary and **more detailed implications and conclusions** will inform subsequent stages of this project:

- Engaging consumers with better information and more market choice can be counterproductive for better engagement outcomes
- Digitally connected lifestyles and more frequent and intense heatwaves are increasing reliance on electricity and generating interest in new energy technologies
- Households want to participate in ways that are meaningful and interesting to them
- Distributed generation provides an important pathway towards engagement
- Consistent communication about demand management, including its aims and impacts, will increase participation and help build trust in the energy sector
- The concept of sharing and householder concerns about equity are emerging engagement opportunities for the Future Grid
- Holding conversations about energy challenges can improve understanding and participation
- National leadership and energy sector planning is urgently needed to build trust and confidence in the sector

CONTENTS

INTRODUCTION

Residential consumers' relationships with the electricity grid and market are changing, and so are the types of consumer engagement needed to navigate this complex environment. Scenarios proposed for the 'Future Grid' (CSIRO 2013, CSIRO and ENA 2017)[1] provide opportunities for (and sometimes require) greater participation from energy consumers to interact with electricity products, providers, services and technologies. However, best practice engagement strategies are yet to be established for this new operating environment. Additionally, households are engaging (and disengaging) on their own terms and in ways the energy sector had not necessarily anticipated.

***The Future Grid Homes project** (2018-19) aims to identify best practice engagement strategies, concepts and relationship models to improve consumer trust, participation in demand management, and adoption of new energy technologies (e.g. solar PV and battery storage) intended to support affordability and reliability objectives for energy consumers.*

The project adopts a qualitative methodology comprised of:

- In-depth household research (Stage 1)
- Stakeholder research and a content analysis of consumer engagement materials (Stage 2)
- An engagement strategy for the sector (including findings from stages 1 and 2) based on the research conducted across all stages of the project (Stage 3)

The project also builds on past findings from the research team's in-home energy research conducted with over 350 households over the last decade in South Australia (SA), Victoria (VIC), New South Wales (NSW), Australian Capital Territory (ACT) and Queensland (QLD), as well as other relevant residential research conducted in Australia.

This report summarises the findings from Stage 1 of the Future Grid Homes project, which involved in-depth and at-home interviews with 51 Australian households in five National Energy Market (NEM) states and territories (VIC, SA, NSW, ACT and QLD).

Over recent years, there has been an increased focus on engaging consumers in energy issues through information provision and consultation, particularly in relation to network regulation, pricing, and infrastructure investment processes (CUAC 2014). The Future Grid project is concerned with engagement around the use of emerging energy technologies and participation in demand management, and therefore adopts a broad definition of household engagement. The term encompasses both energy sector and household initiated forms of engagement:

- Direct and indirect communication and interaction with residential energy consumers via energy retailers, distributors, governments, media and commentary, and other third parties
- Household interaction with emerging technologies, such as solar PV and battery storage, and energy feedback (data) systems
- Household interest and participation in the current retail energy market and new market arrangements (e.g. peer-to-peer trading) and/or demand management programs (e.g. peak alerts and Direct Load Control)
- Changes in household routines and activities arising from unplanned outages, participation in demand management, and/or interaction with new and emerging energy technologies

[1] See '**Background**' for further definition of this term

AIMS & SCOPE OF STAGE 1 HOUSEHOLD RESEARCH

Stage 1 involved in-depth and at-home **interviews with 51 Australian householders in five NEM states** (VIC, SA, NSW, ACT and QLD) to identify how they understand and relate to demand management, the role of the grid and grid constraints, and opportunities and risks relating to future energy technologies and demand response initiatives.

A key aim of Stage 1 was to understand how households are engaging, wish to be engaged, or could be better engaged, in Future Grid initiatives.

Recruitment of households focused on **3 overlapping consumer categories** with recent experience of events, technologies or initiatives that typically involve engagement with the electricity sector and issues relevant to the Future Grid (see Table 1).

Table 1 Consumer categories selected for Stage 1 household research

	DEFINITION	POSSIBLE TYPES OF ENGAGEMENT (AND/OR)
Early adopters	Have solar PV array combined with battery storage and/or electric vehicle, or are planning installation of battery storage for self-generated electricity	• Interaction with emerging technologies and their suppliers/installers • Interaction and communication with electricity utilities through installation or alternative tariff arrangements (e.g. FIT). • Modification of household routines and activities around supply, storage and financial incentives
Demand management participants	Households participating in a demand management initiative (Peak Rewards program or Direct Load Control program)	• Retailer- or distributor-led marketing and communication • Interaction with new demand response messaging and technologies • Modification of routines and activities for short periods of time
Blackout experiences	Households who reported experiencing at least one memorable electricity outage in recent years	• Messaging from electricity utilities and governments • Media discussion and public commentary • Contact and communication with electricity retailer and/or distributor • Impacts on household routines and activities due to electricity unavailability • Modification of household activities at times of supply constraint (to avoid load shedding)

The rationale for selecting these three categories is described below.

1. **Early adopters:** Two million households now have solar panels (Clean Energy Regulator 2018) with increased adoption by households and businesses expected over the next decade (CSIRO and ENA 2017). The 2017 Energy Consumer Sentiment Survey (ECSS) indicated that up to 44-81% of households (depending on the state) have or are considering rooftop solar, and around half of these are also interested in battery storage (ECA 2018). Interest in on-site generation has been largely attributed to consumer concerns about energy cost (ECA & UMR 2016). Households interested in battery storage and other solar-based market initiatives may adopt a 'prosumer' relationship with the electricity grid (CSIRO 2013), in which they both produce and consume their own power. This could reduce network costs (KPMG 2016). However, similar to the rapid uptake of mobile phones and disconnection from landlines, financially-able electricity consumers could opt to leave the grid if they do not perceive benefits in staying connected.
2. **Demand management participants:** A wide range of demand management initiatives are currently in ongoing use or being trialled across Australia to reduce peak electricity demand. Several peak alert programs were trialled over the 2017-18 and 2018-19 summer periods, involving financial or other incentives. These programs typically try to engage households in an economic exchange (financial incentive) to reduce demand for a period of time. Direct Load Control (DLC), whereby utilities remotely cycle the power use of air conditioners down for short periods of time, has also been trialled and is in ongoing use in Queensland.
3. **Blackout experiences:** Unplanned outages are an undesirable feature of electricity grids and occur sporadically in Australia due to extreme weather or other events, peak electricity demand, breakdowns and faults in the network. While

not typically viewed as a form of 'consumer engagement', blackouts can increase contact between households, utilities and governments, and are often extensively discussed in the media. Historical research on blackouts indicates that they can generate a range of reactions amongst consumers – from chaos and anger through to community connection and joy (Nye 2010). Recent unplanned blackouts in Australia (such as the 2016 South Australia storm and the January 2018 Victorian and NSW heatwave-associated blackouts) received considerable negative media commentary and generated consumer confusion. These and other similar events may affect consumer trust and confidence in the electricity grid and market, and interest in energy technologies, such as household solar and batteries.

Further detail on the households interviewed for this research is provided in the Methodology (Section 2).

BACKGROUND

Distributed energy resources (DER) are increasingly important components of Australia's electricity system and include 'distribution level resources, which produce electricity or actively manage consumer demand e.g. solar rooftop PV systems, batteries, and demand response like hot water systems, pool pumps, smart appliances and air conditioning control' (AEMO 2018). The rapid and anticipated growth in DER presents:

- Opportunities (including significant reductions in network augmentation and associated costs, increased network resiliency, and integration of greater levels of renewable energy)
- Technical and operational challenges (unpredictable flows of energy into the grid, unfavourable local impacts on voltage, and potential impacts on network components and household appliances)
- Costs – which may fall more heavily on non-DER households (Byrne and Parmenter 2018).

In response, Australian Energy Market Operator (AEMO) and Energy Networks Australia are investigating how to transition to a two-way grid and optimise DER to maximise outcomes for consumers (AEMO & ENA 2018). It is anticipated that this will involve a combination of technical solutions and residential consumer actions to coordinate solar production, storage and demand response with centralised energy resources and constraints. As such, the ways that energy consumers do and don't engage with new energy technologies (including the pace of uptake), demand management and the energy market has the potential to increasingly impact the efficiency, sustainability and reliability of the electricity grid.

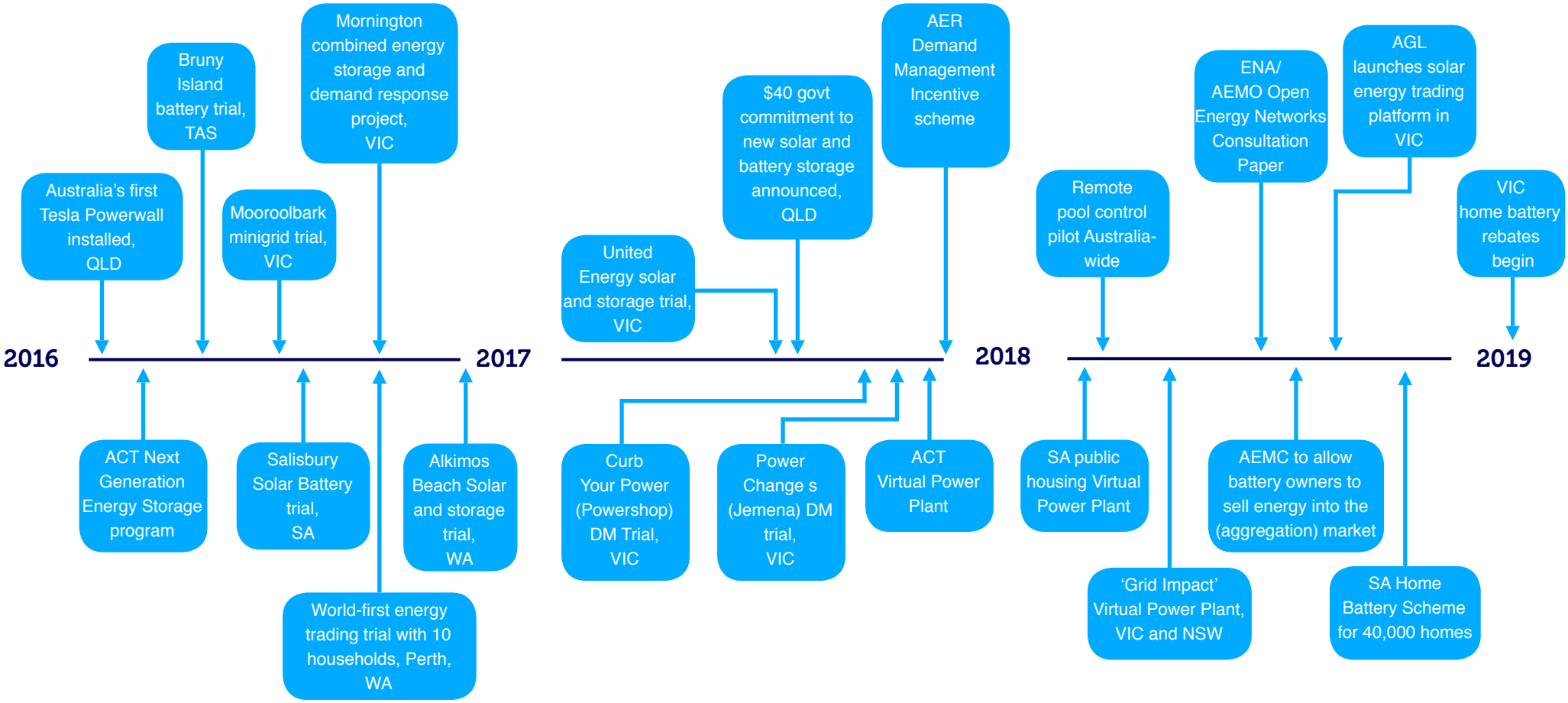
The CSIRO's 'Future Grid Forum' proposed and modelled four scenarios in which 45% of electricity is generated by end-users by 2050 (CSIRO 2013):

1. 'Set and forget': passive consumers accept industry-led demand management and tariff regimes that require some decisions up front but very little engagement afterwards
2. 'Rise of the prosumers': engaged consumers demand a wide range of active and ongoing choices particularly around home energy generation
3. 'Leaving the grid': consumers respond to energy costs and technology availability by going 'off-grid' with their own energy generation and storage
4. 'Renewables thrive': consumer uptake of on-site generation combined with engagement in demand management and support for the centralised grid

It is likely that the Future Grid will involve a combination of the four scenarios, as well as other possible scenarios not covered by the CSIRO modelling (Strengers et al. 2019). The uptake of DER in Australia has moved rapidly since this work was completed (for examples see Figure 1) and it is generally agreed that solar prosumers, residential or localised storage and demand management will all play a role.

Given the emerging and changeable nature of this area, this research adopts a broad definition of the Future Grid informed by emerging industry initiatives and peer-reviewed literature, and consultation with ECA and the project's Expert Panel. The research explores a range of issues and engagement opportunities in relation to an electricity grid characterised by increasing DER and demand management (see **Methodology**).

Figure 1. Sample of household solar and demand management initiatives and announcements in Australia 2016-2018



GLOSSARY & DEFINITIONS

Term	Explanation
AirBnB	Online marketplace for short term accommodation in residential housing
Battery	Energy storage device typically used by households in conjunction with solar PV systems to store electricity generated onsite, and to draw on to maintain supply of electricity
Blackout	Used by householders (and sometimes researchers) to describe an unexpected loss of electricity to the home and other homes nearby. Some householders may include load shedding events under this terminology.
Clean Energy	Electricity that is generated from renewable sources such as solar, wind, hydro
DM **DM-DLC** **DM-PR**	Demand Management – initiatives to reduce the amount of electricity being used during peak demand Direct Load Control demand management participant Peak Rewards demand management participant
DER	Distributed Energy Resources. Includes distribution level resources, which produce electricity or actively manage consumer demand, e.g. solar rooftop PV systems, batteries, and demand response like hot water systems, pool pumps, smart appliances and air conditioning control.[2]
DLC	Direct Load Control – refers to electricity use in households being controlled remotely by energy companies, typically during periods of peak demand
Early adopter (of new energy technologies)	Have solar PV array combined with battery storage and/or electric vehicle, or are planning installation of battery storage for self-generated electricity
EV	Electric Vehicle (battery or plug in hybrid)
FIT	Feed-In-Tariff. A payment for electricity fed into the supply grid from a renewable energy source, such as wind or solar panels.
Flat rate (tariff)	Electricity pricing that remains the same throughout the day and night
HH/HHs	Household/Households
NEM	National Electricity Market
Off-grid	Disconnection from mains electricity services in favour of on-site energy generation and provisioning (may also be used in reference to other utilities)
Outage - planned **Outage - unplanned**	Electricity outage for which customers are sent prior notification, e.g. for works on network Unexpected electricity outage (no notification). Also often referred to as 'blackout', and may be caused by site specific incidents (e.g. storms damaging grid infrastructure) or overloading of grid during peak periods
Peak Demand	The period in which the overall amount of electricity being used is at its highest. May refer to daily peaks or overall peaks.
Power outage	Electricity outage
PV	Photovoltaic (e.g. solar PV array)
Rolling blackout/ load shedding	Last-resort measure used by an electric utility to avoid a total blackout of the power when demand exceeds supply, by temporarily cutting off supply of electricity to parts of the grid
Smart	Infrastructure or appliances that are automated and/or connected to the internet that generate and communicate data
ToU (tariff)	Time-of-Use (tariff) - whereby households are charged different rates for electricity use at different times of the day
Technophile	A person who is enthusiastic and knowledgeable about new and emerging technologies (self-identified or identified by the research team). Some but not all early adopters are considered technophiles.

[2] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program

METHODOLOGY

The Future Grid project adopts a **qualitative methodology** comprised of in-depth household interviews (Stage 1), energy engagement stakeholder interviews, and a content analysis of consumer engagement materials (Stage 2).

In **Stage 1** (discussed in this report), a total of 51 in-depth and at-home interviews involving 56 householders were conducted with households in Victoria, South Australia, New South Wales, Australian Capital Territory, and Queensland. This stage targeted households in three (sometimes overlapping) categories as outlined in the introduction:

> **Early adopters:** Have solar PV array combined with battery storage and/or electric vehicles, or are planning installation of battery storage for self-generated electricity
> **Demand management participants:** Households participating in a demand management initiative (Peak Rewards program or Direct Load Control program)
> **Blackout experiences:** Households who reported experiencing at least one memorable electricity outage in recent years

Household recruitment took place via energy sector and sustainability organisations, social media, community groups, local governments and associations, public events relating to energy technologies, and personal and professional networks. Recruitment efforts in some locations were directed towards a specific research category depending on what was known to be relevant, or having suitable recruitment channels.[3] For example, demand management participants were sought in Queensland and Victoria, and households who had experienced electricity outages were sought in South Australia and parts of Canberra (but were also sourced in other locations).

Electricity distributors assisted with demand management recruitment by emailing a research invitation to their program participants (Jemena Power Changers participants in Victoria and Energy Queensland PeakSmart participants in Queensland). Householders interested in being interviewed contacted the RMIT research team directly or via the project webpage (**http://www.futuregridhomes.net/**), which provided additional information about the research and a contact details submission form.

To be eligible for participation, households had to match the criteria for at least one of the three research categories identified above. Where more households registered than could be included, characteristics such as gender or country of birth were considered to achieve a more demographically balanced and diverse sample of households.

The interviews were conducted between August and November 2018. Each household was given a $50 Coles/Myer gift voucher to thank them for being interviewed. The project was approved by a research Ethics Committee at RMIT University.[4]

Interviews were generally conducted in participants' homes, involved one or multiple household members, and lasted between one and two hours depending on their responses and time availability. All households received detailed information about the project and gave consent to be interviewed. Each interview was conducted by one or two members of the research team.

A **short questionnaire** was also used to gather demographic, home and energy technology details. Early adopter

[3] This also helped to make recruitment communications about the project more engaging and less confusing for potential participants, i.e. flyers sought participants in one of the research categories instead of three.
[4] Approval number: CHEAN A 21520-05-18

technologies were photographed by a researcher where relevant and agreed by householders during a short **technology tour**. Interviews were semi-structured and conducted as an open-ended conversation between the researcher(s) and householder(s) with interview topics and questions used as a guide. Interviews were voice-recorded and professionally transcribed. Transcripts were thematically analysed using qualitative analysis software.

Interview topics included:

- **Introductory discussion:** interests and concerns relating to electricity
- **Household generation and battery storage:** what they have and/or what they want, experiences so far, concerns and expectations (including whether they are, or aspire to go, off-grid), modification of household routines and activities around solar/battery generation and storage
- **Electric vehicles:** why they want(ed) an electric vehicle and how they (intend to) use and charge it
- **Electricity outages:** experiences, understandings and opinions regarding electricity reliability, and disruptions to household routines and activities
- **Demand management programs:** awareness, experiences, participation, receptivity, concerns, and changes to household routines and activities during peak times
- **Emerging issues:** peak demand, accommodating distributed generation of electricity into the grid, peer-to-peer electricity trading and sharing, sustaining the grid if substantial numbers of households opt to go off-grid, consumer protections and new energy technologies (see below)
- **Engagement and consultation:** experiences and preferences
- **Trust in the energy sector:** current position and opportunities for improvement (if not already expressed in earlier discussions)
- **Future challenges for electricity provision:** predictions, implications for the sector, and desired outcomes
- **Review:** reflection on the interview and any resulting impact on their understandings of electricity and the sector

The order and inclusion of questions were modified for each household depending on which of the three research categories they fulfilled – early adopter, blackout experience, and/or demand management participants.

The **'emerging issues'** component of the interviews was presented in the form of five statements, one for each issue (structured towards the end of the interview). The statements were designed to raise and provide information about issues that may be challenging for the electricity sector and/or impact outcomes for households as new energy technologies and demand management strategies are adopted. Some householders were already aware of some of the issues raised.

The statements were selected by the research team based on:

- A review of peer-reviewed literature and past research to identify emerging issues for the sector
- Consultation, advice, and a review by members of the Future Grid project's Expert Panel, consisting of representatives from energy advocacy, distribution, research, consultancy, and market operation organisations (see **Acknowledgements**)

After hearing or reading the statement, householders were prompted for their thoughts and interest in the issue.

Analysis focused on identifying engagement challenges or issues, and opportunities or pathways to engagement in relation to the Future Grid. As such, it did not focus on evaluating any specific technology brand or configuration, demand management program, or blackout experience.

Consistent with qualitative research methodologies, the sample is large enough to achieve thematic saturation for each of the three household categories (where no new themes arise despite subsequent coding) (Boddy 2016). The study is not intended to be statistically representative and instead identifies, and provides in-depth insights into, emerging issues regarding household engagement with the Future Grid.

SUMMARY OF HOUSEHOLDS

Table 2 breaks down the sample of households interviewed in each state and research category. Thirteen households fulfilled two of the research categories resulting in a total of 21 interviews with early adopters, 22 interviews with households who reported blackout experiences, and 21 interviews with demand management participants. The 11 Queensland demand management households were part of PeakSmart (Direct Load Control) program. In Victoria, demand management households were in the Jemena Power Changers (9) or Powershop Curb your Power (2) programs.

Table 2 Household interviews conducted for each research category

LOCATION	HOUSEHOLDS INTERVIEWED	RESEARCH CATEGORY*		
		Early adopter**	Demand management participant	Blackout experiences
Vic	17	6	11	3
NSW/ACT	14	11	0	6
SA	9	2	0	9
Qld	11	2	10	4
TOTAL	**51**	**21**	**21**	**22**

** 13 households fulfilled two categories (total of 64 representatives of the three categories)*
*** Households with solar PV only were not categorised as Early Adopters. To fulfil this category the household needed to have battery storage and/or an electric vehicle or be planning installation of battery storage.*

Table 3 summarises the demographic and other characteristics of the 56 householders from 51 households (five interviews involved two household members). Households were classified as Low, Medium or High income based on their gross annual household income (if disclosed). Thirteen (25%) of the households interviewed disclosed low income and/or experienced 'energy stress' (defined as on a hardship program, sacrificing other things to pay bills and/or unable to pay bills when due).

Table 3. Characteristics of households (51) and interviewees (56)

CHARACTERISTICS	DETAILS
Gender	Women: 28; Men: 28
Cultural diversity	Born outside Australia: 21 (including India, Germany, France, Brazil, Fiji, China, Vietnam, Netherlands, North America, UK, and Hong Kong) Residing in Australia for less than 10 years: 5 First language other than English: 11
Education level and work	Post-graduate degree: 18; Bachelor degree: 22; Vocational or other tertiary qualification: 9; Year 12 equivalent: 3; Year 11 or below: 3; Unstated: 1 Full-time work: 27; Part-time: 9; Casual: 3; Not in paid work (retired/home-maker): 17 Various occupations & work backgrounds
Household structure	Couples with children at home: 22 HHs* Sole parents with children at home: 8 HHs Couples with no children: 15 HHs Sole occupants: 6 HHs Multi-occupancy: 4 of the above HHs had related or non-related people living or staying in conjoined but separate units/homes at the same address

Dwelling and occupancy	Free-standing home: 46 HHs Semi-detached: 3 HHs Apartment/Unit: 2 HHs
Tenure	Owner occupier: 48 HHs Private rental: 3 HHs
Solar PV	< 5 kW: 16 HHs 5-10 kW: 14 HHs > 10 kW: 1 HH Total: 34 HHs (3 did not know the PV array size)
Battery storage	< 10 kWh: 4 HHs 10+kWh: 10 HHs Several more HHs in planning stage
Electric vehicle	6 HHs (plus 1 on order)[5]
Financial situation**	High income: 13 HHs Medium income: 21 HHs Low income: 7 HHs Did not disclose: 10 HHs Energy Stress: 8 HHs (2 Low, 4 Medium, 2 undisclosed HHs)

** HHs = households*
*** Income = gross annual household income; Low = < $41,600,[6] Medium = $41,600-$130,000, High = > $130,000;[7] Energy Stress = on a hardship program, sacrificing other things to pay bills and/or unable to pay bills when due*

LIMITATIONS

The research recruited households in specific categories which were anticipated to skew the sample towards particular demographic characteristics. For example:

- Early adopter sampling skewed the sample towards higher income households, middle-older aged, owner occupier, and free-standing home households
- Early adopter and Direct Load Control sampling skewed the sample towards owner occupiers
- Using social media to recruit households who had recent experiences of blackouts skewed the households in this category towards young-middle aged households
- Households with new energy technologies and/or participating in demand management skewed the sample towards households who may be more engaged with electricity issues than average

A possible bias in the sample is that participants may already be more engaged and aware of energy issues than 'average' households, and more interested in contributing to the 'common good' (e.g. participating in national research to improve electricity outcomes for others). However, while this is likely to be the case in the early adopter sample, it is less likely in the demand management and blackout categories who also had other motivations to participate in the research, such as receiving a financial reward ($50 voucher) and/or expressing dissatisfaction with some aspect of the electricity system.

[5] Recruitment of early adopters sought households with battery storage and/or electric vehicles
[6] Approximately one full-time minimum wage, www.fairwork.gov.au/how-we-will-help/templates.../minimum.../minimum-wages
[7] Approximately 1.5 times average individual earnings of $85,982, https://www.livingin-australia.com/salaries-australia/

READING THIS REPORT

The remainder of this report is structured around the household research findings. It begins with three challenges (reliability, distrust, and disengagement and different priorities). The report then identifies four pathways to engagement: participation via energy generation and demand response; sharing and equity; communication; and leadership and consultation. It concludes with a discussion of the implications from these household findings to inform subsequent stages of the research.

The themes, summarised findings and householder quotes are intended to foreground the experiences and views of research participants in their own words. A range of household concerns are represented that do not necessarily represent the views of the authors on these issues.

The findings are presented in three ways:

1. Thematically organised sections with dot points summarising the issues, themes and priorities discussed by householders
2. Emerging issues (box format) introducing each issue and prepared statement (read to householders during the interview), and identifying householder responses and views on the topic[8]
3. Selected household case studies that highlight emerging issues and concerns in more depth

All generalisations made within this report refer to the sample of households we spoke to. We also highlight exceptions and differences amongst the sample where relevant. While the findings reflect broader trends and research findings reported elsewhere, this report does not claim to speak for all Australian households.

As already noted, the analysis does not focus on evaluating or commenting on individual demand management programs, but instead looks across the three programs for insights. All Direct Load Control participants were derived from one program – however Direct Load Control-specific program findings are likely to apply to other similar programs, and are consistent with past research the authors have conducted with a Direct Load Control trial in NSW (Nicholls and Strengers 2013).

The report mainly adopts the term 'households' instead of 'energy consumers' to highlight the shared nature of energy consumption within a household unit, and the multiple roles and views that may exist within one household.

Included quotes represent an illustrative sample and are used to highlight new and emerging findings that are likely to be of interest to the readers of this report.

Householder quotes are represented in italics and included verbatim. As such, they may contain grammatical or typographical errors. Ellipsis points (…) mark an omission from a quotation. Supplementary text for quotations is provided in square brackets ([]) for clarification.

Householders are referred to throughout by pseudonyms. Additional information (e.g. age or location) is provided only when necessary for context.

[8] See earlier text in Methodology section for discussion on the process for selecting these statements

FINDINGS

CHALLENGES

This section identifies three key challenges which impact household interest and capacity to engage with electricity sector priorities for the Future Grid:

- Reliability
- Distrust
- Disengagement from the energy market and Different Priorities

These challenges are significant for consumer outcomes in relation to householder interest in 'taking control' of their energy supply, and participating in the Future Grid in ways which help manage network costs and reliability.

When discussing these challenges below, we focus on new or emerging concerns that are likely to be most relevant to current and future planning. These relate to Australians' changing lifestyles; the introduction of emerging technologies; climate change impacts; infrastructure upgrades and constraints; and regulatory, policy or planning issues.

Reliability

Reliability was discussed with all households – including those specifically recruited to be interviewed about significant unplanned outages (typically described by households as 'blackouts'), and early adopter and demand management households who recalled blackouts in recent years.

Over half of the households interviewed recalled no significant electricity outages in their area other than planned outages (e.g. for line works). Planned outages were understood as necessary and householders were mostly satisfied with planned outage communications and all were able to manage through the disruption.

Twenty-two households reported experiencing significant blackouts ranging from brief through to several days in length, including:

- Localised outages (e.g. due to weather events, car accidents, or local faults)
- The 2016 state-wide outage in South Australia
- Load shedding events

Most householders did not expect the electricity grid to deliver a higher level of reliability to their home. The blackouts discussion focused on blackouts that were remembered as having impacted household activities.

Blackout experiences

- Blackouts are often accepted as unavoidable outcomes of weather and other events.
    - some householders in South Australia also attributed outages to high household demand for electricity
    - preparedness (material and emotional) improves after blackout experiences, e.g. with candles, torches, generators
    - even when inconvenienced, most householders do not expect increased reliability from the grid

'I don't think it's the fault of the suppliers particularly for any of the outages, they've been acts of God.' (Chris)

'I don't know how they would make the grid more reliable when we get those severe storms that knock out whatever it does, the trees or the poles or the big generators.' (Debbie)

- The 2016 statewide outage in South Australia had broader unsettling impacts. These included:
    - safety concerns about driving without traffic lights and street lighting
    - work and workplace disruption
    - feelings of isolation and danger in extreme weather
    - concerns for vulnerable others at risk from lack of heating or falls in the darkness

'My neighbour came over. Helped me carry all my baby stuff and I stayed over there for the night until my husband got home... it was really scary though. I didn't like it at all because Jenna [her baby] was so tiny. It makes me feel sick thinking about it because it was just such a horrible time.' (Bella)

'I had elderly neighbours next door... that [blackout] didn't do them any good.' (Clare)

Key reliability concerns

- Changing lifestyles involving new and more embedded information and communication technologies, and growing dependence on internet connectivity, are increasing the visibility of outages and raising interest in ways to secure continuous access to electricity.
    - people working from home are concerned about loss of productivity due to outages
    - loss of connectivity (via social media, internet, phone contact) during outages can be more concerning than loss of electricity (especially for younger households, and those that are alone, pregnant or caring for infants)
    - technophiles may be dissatisfied with even brief outages, e.g. those running their own servers or other impacted technologies
    - people experiencing domestic violence using electricity-dependent home security systems for protection may feel more vulnerable during an outage

'If you don't have internet, like, my god, I can't work.' (Deon)

'To me it's very important [for electricity] to be reliable. For a couple of things, for security purposes because we want the outdoor lights to be on, the cameras to be working. Mainly for security purposes. It's not so much for inconvenience but I think it's more necessity.' (Sharon)

- Climate change impacts such as hotter weather and more frequent heatwaves (Steffen, Hughes et al. 2014) are increasing the perceived (and actual) need for air conditioning.
    - concerns about increasing health risks from heat as heatwaves get longer and hotter
    - air conditioning is being recommended by health authorities to manage hay fever, thunderstorm asthma and other health impacts exacerbated by hot weather

'Hay fever – where the conditioning is good for health reasons. My wife has got it more than me... air conditioning is one of the best things which pull this pollen out [of the air] and give you a room where you sit.' (Munir, Vic)

'We couldn't sleep in the heat... this house, without the air conditioning for three days, I had to go and live with someone else.' (Nadia, Qld)

- Dissatisfaction with reliability is sometimes linked to gaps in understanding about the vulnerabilities or challenges for Australia's electricity system.
    - underground power lines perceived to be an obvious (and not necessarily expensive) solution
    - surprise that electricity issues not eliminated in a 'developed' country

'That thing you don't expect... that Australia is going to have problems with power outage. You don't expect it, you expect this with Brazil or Venezuela, Bolivia.' (Eddie)

- Households are interested in (or already using) home battery storage to secure access to electricity at home

and increase reliability.

- especially technophiles and those working from home
- not necessarily a response to dissatisfaction with energy sector performance on reliability – more an appreciation of new technologies as potentially offering a more efficient and achievable path to higher reliability
- some households have already adopted home battery storage to improve reliability, or view this as an unplanned side benefit to home storage

'The battery... it'll reserve power for an outage so it doesn't use up the whole amount... typically we only lose power for five or ten minutes... but it's enough to cock all my servers and that sort of stuff up.' (Deon)

'He quoted us on a battery system because of the fact we were getting brownouts and because I run a computer repair business the last thing I want is for somebody's system to be on, rebuilding... and then the power goes off.' (Aaron)

CASE STUDY 1: LEAH

Theme: Reliability
Household Type: Couple with 1 child
Age: 42
Location: Outer North West Sydney, NSW

Category: Blackout Experiences
Emerging Energy Technologies: None
Income: High

'Reliability… it's a real gripe for us'

Summary: Leah and her family live in the semi-rural fringe of Sydney. Working from home as a CEO, she is highly reliant on electricity and internet communications technologies to run her business. She regularly uses email, video conferencing, and web browsing to communicate with business partners and clients, and any disruption to her broadband internet connection – powered by electricity – impacts her work productivity, *'you just can't operate a business from here without having internet or power'*.

To continue working, Leah can drive eight kilometres to the nearest town library but it is very difficult for her to manually open the electricity-reliant automatic garage door. Reliable electricity is also important for health and productivity as her husband uses a breathing device for sleep apnoea.

Leah's well insulated home stays reasonably cool during summer. However, a power outage over Christmas caused a failure in the controller for their air conditioner and it could not be fixed until after the holidays. Leah felt that very hot weather with no cooling over an extended period could be detrimental to her family's comfort and health.

Without access to mains water, the home also relies on electric water pumps to supply water from their tanks. They store a small amount of water for essentials such as drinking, but power outages mean Leah and her family are unable to bathe, flush toilets, or cook meals.

> *'It's a real gripe for us, especially on the land out here 'cause we don't have any water. So if we have no power we have no water.'*

The household has experienced numerous planned and unplanned outages over recent years due to storms and works on the network. Leah attributes frequent planned power outages to increased electricity demand and is concerned a nearby housing development may further reduce reliability. These concerns prompted Leah to investigate a solar PV system and batteries as a way to ensure a 'continuity of supply':

> *'It's nice to have solar because then you get to offset… [on] your electricity bill. But for us it's… just continuity and making sure that we, you know in the event that just say an apocalypse happened and there's five days or a couple of weeks without power, we would have an alternate power source.'*

Going 'off-grid' appeals to Leah as 'a feel-good thing' that may improve the 'resilience' of their home and productivity of their household. Her main reasons for not yet taking this step are the high cost of batteries and uncertainty about where to find reliable advice and installation.

Leah's Priorities:

- More reliable electricity supply to maintain work productivity and family health
- Trusted advice about new energy technologies and reputable installers

Distrust

Almost every householder we interviewed expressed some distrust about energy businesses, organisations or policymakers in Australia. Their concerns were usually discussed through the course of the interview (without requiring specific questioning about trust or distrust). Distrust was frequently attributed to the entire sector and 'system', rather than a specific business, government or market player (e.g. retailers, distributors, generators). High energy costs in Australia were central to householder distrust, and often attributed to privatisation of energy provision, complexity, and policy failures.

Key reasons for distrust

- High energy bills and lack of apparent transparency or justification for price rises

'Everyone knows the prices are going up, but how much, why? More answers would help.' (Aadesh)

- Lack of leadership or coherent plan for energy issues
    - energy used as a 'political football'
    - lack of considered and enduring energy policy with clear concern for consumer and environmental outcomes

'We have absolutely no leadership at a federal level, and precious little at the state level... we're still at that leading edge and it's still nowhere near enough. No one's sort of thinking, okay, 10 years what do we need... This is an issue that has enraged me more than any other.' (Tim)

- Unfairness and inequity in access to energy as an essential service

'These services are a fact of life and a necessity, they need to be provided in a way that's affordable to most people.' (Megan)

- Dissatisfaction with privatisation of energy services
    - high energy costs seen as a result of corporate interests and profits being achieved at expense of households
    - not apparent who is running, providing oversight, or planning for future energy needs
    - calls for 'renationalisation' and/or government to take more responsibility for energy

'This privatised, chopped up electricity system that we've got now isn't working to everybody's interests, and the old system where it was all publicly owned was maybe a better system.' (Grant)

- Concerns that energy market complexity is a deliberate strategy to disadvantage households

'To compare with other plans, I've just been at a bit of a loss of understanding what they're trying to... I feel like they try and confuse you.' (Jared)

- Lack of (or unsuccessful) communication
    - perception that households are being disregarded or that information is being kept from them
    - uncertainty, confusion and distrust about reasons for the storm-related South Australia state-wide outage in 2016
    - politicians or vested interests perceived as using (incorrect) explanations for political aims
    - low visibility of challenging issues for the electricity grid/sector
    - peak demand awareness is developing but often not linked to electricity cost increases

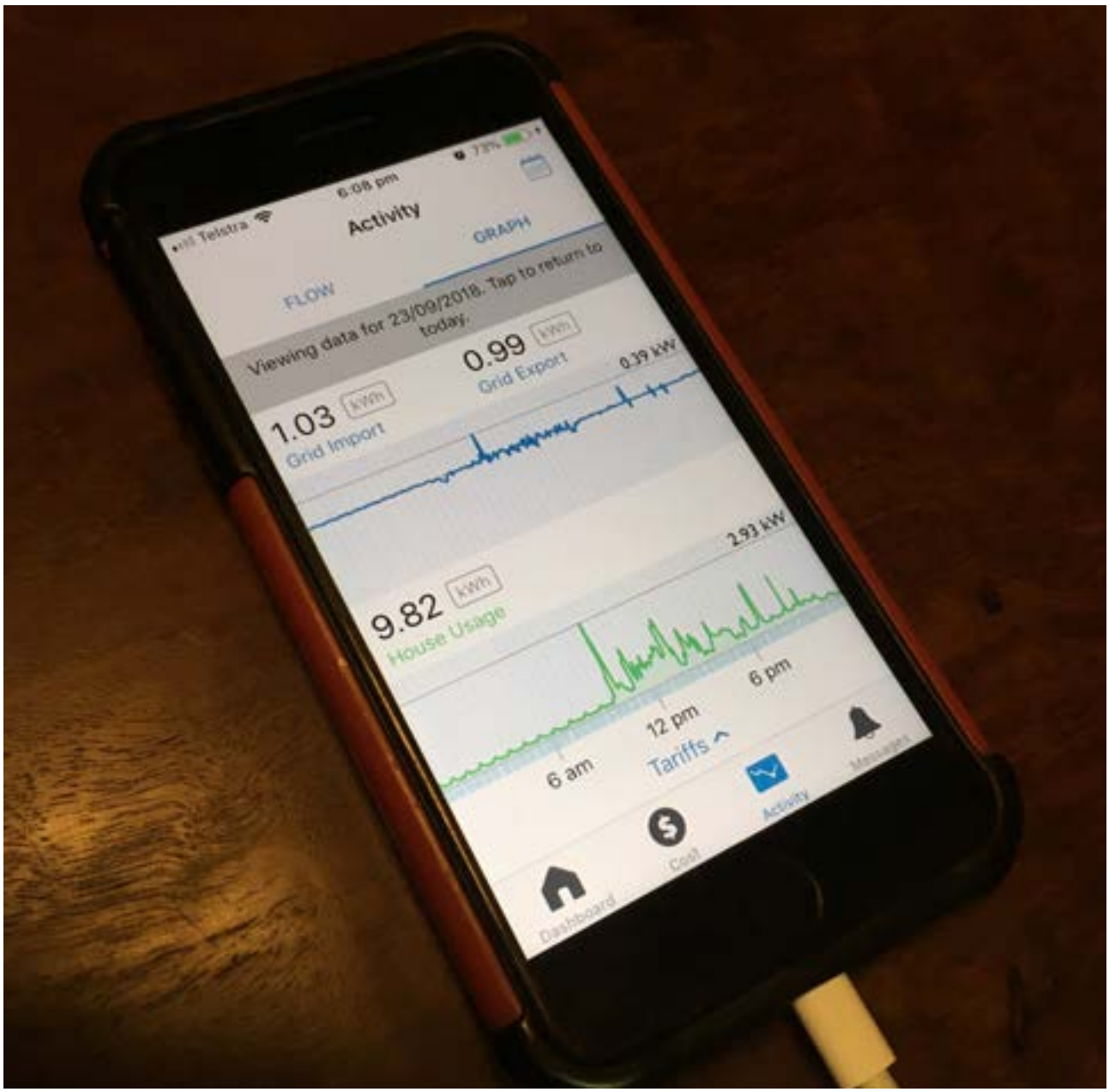
'[The language] isn't transparent. It doesn't help you understand. I don't have an electricity background... I don't actually know what they're upgrading... it kind of feels like they're being secretive... you can look on the [distributor website] and they're doing "blah, blah, blah, blah", I've no idea what that is.' (Clare)

'There's a lot of stuff in the news and you get different views, especially it's become very political, so I guess even with information like that, to me it's you can choose different data, like numbers or percentages, gives different impressions.' (Vera)

- 'Unfair' feed-in-tariffs and arrangements for energy produced and exported by households
    - households being 'punished' or taken advantage of by energy companies
    - households looking for ways to avoid giving energy companies their surplus clean energy for less than they think it's worth through their FIT (e.g. by installing batteries)
    - concerns about choice and transparency of control of their batteries (by the energy sector)

'They can take that one kilowatt and they can sell it for four times more than what they're giving us and I don't see that as fair because it's a commodity really.' (Aaron)

'When our feed-in-tariff dropped from 60c to 7c, I though well now's the time to install a battery.' (Preston)



CASE STUDY 2: ALAN

Theme: Distrust
Household Type: Couple
Age: 52
Location: Sydney, NSW

Category: Early Adopter
Emerging Energy Technologies: Solar PV (2kw), Battery (9.8Kwh)
Income: Medium

'I want to stick it to the energy companies'

Summary: Alan lives in a free-standing house with his wife. He works in the IT field and describes himself as '*excited*' about anything to do with energy and new technology. He installed solar PV and storage to be '*carbon neutral*' and to '*stick it to the energy companies*'. Alan believes the current feed in tariff (6c/kw) is '*pitiful*', and '*not fair*':

> *'I know how much it costs for those big transformers to step down the power and then step it up... I'm actually saving those transformers from having to do that and they're giving me a crap rate.'*

Alan is considering installing air conditioning to ensure he keeps all the benefit from the electricity he generates:

> *'I want to use up that little bit of power that I do get in the summer... put it through the air conditioner... because I don't get anything from putting it into the grid.'*

Based on the agreement he was required to sign as part of his installation, Alan is concerned that the energy company has control of his battery:

> *'They could just drain my battery every day and I've sort of said, yeah, I've said yes to that... I'm in a poor position to fight that because I've basically agreed... And so I'm just praying that they aren't nasty.'*

In response to these concerns, Alan has considered going off-grid, '*if you can't give me a better deal, well, bye*'.

However, he is interested in the prospect of getting involved in community-based energy generation and trading *'to sort of cut the big guys out that are actually making a killing on our infrastructure… [and] the retailers that aren't giving us a fair deal.'*

Alan's Priorities:

- 'Fair' feed-in-tariff rates and incentives to feed battery-stored energy into the grid – to encourage his interest in participating in the grid and reduce temptation to go off-grid
- Transparency about how and when household batteries are used to assist with peak demand

Disengagement from the energy market and Different Priorities

Consumer disengagement is a known issue which the energy sector aims to address by building 'consumer trust and confidence' (AEMC 2018). The research found two main types of disengagement: householders who were 'unengaged', meaning they weren't particularly interested in tariffs, the energy market or grid technicalities; and those who were 'deliberately disengaged', which describes people who were purposefully and wilfully disengaging due to dissatisfaction with aspects of the energy market.

Main types of disengagement

- Unengaged by tariffs
    - householders are mostly unsure about their own electricity tariff and dissatisfied with complexity in the energy market – an approach which requires substantial time, skills and interest to navigate, and which they doubt is serving their interests
    - Time-of-Use tariffs rarely impact timing of energy use

'I don't think we're on a flat rate... I'm not entirely sure.' (Bart)

'No I don't [know the times]... I don't know if my lifestyle would change if I knew the different times of peak and off-peak... I've never really taken notice.' (Julia)

- Considered and deliberate market disengagement
    - a response to frustration and feeling powerless to understand or confidently navigate complexity in the energy market, tariffs and structure of the energy sector
    - a result of unsatisfactory outcomes from previous attempts to engage
    - intended to minimise unproductive time loss and disappointment

'I'm not brilliant, but I'm not stupid either and yet some of these [electricity plans], some of them were really a nightmare to get your head around.' (Aaron)

Key reasons for disengagement

- Electricity issues a low priority – householders unengaged
    - energy and the market not inherently interesting
    - want things to work and be affordable to run at a convenient time
    - prefer to focus on other lifestyle priorities such as family, health and wellbeing, work, education, and leisure

'People's lives are busy and they're probably going to forget that they signed up to it or why they signed up to it, and all those things.' (Jackie)

'I think it's actually better to have all appliances that you need to use running at that time because it's such a busy time in most people's lives... trying to prepare meals, trying to get kids bathed.' (Megan)

- Experiences of complexity and excessive time demands in navigating energy sector lead to disengagement

'I find it very taxing... that you've got to shop around for electricity... you haven't got time.' (Debbie)

'I have to sit down and go through and make sure there's no hidden dodgy things happening when people offer me stuff. And I don't have the time to do that.' (Jackie)

- Energy sector communications unengaging, unhelpful, confusing or discouraging

'You start to read the email and I thought, "I can't make sense of this" and you put it aside.' (Joy)

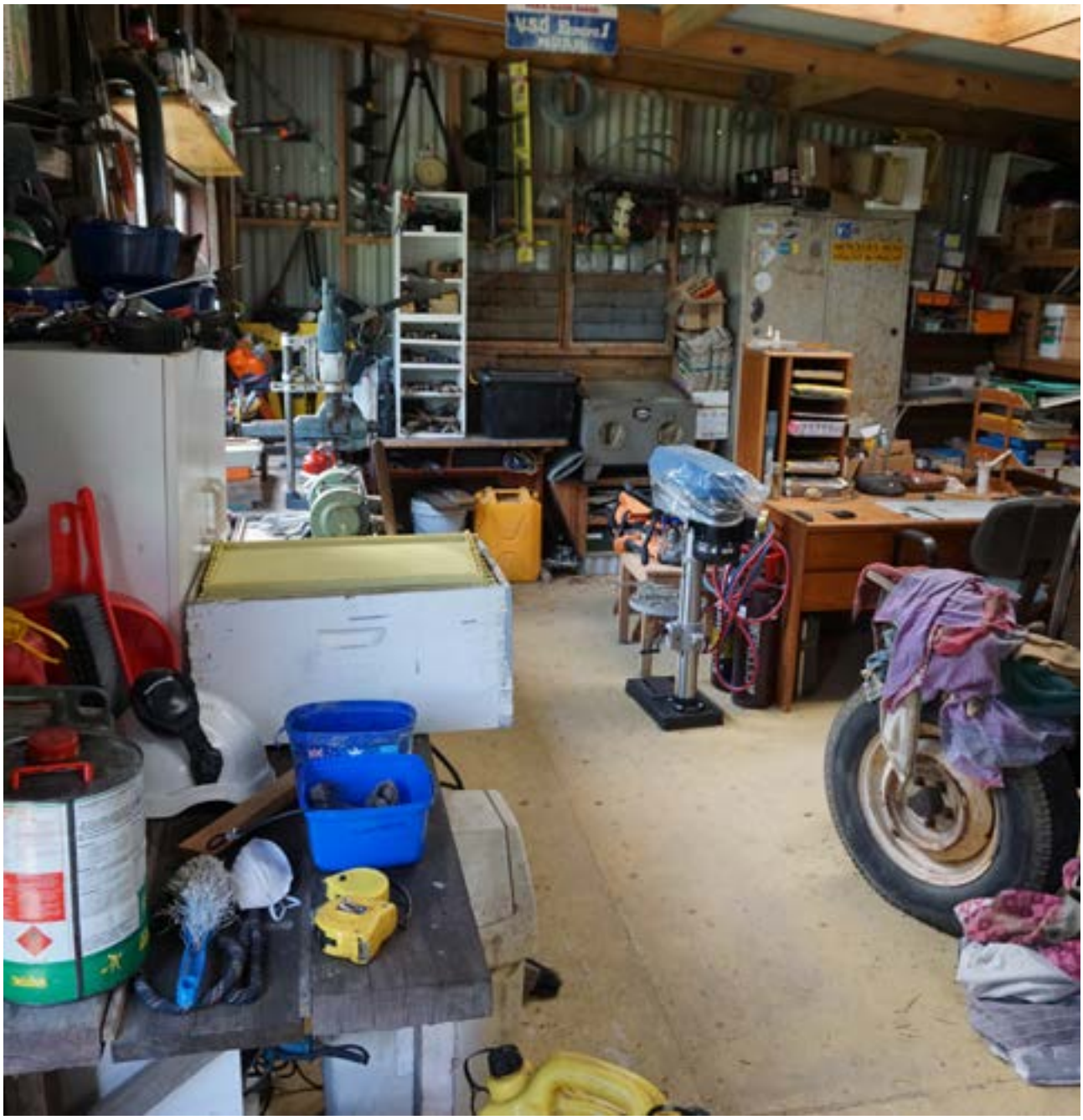
'I get one or two calls every third day asking... you'll get a call from somewhere else... that's why

people are switching and you get phone calls from different suppliers and they are so variant… it's very confusing in the market.' (Aadesh)

- Distrust (**see above**)

Different priorities

- Unengaged or deliberately disengaged does not mean householders are always disinterested – disengagement from energy market, tariff and energy businesses occurs alongside interest in other aspects of energy including:
    - energy policy responses to address affordability, reliability and environmental impacts of energy
    - ensuring health, comfort and productivity in the home
    - improving the energy efficiency of Australia's housing
    - adoption of new energy technologies (e.g. automation, demand response and distributed energy generation)



CASE STUDY 2: EDDIE

Theme: Disengagement
Household Type: Couple with 3 children
Age: 46
Location: Adelaide, SA

Category: Blackout Experiences
Emerging Energy Technologies: Solar PV (5kw)
Income: Medium

'Australian citizens don't need to worry about poles and wires'

Summary: Eddie and his wife moved to Australia from Brazil 10 years ago. One of their three children has a disability and they maintain an electric heated pool for regular therapy sessions. Eddie is an IT professional and his wife runs a small internet-based business – both do some work from home.

Eddie doesn't want to spend time understanding the details of different electricity tariffs. Recently when he did get around to switching retailers, Eddie saved over 30% on his electricity bill. He thinks the government is not doing enough to ensure households are not paying too much for electricity:

> *'There are things that you expect that the government [to] come and say "we are on your side, these options are not good"... I don't see that happening.'*

Eddie thinks it is the electricity sector's responsibility to build the infrastructure to operate reliably and that households should not need to understand the complexity of issues associated with electricity, *'I think that Australian citizens don't need to worry about poles and wires… I don't need to know everything about everything.'*

Power outages have become quite common in his area and are disruptive and he said they '*break the whole routine*' for his family. Using the example of new suburbs, Eddie sees urban infrastructure are '*so well planned*' in Australia and is confused about why his electricity supply is not more reliable:

> *'You don't expect this. You imagine that you have this covered you know. It's basic stuff, you know? Like water, like gas. I don't see this with good eyes... I don't know if the gap is with the companies, [or] with the government.'*

Eddie is largely unaware of the issue of peak demand and the idea that high demand could make electricity prices more expensive is contradictory to his understandings of pricing, '*so people are demanding more [electricity] and then it's going to stay more expensive. I thought it was the opposite.*'

Eddie appeared frustrated by aspects of the interview, including some of the emerging issue statements which he perceived as 'statements from companies', '*too technical' and 'not talking about people*'. However, he found the idea of being able to trade electricity with other households 'interesting' with potential to help with '*negative*' perceptions if the electricity sector is not '*looking [at] this with their money eyes*' but instead looking at it as an '*option*' that is '*good for everybody*'.

Eddie's Priorities:

- More reliable electricity supply
- An electricity market in which households can easily identify the more affordable offers
- An electricity sector that communicates about people and their issues, and does not expect everyone to become technical energy experts

PATHWAYS TO ENGAGEMENT

This section outlines an initial set of pathways identified by households we interviewed for the sector to engage them towards the challenges and opportunities presented by the Future Grid. These pathways are best thought of as a package of engagement opportunities that householders are either interested in, or are already doing. Stage 2 of this research project will undertake further research on these pathways to develop an engagement strategy for the sector.

PARTICIPATION

Despite distrust and disengagement, the early adopter and demand management participant households demonstrated willingness to participate in energy initiatives which they perceived to be productive – not only for personal gain but to support the energy system.[9] While not necessarily aware of all the challenges the energy sector faces (e.g. changing demand profiles and integration of distributed energy generation into the grid), they were engaging through participation. Even those households not involved in early adoption or demand management (included in the research due to their experiences of unplanned electricity outages) wanted to participate via installation of solar PV or other renewable energy technologies.

Participation via Energy Generation

Twenty-one households using, or planning installation of, either battery storage and/or an electric vehicle were interviewed (Early Adopters). An additional 13 households interviewed about demand management or blackouts had solar PV on their homes. Enthusiasm for new energy technologies was widespread, regardless of whether households were already using them or whether they hoped to be able to install them in the future. Householders were interested not only in the personal financial benefits of generating and storing energy but how these technologies could improve the energy system.

Key reasons for participation

- Generating (and storing) your 'own' energy makes sense to householders
    - regardless of political and environmental positions
    - responds to a perceived lack of control over energy costs and issues (e.g. environmental and climate change concerns)

'The solar market is a way of being involved and almost having a say, because by having solar, you're saying like, "I agree with this. I think this is a good thing and a helpful thing".' (Clare)

'[Everybody] want[s] to be the driving force behind their own future.' (Aaron)

'It seemed to me that it would be much better to have your own personal grid in the form of a battery to take this excess stuff, so that was the motivation... to make us independent.' (Preston)

- Energy-engaged early adopters want to use their technologies to help 'support' the Future Grid and energy demand management objectives
- Awareness that their technologies can have beneficial (or potentially negative) impacts on the grid
- Responsive to off-peak rates for charging (home batteries and electric vehicles) at times of low demand and/or high solar (and wind) production
- Looking for mechanisms to provide energy to the grid when needed

[9] Interviewees mainly comprised middle to high income households and owner occupiers. Other households may have less capacity to participate in energy initiatives

'Folks like us are happy to feed back into a grid or mini grid in order to help thy neighbour.' (Mario)

'The more diverse users and generators are on the grid the better.' (Robert)

Key forms of participation

- Significant modifications in household routines when making 'own' energy[10]
    - maximising use of energy generated at home and/or trying to live mostly within own energy production (and storage), e.g. staggering use of appliances
    - diversity of activity timing shifts between solar PV households receiving high and low feed-in-tariffs (and little impact if gross metering for solar PV)
    - organising activities around energy production (of more interest to men than women as found in past research) (Strengers 2013, Strengers, Kennedy et al. 2018)

'To get the max out of it [solar generation], we do all the dishwasher... the washing machine, we just make sure we use it in the morning. Nothing gets used at night.' (Aadesh)

'Even in the morning you get up and you go to make your toast, and you look at it [the Tesla app] and you go, Oh Mum and Dad next door are boiling a kettle. If I turn them, both on at the same time, because the [battery] can only push out 5kw, I'll wait until they're done... it just alters the way you do things.' (Deon)

- Monitoring energy production, use, storage and flows associated with battery storage
    - batteries can be more engaging than having solar PV alone
- Helps households get closer to an appealing idea of 'self-sufficiency' or reducing 'dependence' on the grid
- Battery owners find well-designed apps make energy fun or more interesting (mainly men as per point above)

'We've also got the [battery] app on a device out there which, it's the first thing I look at in the morning and the last thing at night.' (Pablo)

'I think it was good to do. I mean, I've really got a lot of pleasure and a lot of happiness out of having a battery.' (Barry)

- Battery adoption can also be a 'one-off' engagement/form of participation
    - not all early adopters want to change their routines to maximise financial or grid benefits from home energy generation and storage
    - home generation and storage sometimes expected to reduce energy costs while operating in the background (solar industry marketing may be a contributing factor)

'A letter came through the post about batteries [promising a large installation 'discount'], not that I knew much about them... to help reduce the cost and to make more benefit of the solar panels... Anything technical, I have no head for... I don't put enough thought into making full use of anything really. I just think, I want to do this, and I do it.' (Betty)

[10] Modification of household routines to suit energy imperatives may not be suitable for households with accessibility issues or other priorities and pressures.

Opportunities to increase participation

- Early adopters want their efforts and contribution of 'clean' energy to support the grid better acknowledged and recognised by the sector
    - most are concerned that the significant initial financial outlay, maintenance and replacement costs for a battery storage system (including impact of deep cycling on lifespan) are under acknowledged by the sector and governments
    - work is needed to establish shared understandings of how early adopters can support the grid and 'fairness' in feed-in-tariffs
    - householders may not have a full understanding of the complexities of energy demand, networks, and costs
    - positive policy and energy sector commentary about early adoption (viewed in the media) can foster trust, engagement and response

'We're doing the distribution grid a favour... we're giving you back a bit which means you don't have to bring it from the Hunter valley somewhere. How about some thanks?' (Pablo)

- Many households want to participate in the energy system by installing solar PV and other technologies but are unable to do so
    - upfront installation costs, not owning their own home, and/or housing type (e.g. apartments) are prohibiting factors
    - facilitating access to home energy generation technologies will help more householders engage and participate in the energy system

CASE STUDY 4: DEON

Theme: Participation
Household Type: Sole occupant and related couple living separately in conjoined dwellings
Age: 42
Location: Central Coast, NSW

Category: Early Adopter
Emerging Energy Technologies: Solar PV (9.5kw), Battery (Tesla Powerwall 2)

'It takes the load off the infrastructure'

Summary: Deon lives in self-contained unit which shares an electricity meter with his parents' adjoining house. They had switched to LED lights and tried to be energy efficient but, due to ongoing electricity price rises, their bills continued to increase so they decided to install a solar PV array and battery system.

Deon wasn't ever very interested in energy, '*I'm not an energy nerd… wouldn't say I'm a greenie either*'. However, since the solar PV and battery installation, Deon enthusiastically monitors and manages energy use. He enjoys the real-time visualisations of his energy generation, use, and export via the Tesla app describing it as, '*better than television*'.

Deon minimises use of grid electricity by staggering the use of the kettle and stove, as well as delaying the pool pump until it can be powered directly from his own energy sources. He also considers how the battery will be charged in the following days based on weather forecasts to ensure he is not drawing grid power at peak times:

> *'If you know you're having really bad weather for a bunch of days and the battery's struggling to even charge because it'd been raining, we'll tell the battery to charge at 10pm because that's the cheapest time of power.'*

His parents have ordered a Tesla electric vehicle, and they now look forward to powering it from their renewable home energy infrastructure. Deon is willing to participate in grid stabilization when the grid is under stress:

> *'They had the blackout last weekend when all the interconnectors all fell over between Queensland and South Australia... you wouldn't mind dumping your battery in that situation and trying to pull the grid up, provided you can choose what price that's at.'*

He felt there should be adequate financial compensation for providing stored energy at critical times because, '*it takes the load off the infrastructure… the poles and wires don't have to carry as much because you're making it.*' Deon had thought about going off-grid:

> *'It's partly revenge... if we can't dictate what the prices are, or we have no control over it... It's almost like a utopia in my mind of being able to be energy independent and not be beholden to [energy companies].'*

However, he thought that by being connected he could support the grid, rather than be a '*burden*' on it, and generating energy locally is '*better for everyone… an insurance policy to make sure the lights don't go out*'. He wanted to share his spare energy with his grandmother or others who were struggling to afford energy.

Deon's Priorities:

- Industry recognition of the potential for households with solar PV and battery storage to contribute to grid stability, especially during peak periods
- A variable feed in tariff that adequately rewards household generators during critical grid peaks
- A platform to share energy with others

EMERGING ISSUE: CONSUMER PROTECTIONS

Given the widespread household interest in installing new energy technologies, the high costs, and the potential for technology problems or failures, protections for consumers of new energy technologies are an important emerging issue. Energy is an essential service for participation in society, and emerging financing arrangements (e.g. power purchase agreements) could create new energy vulnerabilities for households (CALC 2016).

STATEMENT:[11] *In Australia, the energy companies are legally required to comply with rules designed to ensure all households have fair access to electricity. For example, providing reasonably reliable electricity and responding rapidly to electricity outages. The Energy and Water Ombudsman is a free service to help households with any complaints about energy companies or their energy supply. In the future, a range of new businesses could offer to install solar and other renewable energy systems on homes, and manage their energy supply, possibly with financing arrangements which remove upfront costs for householders.*

In effect, these businesses could become the household's main electricity supplier. But these businesses may not be regulated by the same consumer protections as traditional energy companies. That may mean that instead of the Ombudsman, households may need to seek help elsewhere if there are any disputes about their energy supply or bill [e.g. Consumer Affairs/ACCC or local Civil and Administration Tribunal].

Summary of householder responses

- The statement about consumer protections raised concerns for almost all householders
  - most had not previously thought about the potential to lose energy consumer protections with new energy technologies
  - some householders were not aware of the current consumer protections for energy supplied via traditional energy companies
  - householders were concerned that they would be unable to (afford to) resolve issues if this situation were to eventuate
- In response to this potential scenario, householders wanted everyone to have similar consumer protections regardless of who supplies their electricity
- Some future adopters of solar and/or batteries were already wary of poor outcomes
  - want a reliable source of information about which solar companies could be trusted to provide appropriate advice, install reliably and affordably, and honour warranties
- Some early adopters who experienced problems with solar and battery installation businesses related strongly to the statement

Householder quotes: Consumer Protections

> *'I don't like this statement. I would think that it would still need to be regulated by an ombudsman. You'd still need something overarching that everyone can access. So, if took away the ombudsman and everyone's got their own individual power oversight person, company, not everyone is going to be able to afford a lawyer to take them to Court.' (Clare)*

> *'So they're outside the Ombudsman network? That's a problem isn't it?... far out, that'd be a nightmare!' (Isaac)*

[11] As discussed in the Methodology, these statements were read to householders during the interview. Participants were then asked to comment on the statement and share their views and/or concerns about the issues raised through a series of prompting questions

'A disaster waiting to happen.' (Aaron)

'I think that given electricity is an essential service that the same consumer protections need to apply to these organisations offering the service.' (Rick)

'There's no site that you can go to that can give [advice] to you, apart from calling up all the different places and asking the questions and you always get the sales pitch from the solar people; all they want to know is how many panels you want and when can they come out to sign you up.' (Chloe)

'Electricity production and companies is a specialist area and you really need an ombudsman who knows the ins and outs of it to understand cases of dispute... you can't put power under the ACCC. God, we'll never get anything done.' (Debbie)

'We were looking into getting solar panels but chickened out at the dotted line because we don't know how we're going to get treated by these companies ... I'm finding it very hard to trust anybody.' (Sophie)

'I was a bit worried about the installation of the [solar panels], like who had inspected them, because we'd had a roof fire. So I went to Actew, went to the ACT Electrical Inspectorate, the company has gone bust that installed them... so we're left now with these dead roof panels... just thankful that our house didn't burn down... so now I'm wary about panels.' (Lana)

Implications

- Negative experiences and poor outcomes in the solar and battery installation market will likely further erode household trust and willingness to engage with energy issues and technologies
- Consumer protections are central to maintaining and building trust in Australia's energy system

Participation via Demand Response

Stage 1 of the Future Grid project involved interviews with 21 households involved in one of three demand management programs (summarised in Table 4). There was strong support for demand management from program participants.[12] They wanted to do something positive – for their household or a wider benefit – but they had varying understandings of the benefits of demand management programs.

Table 4. Summary of demand management programs participated in by Future Grid interviewees

PEAKSMART (QLD) Direct Load Control Program	POWER CHANGERS (VIC) Peak Reward Program	CURB YOUR POWER (VIC) Peak Reward Program
- 'Passive' program: no active response by households required ('set-and-forget') and households do not control their response - Air conditioning remotely shifted to 'economy' mode during peak events - One-off financial reward for households who sign up ($200-$400 depending on system size) - Long running program (since 2012)	-'Active' program: households choose whether to respond and howHouseholds sent messages asking them to reduce electricity use during peak events - Households can earn points to use on personal rewards (e.g. movie tickets, gift vouchers) rewards or community donations (e.g. to local school or a charity) -Recent program (started 2017/18 summer)	- 'Active' program: households choose whether to respond and how - Households sent messages asking them to reduce electricity use during peak events - Households can receive nancialreward (credit with energy retailer) each time they reduce power use during a peak event - Recent program (started 2017/18 summer)
Intended engagement pathway	Intended engagement pathway	Intended engagement pathway
- Appeals to households wanting to 'do their bit' with minimal effort or discomfort, and receiving a financial benefit	- Rewards households with ways they like to spend their time (e.g. going to the movies) or by contributing to the community (e.g. donating to charity) commensurate with their level of engagement and effort	- Rewards households with lower their energy bills in accordance with their level of engagement and effort

Reasons to participate

- Reasons to participate in demand management vary and may be shaped by household interests and/or program communications
    - Direct Load Control households view participation as assisting the electricity grid (not a personal energy saving initiative)
    - even when aware of peak demand, most Peak Rewards program participants do not associate the program with network constraint in their local area
    - both personal financial and community benefit rewards engage households
    - householders often appreciate their participation in a demand management program as educational (helping households become aware of their energy use), environmental (reducing negative impacts of energy use) and/or contributing to an experiment or research

'It was really educational; I got a lot out of it and it was rewards through the time too which was an incentive to keep me engaged... when you're a busy mum, a single mum with three kids, it was an incentive to stay engaged on the program and continue learning.' (Chloe, DM-PR)[13]

'[The program] is a very interesting activity... it can happen to make the people aware of what they're using and how to control their day's work because... the more electricity we use, the more the emissions we'll produce and in the long term, it will affect the environment as well.' (Qui, DM-PR)

[12] Very dissatisfied households may have withdrawn from the program and not been interviewed

'I got the impression it was just a research trial thing, just to maybe see how their app works, see if they can communicate with people... seemed to me, is that they were kind of practicing to see if they can get an engagement going.' (Jared, DM-PR)

- Strong interest in collective action and benefits for the community, society and electricity grid
    - interest in collective outcome/positive impact for the wider community of household participation in demand response (both Peak Rewards and Direct Load Control)
    - Direct Load Control participants want all air conditioners to be similarly controlled to increase collective benefit

'I'm trying to do the right thing, I guess, more than the money... there's people that need power more than others. Elderly people, sick people, babies, there are people that are going to be more impacted if they have a blackout.' (Jackie, DM-PR)

'I think our personal comfort is less of a value compared to an overloaded grid [so I support Direct Load Control].' (Moses, DM-DLC)

'Being aware that everybody's sharing the same power grid and needing not to overuse the electricity, so it comes back to that people aren't cut off totally because the grid can't cope... I just think it's a socially conscious think to do.' (Debbie, DM-DLC)

Participation experiences

- Peak events facilitate participation because they are occasional and capture household attention for short periods of time
    - more households able to significantly change activities on an occasional basis than respond regularly (e.g. for a time-of-use tariff)
    - event notifications encourage households to occasionally modify their routines, e.g. spending more time as a family and/or doing activities outside the house (playing games, going to a park, movie, swimming pool or shopping centre)
    - devoting a short and occasional burst of attention to responding to a peak event engages some households in competitive activity

'So you can say okay... this is the timing, what we can do, something else? So then we start working on that as a family... just play games... the board games or sort of chatting or yeah, just simple thing.' (Munir, DM-PR)

'Someone at work... I got to know it from her... pretty much I think 12 or 14 people at work, we did it, and just new network... everyone was excited how you accumulate points... when we were talking in the group, the main thing was how much points have you got?' (Aadesh, DM-PR)

- Experience of Direct Load Control more acceptable than 'the idea of it'
    - householders who have not experienced Direct Load Control express concerns about 'Big Brother' and lack of access to air conditioning when they (or others in their home) most need it
    - willingness to continue with Direct Load Control (QLD program participants) even if noticeable reduction in cooling and increase in discomfort
    - financial incentives can assist household sign up, but ongoing participation solidified by communication of value of the program to grid

'Is it annoying? Yes. Do I want to change it? No... because I understand why it is... I would far rather be uncomfortable for a short while than have some poor woman cooking dinner for her children, have her power go down.' (Lily, DM-DLC)

[13] DM-DLC = Direct Load Control demand management participant; DM-PR = Peak Rewards demand management participant

Participation benefits

- Demand management programs are improving overall engagement with energy and constraints
    - understanding of peak demand and awareness of air conditioning as a problem for the electricity system (more so in Qld Direct Load Control participants)
    - more awareness of energy use of appliances (particularly among Peak Reward households)
    - Peak Rewards programs facilitating change in energy use outside of peak events, e.g. general heightened focus on reducing home energy use or specific attention to energy use at times perceived as difficult for the grid (such as during very hot weather)

'If everybody puts their hand in and shares that, there is a reduced electricity to that thing [air conditioner]. But if you don't notice the difference that much, come on, would you rather have a power outage, or you have a continuous supply power?' (Sharon, DM-DLC)

'Give[s] us a little bit of insight about where, which appliance is basically using more electricity because you had to switch it off and also you start thinking how many appliance[s] you are using at the one single time.' (Munir, DM-PR)

'I remember looking at when I turned the aircon on, what was the jump. I remember that, just visually seeing the amount of wattage, or things like that, certain things that are pulling off the system, which is not something which I necessarily knew before I had that live feed.' (Jared, DM-PR)

Opportunities to improve participation and perceptions of demand management

- Householders who have had little exposure to demand management initiatives have diverse reactions to the concept
    - some distrust that demand management would be necessary or productive
    - some are highly supportive and indicate that more attention to demand management would increase their trust in the energy sector
- Improving communication about demand management in Australia is likely to build trust, encourage participation and sustain interest
    - consistent messaging about grid constraints and demand management
    - increased visibility of demand management initiatives and outcomes to increase enrolment of new households into programs (when they become available in their area)
    - timely feedback to households about their individual response to demand management and its relevance to the local network
    - feedback about how much energy was saved collectively in response to the program and whether (and how) this is of assistance to the grid and/or consumers (locally or in general)

'I never really felt that overall, as a group, that there was any sort of impact going on... it wasn't like we ever got any sort of tally of... what was achieved... I think that would be part of the reward... if we were getting feedback of the actual impact it was having... I might have ended up talking to people about it more.' (Jared, DM-PR)

'I don't think we got any information on how the community went... to find out what pieces of the puzzle they're trying to work out in the big picture to achieve what goals... to include some information on what's been done with the results. You know, where does it all lead, where is it all going to, to help what?' (Chloe, DM-PR)

- Responding to concerns about who could be negatively impacted and who should be expected to respond to demand management, e.g. younger and healthy households instead of sick, elderly or vulnerable households

'The oldies and those with kids because you don't want them to be sitting in a stinky, hot house... you want to get the message out, like, "Hey you 20 to 40-year olds that are quite healthy and fine, start thinking about what you're doing".' (Clare)

- Enabling more 'analogue' and culturally diverse householders to participate
    - providing communication for householders who do not use mobiles or apps regularly (but may understand themselves to be participating) and are therefore unaware they are missing most program communications
    - some migrant communities engage strongly with energy saving strategies

'I don't use apps in general for anything like that...I hardly use any apps at all...I have security paranoia... I just try to limit my technology use as much as possible.' (Jackie, DM-PR)

'Chinese and Mandarin customer service... because there are lots of immigration, yeah and you know sometimes like me, English is my second language... if they'll provide more language information... more information for more people.' (June, DM-DLC)

- Acknowledging householder willingness to respond despite not being home or having minimal energy use to curtail
    - being at work or away prevents some households from taking action during a peak event and can be a source of frustration
    - very low energy users can feel unfairly excluded from rewards due to having very low baseline energy use (e.g. nothing but a fridge to turn off)

'On some days I wasn't even home, so there was nothing to do.' (Jared, DM-PR)

'I wasn't using any additional power at those times anyway, so I didn't have an air conditioning system to turn off, because it wasn't on anyway.' (Lucy, DM-PR)

- Building on household interest in different ways of spending time and engaging with others when it's hot, e.g. promoting sharing of cool spaces or supporting provision of cool public spaces
- Making demand management programs widely available with some coordinated and consistent national messaging to develop household familiarity with the reasons for, and benefits of, demand management

CASE STUDY 5: VERA

Theme: Participation via Demand Management
Household Type: Couple with 2 children
Age: 54
Location: Melbourne, VIC

Category: Demand Management (Peak Rewards program)
Emerging Energy Technologies: None
Income: High

'We need to co-operate, and we need to contribute'

Summary: Vera works on a national infrastructure project but describes herself as 'not very informed' about electricity. She is not particularly interested in installing and using energy technologies such as solar panels and energy storage because '*life is complicated enough*'. However, she is concerned about climate change and would like to see '*more solar and wind and less coal*' in the system as a whole. She agreed to be interviewed to contribute to broader planning for the future.

Vera was enthusiastic about participating in a Peak Reward demand management program. She did not remember or care about what incentives were offered or received but thought they would have value for more 'competitive' households:

> *'I want to raise awareness, see if I could get any tips and even just to be motivated to do something helpful, whether it's reducing costs or helping with the environment or yeah even partly way to have a say in more energy efficient or different ways of getting energy. So just being more involved'.*

Vera saw value in signing up to a program which she understood to be primarily a response to problematic peak usage of air conditioners – even though Vera's house didn't have air-conditioning. The high-income couple recently completed an extensive home renovation – participation in the demand management program informed their decision not to install air conditioning.

> *'I don't know anyone who doesn't have [air conditioning] ... But I thought, yeah, we can afford it, but... if that's going to risk... having blackouts or other people not having it available... we decided not to get it.'*

The program also encouraged her to use air-conditioned public spaces, particularly shopping centres, to keep cool – something she hadn't previously done.

For Vera, participation in demand management is not about individualised benefits. She wants to be part of something that is contributing to shifts towards greater efficiency and wanted to see '*campaigns or ads or policy*' towards wider impact. Vera repeatedly emphasised her view of electricity as '*an essential service*' that needs everyone's co-operation and contribution. She says she'd '*be surprised if you'd have a significant number of people that wanted to go completely off-grid and not pay a bit even to have that backup*'. Vera believes that the efficient management of the energy system should be a matter of bi-partisan government policy, ensuring that a gradual move towards cleaner energy sources is handled equitably, '*we're part of a bigger picture… we need to co-operate and we need to contribute*'.

Vera's Priorities:

- Broader scale energy management campaigns and integrated (industry/government) policies
- A clear long-term strategy for moving to a renewable energy system
- Emphasise and enhance the value of the grid as essential public infrastructure

CASE STUDY 6: NADIA

Theme: Participation via Demand Management
Household Type: Sole parent with 1 child
Age: 48
Location: Logan City, QLD

Category: Demand Management (Direct Loal Control)
Emerging Energy Technologies: Solar PV
Income: Low, energy stress

'If everyone's doing it together, that makes a difference'

Summary: Nadia is a sole parent living on a low income. Nadia shops around for discounted energy plans but struggles with electricity bills particularly around Christmas with the added pressure of '*holidays and presents*'. She mostly uses pedestal fans but her daughter's bedroom (the hottest room in the house) has a direct load-controlled air conditioner.

The cash rebate for signing up to the Direct Load Control program was definitely an incentive. However, Nadia sees it as a way to contribute to a broader good, because *'if everyone's doing it together, that makes a difference*'. 'The feeling that we're using less power' maintains Nadia's commitment to the program, despite some comfort concerns when the electricity distributor remotely reduces the power use of the air conditioner:

> *'I was playing with [the air conditioning controller], trying to... we just couldn't get the room as cool as usual... [my daughter] was fussing and couldn't get to sleep because it wasn't cold enough... there was a lot of complaining that night.'*

Sometime during the event, Nadia realised that the lack of power was due to the Direct Load Control. She called her supplier the next day to confirm. However, she was still surprised at the effect:

> *'I didn't know that they would literally like, not do as much cooling, as little as they did... I thought maybe... it would just be like using less electricity.'*

Despite this experience, Nadia is willing to 'put up with' her own discomfort and remains supportive of the program, which she thinks is '*overall...a good idea*'. Indeed, she believes all air-conditioners, and even other appliances, could be controlled in this way, but only '*if there was more customer consideration'*. This could include forewarning of events:

> *'We could prepare... to do other things like use just normal methods like ice and ice packs... go for a swim, have a shower... if there was pre-warning... if they announced it in the news... there's going to be a power down or an economy put into action tonight.'*

She would also like the option to override the direct control at certain times, 'even just… for half an hour'. Finally, Nadia would appreciate broader feedback on the program, 'to know… that it is making a difference'.

Nadia's Priorities:

- Forewarning of Direct Load Control 'events' to enable preparation to cool other ways
- Override capability during Direct Load Control events
- Feedback on broad impacts of Direct Load Control to affirm commitment and support further energy reductions

SHARING & EQUITY

Households using on-site generation (in the absence of batteries) generally have little option other than to sell their surplus energy into the grid at a price set by government regulation and/or their energy retailer. Peer-to-peer energy platforms could allow households to sell or share their surplus energy from distributed energy resources (DERs) with other households or organisations via an intermediary. The prospect of energy sharing appealed to most households as a response to their concerns about energy affordability and equity. Early adopter households had often already investigated and/or actively pursued options for peer-to-peer trading.

Interest in sharing and equity

- Widespread concern for more vulnerable others who may not be able to afford or access reliable electricity in their homes, including:
    - the aged, the young, and people on low-incomes
    - people living in poorly insulated/equipped housing
    - those needing air conditioning in hot weather

'All retired people, they have lots of difficulty to heat the house... it's getting difficult for those people to pay the bills... I just think that no one should feel like this.' (Emma)

Types of sharing

- Feeding electricity into the grid (understood as a form of sharing by some solar PV households)
    - 'feels good' to contribute clean energy to the grid and 'share' it with others

'It's a feel good thing, having a battery, and knowing you're not having to pull from the grid. Especially when it's that time that everyone else needs it.' (Deon)

- Sharing energy with other households who share the same property through alternative dwelling and housing arrangements
    - Although not deliberately recruited, the household sample included several who shared a property with others, including:
        - a couple with their home divided into four self-contained living spaces, two of which were occupied by elderly relatives and another generating short-term rental income
        - a divorced man living in a separate unit attached to main home owned by his parents.
        - an older woman with her adult daughter, son-in-law, and grandchild living in the second story of her house
    - Early adopter households (in particular) exploring new living arrangements to care for others/reduce financial vulnerability and using solar and batteries to share energy between the households to reduce energy costs for everybody
    - Different living spaces not separately metered so other technologies to monitor or manage consumption and costs are of interest

CASE STUDY 6: ISAAC

Theme: Sharing and Equity
Household Type: Couple (plus 2 elderly relatives)
Age: 57
Location: Central Coast, NSW

Category: Early Adopter
Emerging Energy Technologies: Solar PV (6.4 kw) and planning battery storage installation
Income: High

'There's a risk in not having peer-to-peer'

Summary: Isaac works in the public service and lives in a free-standing house with his wife. The couple invited an elderly parent and an elderly uncle to share their property to provide a better quality of life than in an aged care facility. The house is being modified to include more independent, comfortable and private living quarters for their relatives. Isaac also rents an external flat to guests via AirBnB.

Isaac is interested in being part of a '*virtual powerplant*', using his own solar PV system to contribute to a more distributed network of energy generation. He is positive about the significant amount of distributed household energy systems being installed, because he believes '*ultimately it will enhance the grid*'.

Isaac wants to trade electricity locally in a peer-to-peer trading of electricity. He discussed how his neighbour's high electricity bills might be an opportunity for him to trade electricity locally:

> *'It's just too obvious that [Bill] has large energy bills, a young family, etc... but I thought if I could sell energy to him for a lot cheaper than he could buy from the grid, and also make a little bit of money to cover the cost of my system, that might help.'*

As household generation of energy becomes more common, Isaac thinks households may try using unregulated or unsafe methods, such as using an extension cord between energy generating households and their neighbours:

> *'I think there's a risk in not having peer-to-peer... because unless the networks provide the service there'd be a lot of temptation for some person to sell the electricity across the fence to somebody else.'*

Isaac has already had three AirBnB guests with electric cars and is investigating how guest charging practices are likely to affect his home's future energy use and needs. So far, he has let the guests charge their vehicles via the power point at no extra cost, but he would like to ensure they don't charging at peak times. To that end, Isaac would like to install charging infrastructure that would provide an incentive to charge vehicles during off peak periods that could be monitored separately from other usage.

Isaac's Priorities:

- A peer-to-peer trading platform to facilitate energy sharing, helping others with their electricity bills, and avoid unregulated and unsafe energy sharing
- Support for households with unconventional living arrangements that want to monitor, control, use and share energy in different ways

EMERGING ISSUE: PEER-TO-PEER ENERGY TRADING

The research discussed the potential for households to trade electricity directly with others. Peer-to-peer trading is emerging internationally and in Australia as a way to for households to control who they sell their excess power to. The popularity of platforms such as Uber, AirBnB and Airtasker illustrate the potential for people to provide, purchase and 'share' services online through privatised, democratised and localised markets. Emerging platforms in Australia include GreenSync, Enosi and Power Ledger. Some householders were already familiar with this possibility and raised it as a desirable outcome (see below). Others were introduced to the concept with the following statement.

STATEMENT: *As the number of households with rooftop solar and battery storage increases, those households may be able to share their power with their neighbours, friends or families via something called 'peer-to-peer electricity trading'. This allows households that generate solar power to sell (or give away) their excess electricity to other households in their community or network area. Similarly, households without solar could buy power from their neighbours. Peer-to-peer solar electricity trading would be facilitated by an online platform, similar to AirBnB or Uber, but for local electricity generators. This would allow private users to buy and sell their electricity directly with each other online without needing to go through an energy retailer.*

Summary of householder responses

- Energy-engaged early adopters were aware of the possibility of peer-to-peer trading and keen to participate
    - interest in peer-to-peer trading often a response to concerns about fairness – either 'unfair' feed-in-tariffs or concerns about less advantaged others being unable to afford energy or get technologies to generate clean energy
    - strong interest in donating surplus energy to those in need instead of 'giving it away' to energy companies to profit
- Peer-to-peer trading a highly engaging concept
    - excitement about the possibility of 'local' generation and trading
    - seen as a way to help vulnerable or disadvantaged others and to facilitate equitable 'sharing'
    - the possibility of sharing or trading surplus electricity reduced householder interest in going off-grid
- Potential to be viewed negatively if not well planned and delivered
    - some concern that it could further increase complexity of energy supply or be misused by energy companies
    - some concerns about who will benefit or be negatively impacted
- Feeding spare energy into the grid is sufficient for some households
    - some householders had little interest or need to specify who gets their surplus energy and for how much – as long as it's helping the grid

Householder quotes: Peer-to-Peer Trading

'I think we [solar PV owners] are already trading, generating that electricity and giving back to the grid.' (Munir)

'I'd rather send it [surplus electricity] to someone who really needs it and at least they get the benefit of it. I don't think these big corporations should get so much of the whack of what we're generating... I'd rather give it away to people that can't afford it.' (Aaron)

'If I could sell my excess [energy] to Jan at a lower price than she's paying her retailer, then

that's an advantage to them. And they live in a rented house which is uninsulated and they have A/C running to heat and cool, and their power bill... ' (Pablo)

'How about I could give [my surplus electricity] to the local community housing co-op and they could use it for their properties. That would be kind of nice.' (Jackie)

'Yeah, why not? That would help. Maybe if someone's struggling, you can help that time and when you need more or something, maybe the other person can help you.' (Aadesh)

'I would be thinking your older people that are like, "No, we won't turn the air conditioner on a 40-degree day, we'll just sit and swelter"... if you could give them some electricity that's affordable for them... I think that should be done... that's really cool, and why doesn't the government tell us good things like this?... instead of always doom and gloom, why don't they share this good news?' (Clare)

'I don't know, this is bringing up dodgy cable deals and, like, Foxtel, I don't know, I don't think that will work... something so wrong about that.' (Sophie)

'It would be an open market. So if you knew nothing about power, I could charge you $5 a kilowatt hour and you would just have to press 'accept' and then you would be locked into a deal with me. I think there should be some caps.' (Rick)

Implications

- Making peer-to-peer trading more widely available has potential to build trust in the energy sector by:
    - giving early adopters a sense of control over who benefits from their energy production
    - implementing a way to respond to householder concerns about people who are struggling to afford energy
    - addressing equity concerns and enabling 'sharing'
- Peer-to-peer trading would need to be an option that does not create extra confusion for those who do not want to engage in this way
- Need for clear rules and regulations to make sure some people not taken advantage of

COMMUNICATION

Householders commonly expressed that the energy sector did not communicate well with households (other than about planned outages), that they distrusted sector communications, or did not find them engaging. As a result, households were often unsure whether they wanted more communication from the sector. However, once energy topics were raised with households (including via the emerging issue statements) households showed interest, expressed opinions, and were more inclined to empathise with the sector and its challenges. These discussions also resulted in some householders changing their mind about what they thought would be reasonable ways to address and respond to challenges, demonstrating the flexibility of household views relative to how they are communicated with.

Importance of communication

- Householders want:
    - clear, consistent and accessible communication for themselves and other households
    - to understand why prices have gone up
    - to know what the benefits of infrastructure upgrades have been and will be
    - transparency and honesty
- Timely and informative communication about outages is effective, particularly if they are accessible and easily updated in real-time (e.g. social media, text message)

- communicating the cause of an outages increases householder understanding of sector challenges, reduces anxiety and enables household planning and flexibility
- expected duration and updates are important
- builds householder trust by respecting householder time

'Irrespective of 2 hours or 10 hours, if they go "no we will have your power [back on] in 5 hours", oh we'll make alternative arrangements or we can go somewhere, we can plan something more constructive than saying that it will be "soon", ... "soon" could be anything.' (Munir)

- Making energy grid/sector challenges visible gives householders a chance to engage, understand, and respond in positive ways
    - householder interest is commonly expressed once an issue is raised (in interview)
    - can reduce disengagement, scepticism, and distrust
    - helps households link their consumption and expectations with sector challenges
        - link between (peak) household consumption and infrastructure costs, outages, and price rises
    - mitigates confusion often caused by media or political commentary about energy (e.g. that immigration is causing energy problems)
- Two-way communication (e.g. conversation and dialogue) helps to shift householders' understandings and views on important issues that affect the sector (see **Peak Demand Statement** below)

EMERGING ISSUE COMMUNICATION: PEAK DEMAND

Meeting peak demand for electricity, particularly from home air conditioning use during hot weather, is an ongoing challenge for the energy sector. The research statement (below) explained peak demand and its impact on the cost of electricity. Householder awareness of peak demand was higher than in earlier research projects conducted by the authors (Strengers 2013, Strengers and Nicholls 2013) even if they did not directly associate electricity price rises with increasing consumption of home air conditioning.

STATEMENT: *In the late afternoon and early evening, most households undertake a range of activities using energy (lighting, TVs and computers, air-conditioning or heating, cooking, washing). As a result, there is a spike in demand for electricity at this time. On the hottest few days of the year – when most homes run air conditioners – the late afternoon to early evening electricity peaks are substantially higher. This is called peak demand. The electricity grid is built with spare capacity to meet peaks in electricity demand and avoid power outages on very hot days. It is expensive to build and maintain this infrastructure to cater for the highest peaks in electricity demand. Grid upgrades to meet hot weather peaks in home air conditioning electricity have been a major contributor to electricity price rises over recent years.*

Summary of household responses

- Mixed awareness of peak demand and the role of household consumption including air conditioning
    - varied understandings of peak demand amongst demand management participants
    - South Australian householders often aware that high consumption of air conditioning can be a reason for rolling blackouts

'During summer normally, and with everyone running their air conditioners, there's not enough power for everyone to access, to use in their houses constantly, so they do rolling blackouts... I think you just suck it up and either put a jumper on or grab a cold flannel. So, it's not massive.' (Clare, Adelaide)

- network constraints often thought to be something that occurs in other areas, e.g. areas with new housing, or due to population growth and/or migration
- Diverse views on grid upgrades to meet peak demand based on limited understanding of available options and costs
    - some unconvinced that more work on grid could be needed and attribute problems to poor planning and management, and/or poor quality (energy inefficient) housing
    - others demand the networks build to current and future demand
    - others think demand management would be more cost-efficient approach

'How much of the grid is already there?… how many upgrades have they done really?… I think management of the peak period is a better way of going about it.' (Chloe)

- Understandings of peak demand can increase support for demand management initiatives
    - households more willing to participate in a demand management program once they understand the peak demand issue
    - some householders view electricity price rises more positively if understood to be an outcome of upgrading the grid to meet peak demand (see Table 5)
    - caution is needed regarding possible overinvestment in some areas

Linking peak demand to water restrictions and drought

After inviting householders to comment on this statement we asked if they could see any similarities or differences between the water restrictions imposed during droughts. Some of the views expressed reflected a change in position or viewpoint on peak demand. These findings illustrate the flexible and changeable nature of householder views in relation to how a topic is introduced, framed or discussed (see Table 5).

- Relating peak demand response to past household responses to water restrictions can shift householder's position regarding their role in addressing peak demand
- Others see water and electricity differently and doubt that households would self-regulate indoor consumption voluntarily because it is not visible to others and therefore would not be subject to the same social monitoring

Table 5. Examples of householders changing their minds during communication about peak demand and water restrictions

SHARON	JILL
Before *'It's greedy suppliers [raising electricity prices], I think that's what it is. Even if the government is subsidising whatever, I think somebody else is benefiting… other than the actual consumers. That's my opinion anyway. I can't justify it, I don't have facts or evidence to prove it.'*	**Before** *'People will always act in their own financial best interests, and if it's going to keep costing them more and more, and they're being asked to change their behaviour, they'll always say, "No way".'*
After reading peak demand statement *'Well if that [peak demand] is what's increased our prices, I'll stop whinging… if that's the reason that the price increased, I am happy about it. I'm happy to stop whining about the price increase because I'm happy to pay for it because to me I'd rather have a continuous supply of electricity than outages.'*	**After talking about water restrictions** *'It's a really good point… The way those [water] restrictions were put in place, it wasn't impossible for people… maybe you could find some way to make those restrictions more palatable [for electricity]… you could have regulations.'*

EMERGING ISSUE COMMUNICATION: GOING OFF THE GRID

As the cost of solar and battery storage falls, it will be increasingly feasible for households to generate and store sufficient energy to run their homes. Transitioning homes in the regional fringes of the network off the grid may be more cost-effective than maintaining poles and wires in areas of low-density housing. However, there have been concerns about the 'death spiral' for electricity networks if significant numbers of households in more populated are able to disconnect from the grid (CSIRO 2013).

STATEMENT: *Another potential challenge is how to maintain and pay for electricity grid if large numbers of urban households generate their own electricity, get batteries, and disconnect from the grid. The grid would still be needed to get electricity to the households without the technologies to go off-grid. But with less households contributing to the cost of maintaining the poles, wires and other grid infrastructure, electricity prices could increase substantially for households who remain reliant on the grid for electricity.*

Summary of householder responses

- There is low awareness of the potential impact of widespread household disconnections on the financial viability of the grid and potential impact on costs to those who remain on the grid
- 'Off-grid' is an appealing idea (particularly to gain a sense of control of electricity costs and issues) but use of this term does not usually mean households would completely disconnect from the grid
    - householders (even some early adopters) often use 'off-grid' to describe being mostly self-reliant for electricity production – but intend to remain connected to the grid for when they want to import or export electricity
    - others (with less knowledge of how the energy system works) speak of going off-grid but have not yet thought about the implications – realisation that off-grid would mean no 'back up' and prevent their excess renewable electricity being used by others or to assist with peak demand, commonly leads to rejecting the idea of going off-grid

'I suppose that going off-grid is, is not as clean cut as, you know... you still need to be grid-connected to go off-grid almost. I mean, I don't mean, if we go off-grid we don't need to use the grid, but we can still contribute to the grid.' (Aaron)

'Even though I plan to go mostly off the grid, I think I would still have electricity as a backup. More and more of our technology relies on it and if you have the means to generate your own energy at sufficient level, great but I don't know that there are really cost-efficient methods for that yet.' (Megan)

- Most early adopters prefer grid connection to enable them to support the grid with their excess energy and (in future) trade their surplus energy (see Participation section)
- Some householders perceive going off-grid as a helpful action, that it would relieve a 'burden' and help make electricity more reliable for others
- The statement generated interest in ways to keep households on the grid (other than at network fringes) and/or ensuring all households make some financial contribution to maintenance of the grid

'It's important that incentives are put in there... If those important services are rewarded properly as they should be, those people will stay on the grid and we can look forward to the benefits that those people provide. (Isaac)

'Make [sharing and trading] more easy to do and therefore make it available for a start, and that will encourage remaining connected.' (Pablo)

- After hearing the statement, most householders who had thought disconnecting from the grid was a good

idea **changed their minds** with interests in **sharing and equity** being common reasons (see Table 6)

Table 6. Examples of changes in householder understandings of going off-grid

CLARE	NADIA
Before *'It would be amazing to be completely off-grid, to not rely on any outside anything… if I could be off-grid then that would help other families as well, or that would help families that can't afford to do solar. I would be one less burden on the grid. Then you'd have more electricity to give to the people that need it.'*	**Before** *'If that [going off-grid] was a possibility, you know. Yeah, if that became a part of life and you had a battery and you could just use your own power, your own stored power, yeah.*
After reading statement *'I wonder if it would be a step forward and all households would end up off-grid… But the middle would be so messy. You couldn't expect that everyone's going to afford solar, like people that are renting.'* *'It would be good to send anything extra back to the grid... I think it would be a good thing to be able to support the grid, so yeah, I guess, you'd want to stay connected so you could send excess [to the grid]. That's very interesting.'*	**After reading statement** *'Then yes do share it, do sell it back… do stay on the grid, yeah. So there is a good reason to stay connected to the grid… just in case there's a situation where yeah, you've got to give back.'*

Implications

- With clear communication about energy sharing (peer-to-peer trading), demand management, equity, and backup benefits of staying on the grid, it is unlikely that a 'death spiral' scenario will eventuate
- Reframing the costs of grid connection as an 'availability charge' (Deon) rather than a supply charge may shift perceptions of the grid – i.e. as public infrastructure rather than a private service

LEADERSHIP & CONSULTATION

Householders were calling for coordinated and effective leadership on energy issues. They wanted to know that the energy sector understands and is responding to householder concerns and interests, and that there is a clear plan to ensure energy in Australia is not only affordable and reliable, but also becoming more environmentally sustainable.

Consultation opportunities

- Householders are willing to give time to consultation processes that:
  - present an avenue to express their concerns and expectations in their own words
  - enable them to learn more about energy issues without having to navigate technical jargon
- Even if not seen as consultation by the energy sector, households hoped that being part of the Future Grid research project would enable their views to be heard

'It's actually opened my eyes a little bit to a few things that I didn't know about.' (Julia)

'I had the solar panel disruption, and then the large expense… with the blackouts, just was timely for me to provide any input to this and to get any better understanding I guess.' (Lana)

'I had no idea it was going to be this in-depth… it's been fun, I've enjoyed it.' (Alan)

'I'd like to contribute to any of the changes that happen with power and energy… any input I can have to try to shape going towards alternative sources and give some information about the PeakSmart program that we are part of. That sort of thing is kind of motivating me.' (Megan)

- Householders are calling for a balance between consultation and leadership
    - current sector consultation efforts not visible to households
    - householders want to know that household consultation happens – even if they don't consider themselves suitable to participate
    - householders often doubt they have the speciality knowledge to provide input on large and complex energy issues
    - some householders suggest organisations with knowledge of household concerns and energy issues may be better suited to consultation on behalf of consumers
    - well considered consultation topics and methods are needed to avoid being perceived as lack of leadership or a waste of (household and energy sector) time and resources

'[Consultation] to some extent, not too much.' (Munir)

'For something new it's harder for people to have a good understanding of that, that thing. So that's kind of waste time, but probably not fair to say that to everyone. Some people have the in-depth knowledge of certain things so… get input from those people… rather than, you know get everyone involved.' (Wei)

Clear vision and plan

- Government leadership is needed to address future challenges for the energy system and set the direction for the sector
- Householders are supportive of government when they are seen to be leading, e.g. via household rebates for solar panel and battery installation
- Householders want to see long-term planning and enduring energy policy
    - outlining the major challenges for the electricity system, what is being done to address them, and who is responsible
    - responding to fairness and equity concerns
    - incorporating opportunities (not expectations) for householders to participate in ways that are interesting and meaningful to them – such as via generation of their own energy, trading and sharing platforms, and demand management

'I recognise that it's inequitable that we haven't developed a mechanism to enable low income households to benefit from solar and storage, and I'm very keen on governments at all levels developing mechanisms to enable that to happen.' (Grant)

'The motive of the government is very good…they are installing small power plants on every household and half of them will be paid by the home owners and then half by government.' (Munir)

'I'd like to see more of a vision for Australia put out there. Leadership to say, this is what we plan to do, we want your input, let's work together towards a solution and have a fixed date in the future you can work towards, and just make it a SMART decision, a specific, measurable, achievable, real, time-specific.' (Megan)

CASE STUDY 8: CLARE

Theme: Leadership and Consultation
Household Type: Sole occupant
Age: 33
Location: Adelaide, SA

Category: Blackout Experiences
Emerging Energy Technologies: None
Income: Medium

'An overall plan would be so lovely'

Summary: Clare is a registered nurse and is not very familiar with the energy system or technologies but agreed to be interviewed because she was 'curious' and wanted to learn '*what we do and how we do energy*'. She had heard about wind farms and a big battery being built but thought the energy sector lacked an overall plan:

> *'We are such a technological society these days and blackouts make it so apparent that we aren't in control of our energy... I don't think you ever get a full account from the government of what they're actually doing for our energy and how we're moving forward in energy... An overall plan would be so lovely.'*

> *'"Here's the things that we need to upgrade" and, "This is why this is failing" and, "This is why we need to do this"... to know what they're actually doing rather than to have this abstract idea of the grid. It would be cool.'*

Although Clare coped well with power outages, she was concerned about the importance of electricity for the health of more vulnerable people. Her elderly neighbour was injured from a fall in the dark during the 2016 statewide blackout resulting in health deterioration and having to move to a more supported living arrangement. Because of communications about rolling blackouts in Adelaide, Clare was aware of peak demand - but didn't know that the sector was pursuing demand management. She supported widespread implementation of demand management – but targeted at younger and healthy households (like herself) because of possible health impacts on already '*frugal*' older people, '*come on, turn it off, go out, see your friends, go the beach, come and do something without electricity… The young and healthy, 'cause pretty much they're the wasters.*'

Despite some distrust in the energy sector, Clare was very willing to engage on energy issues. The issue of accommodating household generated electricity into the grid was new and challenging. She likened higher charges for solar households to a '*death tax*' and felt privatisation had enabled government to '*sidestep*' responsibility for this issue and energy provision more broadly:

> *'That should be a government thing. They should be dealing with that... they shouldn't be on the sidelines. They should be in the middle of it trying to do the best for the people... It would be good if [government] were overseeing and they were the body for [energy], as the umbrella, for everyone to turn towards. But then, that's not always most helpful, but in an ideal world they would be making the pie that everyone is eating.'*

Clare wanted households to be given more opportunities to get involved with energy issues. She suggested '*street corner meetings*' (like those run by politicians in her area) to '*share information*', respond to questions, and '*further opinions*' in the community. She also thought that drawing on the community engagement capabilities of local government and social media were important avenues for consultation.

Clare's Priorities:

- An overall plan for energy
- Opportunities to hear about energy issues and consultation opportunities
- More demand management – targeted to younger and healthier households

EMERGING ISSUE: INTEGRATION OF DISTRIBUTED GENERATION INTO THE GRID

Integration of on-site generation of electricity by households is an emerging challenge (AEMO & ENA 2018) with low visibility but high relevance to household interest in adopting new energy technologies. Its eventual impact on household use of solar PV and batteries, load profiles and operation of the electricity grid, energy bills, and carbon emissions reduction in Australia, will depend on how the energy sector, regulators and governments respond.

After households heard the statement, researchers prompted a discussion about infrastructure costs and who should be responsible.

STATEMENT: *Up until recently, the electricity grid carried electricity in one direction – from the grid out to electricity users. With households using solar panels and other technologies to feed electricity into the grid, the electricity system now needs to operate as a two-way system. In some areas, infrastructure upgrades may be needed to ensure that the electricity system continues to operate safely and reliably as the amount of electricity fed into the grid increases. Alternatively, customers may be prevented from connecting solar panels, or have limits placed on the amount of electricity they can export to the grid.*

Summary of householder responses

- Low pre-existing awareness of this issue[14]
- A few households were sceptical that this statement reflected a genuine issue and some doubted that it would be costly to address
- Accommodating household energy generation was considered a national priority
    - appears obvious to households that any grid upgrades needed to accommodate household energy generation would proceed
    - potential to erode trust in the energy sector if not addressed or hindered by lack of leadership or forward planning
    - concerns that making it too hard to connect on-site generation (or limiting connections) would force people off-grid
- The issue of how to distribute the costs of any upgrades is a new idea to most householders and they recognise it as a complex issue
    - some suggest network businesses could fund required upgrades by reducing profits
    - some think government should be involved in this 'national priority', including contributing to the cost
    - the tax system was suggested as a fair way to fund this infrastructure requirement because wealthier households would contribute more than those who had low incomes and may not be able to participate in, and benefit directly from, distributed generation

Householder Quotes: Distributed Generation into the Grid

> *'It's absolutely essential. It has to happen and it has to happen in a planned way.' (Grant)*

> *'I'm not sure, I don't know too much about the technical side of the grid, so I'm not sure that they do have to spend a huge amount to put that into place.' (Aaron)*

[14] Several media stories relating to this issue emerged while interviews were being conducted for the project, which meant that some householders had heard about this issue very recently

'I think it's a worthwhile investment, because that's the trend of the way things are going.' (Chris)

'They definitely need to do the upgrades to that they can support the solar going back into the grid.' (Chloe)

'You've got to do it, otherwise everybody's going to turn into an island.' (Alan)

'The energy companies will be forced to do something that's a little, that can cope with it. If they don't, they're, they themselves are struggling, will be struggling to survive because people will start disconnecting from the grid.' (Karl)

'I think the power companies have to pay for it... They're making the dollars; they're the businesses.' (Chloe)

'They've got to invest money to be able to deal with the more solar and stuff? It's like, they're announcing record profits... that money should be getting sunk back into the grid, that's their business.' (Deon)

'I think there has to be some buy-in from the government... the government is probably in the best position to invest across a federal level to be able to say, this is something that's going to work for all of Australia.' (Megan)

'[Government] are the ones that should set the direction that suits the community... it's the government's job to tell us what's going on and what we need to do.' (Barry)

'The government can increase certain percentage of tax to support those people who cannot afford that.' (Wei)

'If people pay tax I'm sure it wouldn't be a huge impost for everybody to pay 10 or 20 bucks or year or whatever, an extra network cost to facilitate this demand, this infrastructure upgrade... it's important that the communication of the tax is, it's important that that's properly done.' (Isaac)

'The taxpayer pays, but it does mean those who earn more [and] pay more tax end up footing the bill... we're also reducing what we're paying to the energy companies. So it means that the total cost shifts more and more onto the people who don't have the panels, which is unfair... You could put a levy on people who are installing the systems as well. Because they're ultimately going to benefit. But you'd need to be a little careful... it would be an incentive for people to go off the grid altogether.' (Karl)

Implications

- Ensuring the grid can accommodate household interest in renewable energy generation at the local level is very important for building and maintaining trust in the energy sector
- This issue needs to be addressed as part of an overall leadership plan for electricity provision in Australia

IMPLICATIONS & CONCLUSIONS

This section summarises the implications and conclusions from the household research which will inform subsequent stages of this project.

Engaging consumers with information and more market choice can be counterproductive for better engagement outcomes

- In the current market, electricity consumers are expected to engage with retailers, make decisions about the best plans and products for their household, and understand and respond to tariffs – to reduce their energy costs and demand for electricity at peak times. However, many households are not engaging in these processes for a variety of reasons.
- The findings from this research indicate that reducing complexity and choice is fundamental to households being able to confidently engage and willingly trust the energy sector.
- Engaging householders through issues that interest them, and through their lifestyle priorities (e.g. comfort, work and health) is likely to lead to more positive outcomes.

Digitally connected lifestyles and more frequent and intense heatwaves are increasing the impacts of power outages

- Working from home and running appliances, devices and other services through electricity-dependent internet connections is increasing the impact of outages in Australian households.
- More frequent and intense heatwaves are also increasing dependence on household air conditioning and reliance on electricity.
- Advanced warning of potential power outages, provision of personal backup systems, and alternative working arrangements are likely to become more desirable and necessary as Australian households increase their dependence on connected technologies.
- Households are increasingly looking to battery storage as an efficient way to enhance reliability despite the current high initial investment cost compared to rooftop solar PV.

Households are embracing new forms of participation

- Generating and storing energy at home, participating in demand management programs, and modifying household routines and activities are important and positive forms of engagement towards the Future Grid.
- Dedicated research and programs are needed to ensure disadvantaged households are not excluded from participation and other benefits of energy generation and storage
- Distributed generation and Peak Reward demand management programs appeal to households because they provide interesting and meaningful opportunities to engage and participate, rather than expectations of engagement and perceived punishment if they do not respond (e.g. time of use tariffs as per our previous research).
- Even initiatives that involve minimal effort, like Direct Load Control of air conditioning, can still be viewed by householders as a form of participation and a way to engage them in issues facing the sector.
- Households are likely to view energy industry support for distributed generation and storage and opt-in demand management programs (if consistently and widely communicated) as steps in the right direction which help build trust that the energy sector is planning ahead and concerned about better outcomes for households.

The concept of sharing provides an important engagement opportunity

- The concept of 'sharing' energy has high appeal and can apply to a variety of situations, such as sharing excess solar generation with others in the community or a household's personal network, helping households who are impacted by energy affordability issues, reducing energy at peak times to share energy with those who need it more than they do (e.g. for cooling), or help the electricity grid.
- Sharing is linked to ideas of community responsibility and helping the 'common good', but it also relates to new and emerging markets (e.g. peer-to-peer trading) or financial incentives (e.g. peak rebates).
- The idea (and practice) of sharing excess distributed energy with others is likely to encourage early adopter households remain connected to the grid.
- Investigating and developing sharing engagement pathways is an emerging opportunity for the energy sector.

Distributed generation provides an important pathway towards engagement

- Rooftop solar and battery storage is making energy more visible to households and linking it to Australia's variable weather. The inherent aspects of the timing of production (during daylight and sunny hours) raises most households' interest in the timing of energy use and peak demand.
- Both high and low feed-in-tariffs (significantly higher or lower than the price a household pays for grid-connected energy) have helped household engagement with timing of their production and use/production – either to maximise export (high feed-in-tariff) or maximise use of own production (low feed-in-tariff).
- Early adopters are enthusiastically interested in helping the grid and improving electricity reliability for others – but their willingness to participate in grid stabilisation is often moderated by distrust in energy companies and perceptions of unfair trading terms between households and energy companies (low feed-in-tariffs and/or lack of transparency over control of their battery).

Holding conversations about energy challenges can improve understanding and participation

- Through discussion about five 'emerging issues', this research demonstrated the value of engaging householders in conversations about energy sector challenges (rather than just 'informing' them of issues and desirable responses).
- Conversations held during the interview made householders more understanding of the issues facing the sector and other householders with equity or health concerns.
- Ongoing dialogue could also increase householders' interest and willingness to be involved in a Future Grid initiative, as demonstrated in this research.

National leadership and energy sector planning is urgently needed to build trust and confidence in the sector

- This research found that households are concerned at the lack of political leadership on energy issues, and the absence of a coherent plan for Australia's energy future. As well as being consulted on energy issues, householders want the government and energy sector to demonstrate leadership on the emerging issues raised as part of the interview.
- Demonstrating leadership and providing a clear plan is integral to developing householder trust in the energy sector, and ensuring strong engagement and participation towards the Future Grid.

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