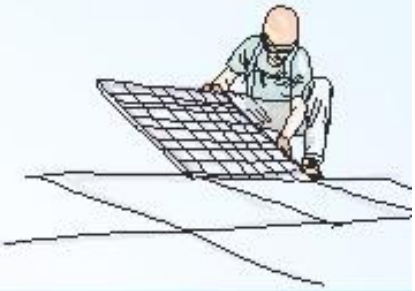
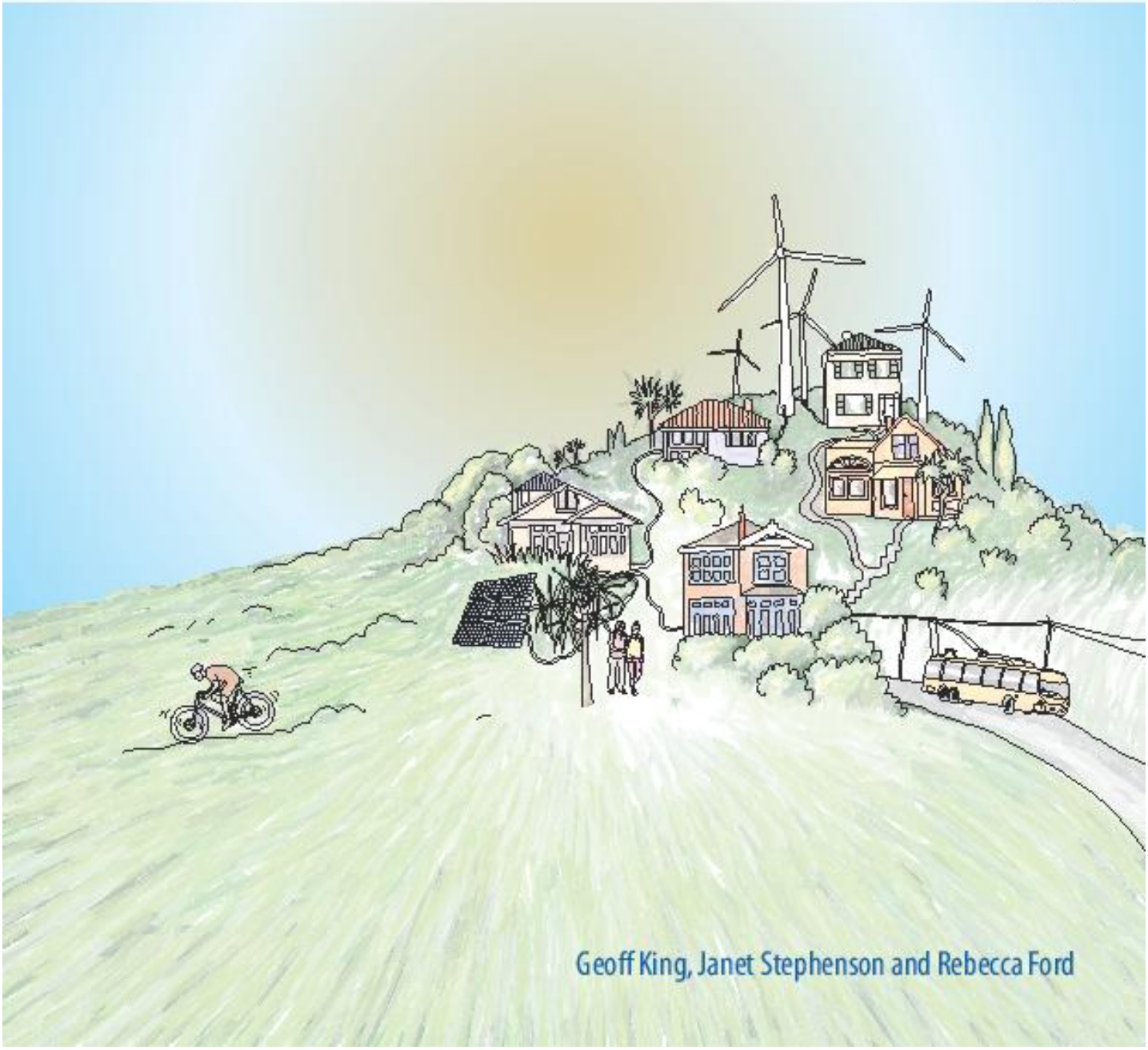
# PV in Blueskin:

## Drivers, barriers and enablers of uptake of household photovoltaic systems in the Blueskin communities, Otago, New Zealand

A report for the GREEN Grid research project

October 2014





Geoff King, Janet Stephenson and Rebecca Ford

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**For further information please contact:**
Dr Rebecca Ford (Victoria University of Wellington), rebecca.ford@ecs.vuw.ac.nz
Dr Janet Stephenson (University of Otago), janet.stephenson@otago.ac.nz

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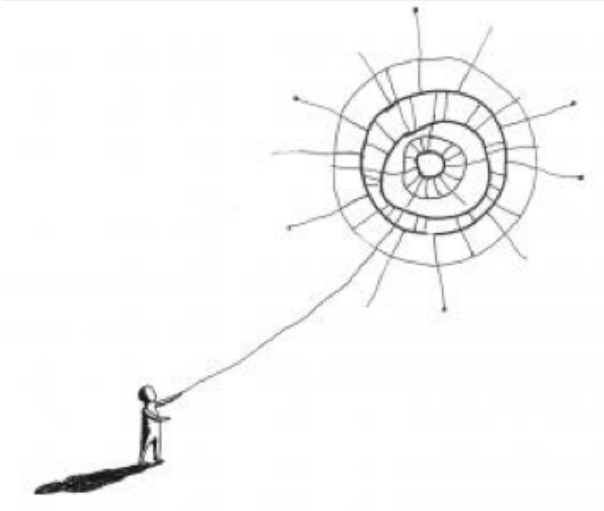

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Kā Rakahau o Te Ao Tūroa

*A report for the GREEN Grid research project*

## ABOUT THE AUTHORS

Geoff King is a consultant at Brook Lyndhurst, an independent research and strategy consultancy, based in the UK, primarily concerned with understanding, promoting and delivering sustainable development. Geoff conducted the research described in this report during a 3-month internship at the University of Otago in 2013.

Dr Janet Stephenson is the Director of the Centre for Sustainability and researcher in the GREEN Grid research project, which is looking at the future of NZ's electricity grid. Janet supervised Geoff's work and contributed to the analysis.

Dr Rebecca Ford is a lecturer at Victoria University of Wellington, and a research associate at the Centre for Sustainability. She also leads the demand side research in the GREEN Grid project, to which this work contributes.

## ACKNOWLEDGEMENTS

We would like to thank all interviewees for their time, honesty and for the welcome into their homes. In particular we would like to extend thanks to Scott Willis, project manager at Blueskin Resilient Communities Trust who, as well as gifting his time on several occasions, allowed us to use the BRCT contact list to source interviewees.

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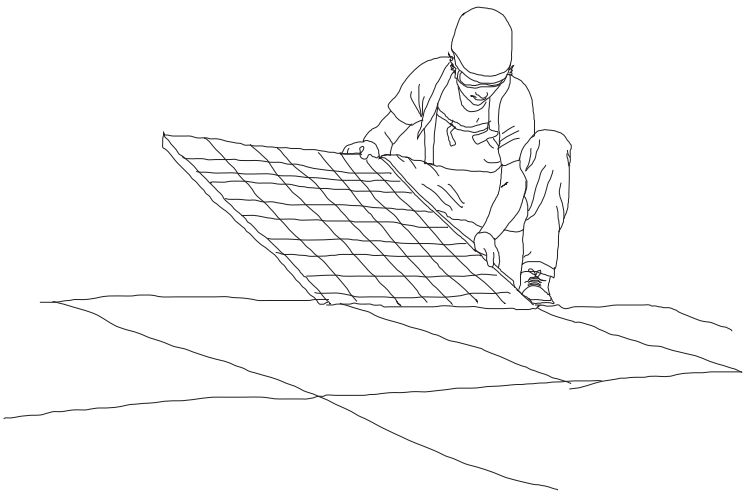


# CONTENTS

# EXECUTIVE SUMMARY


- Householders in the Blueskin area near Dunedin show a strong interest in installing PV. To explore the reasons for this interest, eighteen interviews were undertaken in late 2013 with people who had either installed PV or were interested in doing so. Four interviews were also held with people involved in supporting the community's energy initiatives.
- Analysis of the interviews was aided by two theories – Rogers' model of technology adoption, and the Energy Cultures Framework, which describes an individuals' "energy culture" according to their material culture (i.e. the physical things they have or own), their practices (i.e. what they do with their energy related technologies) and their norms (i.e. what their think about these energy related technologies and issues).
- The 'energy culture' displayed by interviewees typically had the following characteristics:

  - Material culture – home ownership, building and site suited to PV

  - Practices – already use energy carefully, sustainable living, energy literacy, actively seeking information on PV, and (for some) technological competence

  - Norms – support for solar energy, desire for partial or full independence from the electricity grid, desire for greater financial control, lack of trust in power companies, confidence in the technology, environmental concern, perceived long-term financial benefits of PV
- The interviewees fell into two main clusters in how they sought information about PV.

  - 'Hunters' actively sought technical information from a wide variety of external sources

  - 'Gatherers' tended to rely on 'hunters' and other local sources for their information.
- External influences that were driving interest in PV included: the improving affordability of PV units, the rising cost of electricity, the cost of grid connection for new builds, increasing visibility of PV, information sharing within community networks, availability of tradespeople with skills in PV installation, and overseas experience in seeing PV more widely used. Influences that related specifically to the activities of the Blueskin Resilient Communities Trust (BRCT) included: facilitating supplier/installer relationships, providing an information source about PV, building energy literacy, and helping develop technical skills.
- The main barrier to uptake was the upfront cost of investing in PV. A few mentioned the lack of financial incentives (e.g. subsidies) and the speed of technological development and dropping prices, meaning they were unsure if they should wait a bit longer to invest.
- Motivations for adoption included perceived financial control and long-term benefits; enabling a degree of independence from power companies and rising electricity prices; interest in the technology for its own sake; and environmental concern.
- A key finding of the research was that the activities of the BRCT, together with other initiatives by community members, initiated or supported enablers that reduce the barriers to uptake. These included collaboration to reduce the costs of purchase and installation, provision of information and advice, building energy literacy, enhancing technological competence, and support from social networks.

# 1. INTRODUCTION

A lot can be learnt by looking at what drives the early adoption of a new technology. The Blueskin area, north of Dunedin, consists of a cluster of small settlements around Blueskin Bay, totalling around 1000 homes. When over fifty households signed up in 2013 to express interest in acquiring household photovoltaic (PV) systems, we wanted to examine what was generating this high level of interest. Geoff King's internship with the Centre for Sustainability in late 2013 created a perfect opportunity for undertaking research with community members and start exploring their growing interest in PV.

The stimulus for publishing this report was seeing the rapid uptake of PV that has occurred in the Blueskin area in the year since the interviews were undertaken. As at September 2014, 23 of the 35 PV connections within the OtagoNet lines network were in the Blueskin area, all feeding into the Waitati substation. The Waitati Substation zone (Blueskin) represents only 6% of OtagoNet's network connections, but comprises 70% of installed DG capacity in OtagoNet's network (84kW installed capacity). Almost all of these connections had occurred within the past year. We clearly had a region of 'early adopters' of PV, and we felt that it was worth sharing our findings on why this might be occurring. This report is the result.

## 1.1 BACKGROUND

Researchers at the Centre for Sustainability at the University of Otago are involved in a research programme called GREEN Grid[1] which is a wide-ranging investigation into how New Zealanders use power, how energy demand can best be met using renewable sources, and how New Zealand's electricity infrastructure can be made smarter and more efficient.

The research being carried out at the Centre of Sustainability focuses on understanding changes in household energy use and energy production, including an evaluation of the potential uptake of new technologies such as home energy management systems, electric vehicles and rooftop solar photolvoltaic (PV) systems. As these new technologies become increasingly mainstream, it is possible that we will see a shift from static consumers (people relying on retailers to provide the electricity they consume, and paying little attention to managing their demand) to active consumers (people who are involved in actively managing aspects of their electricity use) and/or prosumers (people who both produce and consume electricity).

The changing roles of consumers in the electricity system will need to be factored in to the design of New Zealand's future smart grid. Over the last few decades PV technology has improved significantly, which, combined with significant price reductions (in part due to increasing production volumes) and subsidies (in many countries), means that it has become an affordable and effective energy generation option for many households globally. Within New Zealand, even in the absence of subsidies, PV installations have increased exponentially over the past two years[2].

1 GREEN Grid is led by the University of Canterbury and involves researchers from the University of Otago, Victoria University of Wellington and the University of Auckland. See http://www.otago.ac.nz/csafe/research/energy/otago050285.html

2 Miller, A., Williams, J., Wood, A., Santos-Martin, D., Lemon, S., Watson, N., Pandey, S. (2014) Photovoltaic Solar Power Uptake in New Zealand. Paper given to the Electrical Engineers Association Conference & Exhibition 18-20 June 2014, Auckland

The research into PV uptake in Blueskin Bay contributes to the GREEN Grid project workstream looking at the factors that are influencing New Zealanders' decisions about whether or not to purchase rooftop PV.

A second research programme called Energy Cultures [3] is also run out of the Centre for Sustainability. Insights about energy behaviour derived from this programme have been used to help analyse the findings from this study.

## 1.2 THE BLUESKIN AREA

The interviews that inform this report have mainly been undertaken with residents of the Blueskin area, a region around Blueskin Bay comprising a number of small settlements (totalling around 1000 homes) located approximately 20km north of Dunedin in the South Island of New Zealand.

The area has seen a number of community-led initiatives and since 2008 these have in part coalesced around the Blueskin Resilient Communities Trust, which has a stated aspiration for improving community resilience with a particular focus on energy, food and transport[4]. The BRCT's energy-related activities include the provision of community energy advice, a 'cosy homes' project, the development of a community-led wind turbine cluster, and facilitation of PV uptake. The Blueskin area was deliberately selected for this study due to the community's considerable interest in PV.

The aim of the study was to determine the various factors influencing, preventing or enabling the uptake of PV in Blueskin Bay. The research aimed to investigate some of the factors influencing PV purchasing decisions amongst 'early adopters' (i.e. those who had already installed PV) and 'early movers' (i.e. those seriously considering installation)[5]. It is pertinent to research these groups, as they tend to discover and resolve issues with the adoption of new technologies before these technologies are taken up by the mainstream population. As well as informing the GREEN Grid research programme generally, understanding the drivers and experiences of early adopter households may assist stakeholders who are looking to promote or enable the uptake of PV technology elsewhere. The findings will also offer a point of comparison with interviews being undertaken nationally with households that are installing PV, as another workstream of the GREEN Grid project.

## 1.3 CONCEPTS

To provide a theoretical underpinning to the research and to help guide interview question development, this report draws on two well-known conceptual frameworks. Rogers theory of technology adoption[6] is used to help situate the ideas relating to the uptake of PV in the Blueskin Bay communities, and the Energy Cultures Framework[7] is drawn on to provide insight into behavioural changes enabling or resulting from PV uptake.

### *1.3.1 ROGERS THEORY OF TECHNOLOGY ADOPTION*

Rogers' theory of technology adoption seeks to explain how innovation spreads, taking into account how an individual learns about, assesses and decides to adopt or reject an innovation (including a new technology). It describes the process by which knowledge about and interest in an innovation is communicated through certain channels over time within a society.

Adoption is aided by both mass media and interpersonal communication channels. Innovations that are technologically superior may not always be widely adopted, especially when existing technologies are heavily entrenched in cultural

3 www.energycultures.org

4 www.brct.org.nz/

5 This term is used throughout the report as it acknowledges that the technology is not new, but recognises that some people have moved to install the technology before others in their social or national context.

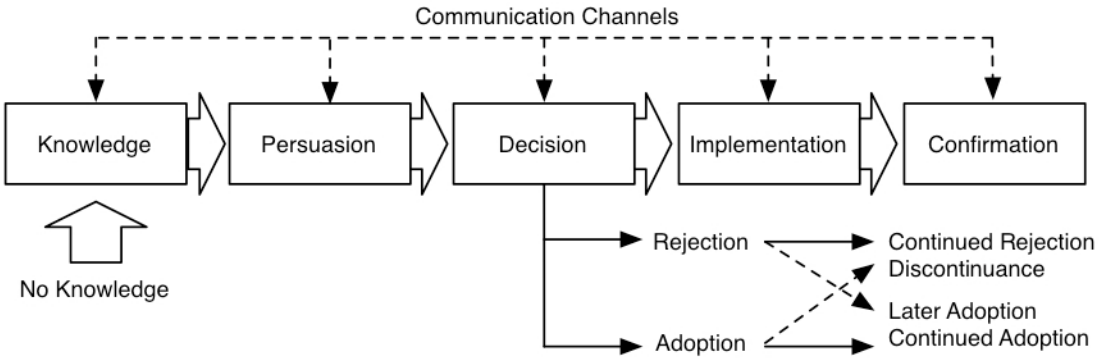
6 Rogers, E. M. (2010). Diffusion of Innovations, 4th Edition. The Free Press. ISBN 0-02926671-8.

7 Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. Energy Policy, 38(10), 6120-6129.

and social processes. When trying to understand the adoption of a new technology, such as PV, it is therefore very important to consider culture, the local environment, and the characteristics of adopters.

Rogers proposes that adoption proceeds in stages (Figure 1): an individual first gains some initial knowledge of an innovation; forms an attitude toward the innovation based on the perceived value of its characteristics; decides whether to adopt or reject; and then implements the decision. Additionally, Rogers suggests that whilst mass media communication channels are influential during the knowledge stage, interpersonal and local communication channels are more influential during the later stages. People progress through the adoption process at different rates.

FIGURE 1: ROGERS DIFFUSION OF INNOVATION MODEL (ADOPTED FROM ROGERS, 2010)




This work uses Rogers Diffusion of Innovation Model to situate findings from the interviews and indicate where the interview participants fit within the model. It also uses ideas from the model related to communication channels to explore how ideas have been spread within the Blueskin community, and how this might have affected rates of uptake of PV in the area.

However, a limitation with Rogers Diffusion of Innovation model is that it cannot account for other factors that may be influential in helping people move through the adoption process. To more fully understand these aspects of behaviour and behaviour change, we turn to the Energy Cultures framework.

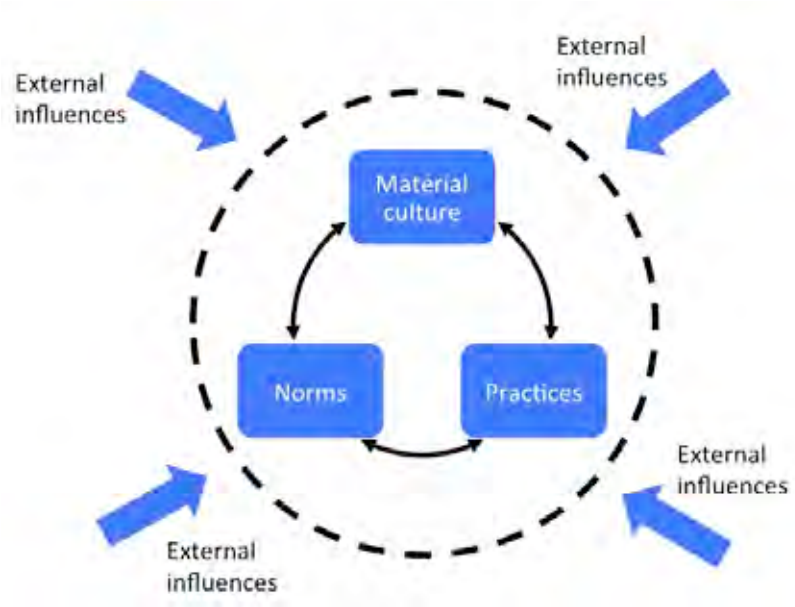
### *1.3.2 THE ENERGY CULTURES FRAMEWORK*

The Energy Cultures framework provides a useful structure to help understand energy behaviour and behaviour change.[8] Under the framework, energy behaviour is seen as the outcome of interactions between 'material culture' (physical items including building structures and technologies), 'practices' (actions that use or avoid the use of energy) and 'norms' (peoples' aspirations and expectations about how they do or should live their lives) (Figure 2). These, in turn, are shaped by external influences that are outside of the control of the individual or household.

Both internal and external influences can lead to a change in energy culture. Internal drivers of change could stem from households' adopting new norms, practices, or material cultures. A change in any one of these elements may have cascading effects on the other two. For example, a shift in technology from portable electric heaters to heat pumps may drive new practices around heating (e.g., higher temperature settings, timer controlled turn on/off), which may in turn affect new norms or aspirations (e.g., the desire for a warmer house). External drivers of change shape the external environment in which energy related decisions are made, for example, policy or market mechanisms that affect the price of new technologies.

8 Most of the Otago University GREEN Grid team members are also members of the Energy Cultures research programme

FIGURE 2: THE ENERGY CULTURES FRAMEWORK (STEPHENSON ET AL., 2010)




In this work we are interested in exploring both the internal and external influences on energy behaviour that exist within the Blueskin Bay communities, and in particular their relationship to PV uptake.

# 2. METHODOLOGY

The project involved three research streams: a literature review, community interviews and interviews with other key stakeholders.

## 2.1 LITERATURE REVIEW

The purpose of the literature review was largely to inform the development of the interview topic guide. As such the review made no attempt to be exhaustive, but rather to be sufficient to scope the different factors that may affect uptake of PV.

Sources were found primarily through using Google Scholar to search for relevant academic articles, and through following up on relevant references in these papers. Some articles were also forwarded by colleagues.

In total around 30 articles were scanned for information, with 18 read in depth. The findings from this literature review can be found in Section 3, with a bibliography available in Appendix A.

## 2.2 COMMUNITY INTERVIEWS

A qualitative approach, involving semi-structured interviews, was selected as the best way to investigate householders' motivations driving and barriers preventing adoption of PV, and their experiences and behaviour shifts during this process. The interviews were structured around 5 main topics, based on the underpinning theoretical concepts selected to frame the research (see Section 1.3), a review of literature (see Section 3), as well as some ideas that the research team wished to explore (drawing from their prior research in the Energy Cultures research programme). The following topics were explored through open-ended questions:

- Interest in PV and renewables;
- Sources of information, competence and awareness regarding PV;
- Social norms and the role of the community;
- Barriers to and enablers of adoption;
- Current energy practices, and any changes subsequent to installing PV.

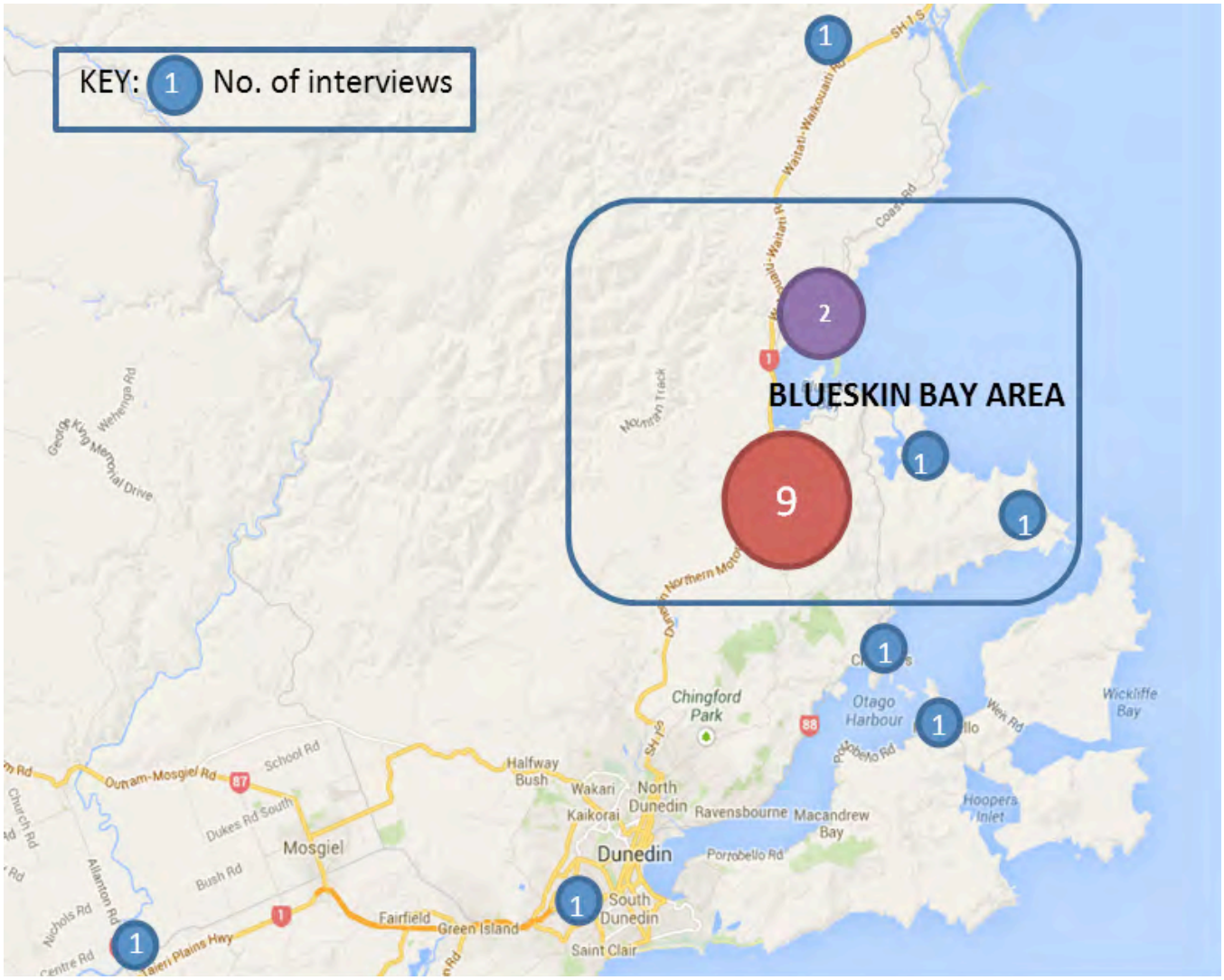
Following the interviews, a short written survey was filled out by the interviewees, which included questions about household energy use and some basic demographic questions.

Participant recruitment was conducted with the help of the Blueskin Resilient Communities Trust (BRCT). In early 2013 the BRCT invited people who received their newsletter to put forward their names if they were interested in hearing more about PV. At the time of commencing this research project, the list contained 81 names. The BRCT contacted all on the list to ask if anyone did not wish to be approached to take part in this research project. No one declined to be approached.

BRCT and Centre for Sustainability staff and contractors were removed from this list, along with participants in another piece of Centre research[9], leaving a total sample of 71. Five people on the contact list had not provided an email address, so 66 people were contacted and invited to take part in this research. Just over a third of those contacted replied positively.

Even though BRCT works mainly within the Blueskin Bay communities, some of the names on the BRCT list were from beyond this area[10]. The majority of those interviewed (13) were located in Blueskin Bay, but a number (5) lived in the wider Dunedin area (Figure 3). The interviews were conducted between September 18th and December 12th, 2013.

FIGURE 3: A MAP OF THE BLUESKIN AREA, NORTH OF DUNEDIN, SHOWING THE LOCATION OF INTERVIEWEES' HOUSES. NUMBERS IN THE CIRCLES REPRESENT THE NUMBER OF INTERVIEWEES IN PARTICULAR LOCATIONS




Drawing our sample from the BRCT contact list makes our study a 'purposive' rather than a representative survey of Blueskin householders. This was quite deliberate, as we were interested in interviewing actual and potential adopters of PV.

Eighteen interviews were undertaken in total. Sixteen of these were one-on-one, while two were with husband and wife pairs. Fifteen of the eighteen interviews were conducted face-to-face; eleven of these in interviewees' homes, three in cafés, and one in a workplace. Interviews were not incentivised, but participants were thanked with a large

9 The Energy Cultures 'Interventions' study on the impact of home energy advice on householder actions.

10 One person that responded to the research call but was not interviewed lived 90km north of Blueskin Bay in Oamaru.

bar of chocolate at the end of the interview[11]. Three interviews took place over the telephone. All interviews were conducted between the 8th and 18th October 2013. Interviews were recorded, transcribed and thematically coded according to emergent themes.

Three distinct types of data (qualitative, quantitative, and network mappings) were collected during the community interviews, as shown in Table 1.

TABLE 1: COMMUNITY INTERVIEW DATA

| Data | Further detail | Completion | Analysis |
|---|---|---|---|
| Qualitative | Semi-structured interviews were conducted, aided by a topic guide. Interviews were recorded and transcribed | All 18 | The researcher's topline thoughts and findings were recorded; interview transcripts were then thematically coded according to the Energy Cultures framework. |
| Quantitative | A short questionnaire was given (either in paper form at the interview, or electronically shortly afterwards), asking a socio-demographic and energy use related questions. | 17 out of 18 | Data was aggregated in order to distinguish the characteristics of the overall sample. Due to the small sample size, no cross tabs were undertaken at this stage. |
| Network maps | During the interviews, participants were asked to draw a quick diagram showing information flows: where they had received or given out information about PV. | All 15 face-to-face interviews | These maps were designed to be a discussion point in the interviews, rather than a robust piece of standalone data. Nevertheless, interesting features and trends in the diagrams were noted, and the findings are discussed in Section 4.4. |

## 2.3 STAKEHOLDER INTERVIEWS

In order to gain other perspectives on PV uptake in the area, four further interviews were conducted with stakeholders and community experts who had some involvement in PV in the Blueskin area and/or the wider Dunedin region.

These were undertaken following the 18 community interviews to explore the wider context and to pick up on any insights and perspectives that they might offer on the widespread interest in PV. Two interviews were conducted face-to-face, and the other two were undertaken on the telephone. The interviews were with the Project Manager of BRCT, a local PV installer, an employee of the lines network company, and a local importer of PV equipment.

These were qualitative interviews, with no additional data collected. They were less structured than the 18 community interviews and allowed time for the stakeholder to discuss their area of expertise or interest in depth. The interviews covered several different aspects of PV including: finance, independence, opposition and barriers, innovations, technical issues, behaviours, knowledge and the future of the grid and energy in New Zealand. These interviews were also designed to gather feedback on the high-level findings of the previously conducted 18 community interviews. The interviews were recorded and transcribed, and coded using the same categories as the community interviews.

11 Or a cup of coffee at the start of the interview, where appropriate.

# 3. LITERATURE REVIEW

The purpose of the review was to identify factors that have been found internationally to drive, prevent or enable the installation of PV, and behaviour changes after adopting PV. The key findings are summarised below and detailed further in Tables 2 and 3.

## 3.1 FACTORS INFLUENCING PV UPTAKE

The literature suggests that the uptake of PV internationally has been influenced by a variety of drivers (things that motivate people to want to install PV), barriers (things that prevent people from installing PV) and enablers (things that help people to overcome barriers to PV installation).

### *3.1.1 DRIVERS OF UPTAKE*

Predominantly, uptake seemed to be driven by internal influences on an individual's energy culture. Environmental motivations and the desire to live a green lifestyle were regularly discussed, as were aspirations of autonomy and the long-term benefits that owning a PV would have on future financial considerations. Some people were driven by their desire to save energy, and others were just interested in new technologies. These perceived benefits that PV would bring to a household (whether financial, environmental, etc.) were also a key factor in governing attitudes and subsequent uptake.

In addition, seeing PV becoming a popular choice (i.e. the emergence of new social norms relating to microgeneration) and seeing good quality systems and satisfied customers also helped drive of uptake.

### *3.1.2 BARRIERS AND ENABLERS*

One of the main barriers identified was the cost of the PV system and installation, often resulting in long payback periods and financial risks for investors. Enablers (mechanisms for overcoming this barrier) included selecting target locations for installation (i.e. choosing sites where the context was more suited such as in remote or off grid locations) or target households for installation (i.e. those that own their homes rather than rent and those with a surplus of income or other funds available), as well as financial subsidies and supportive local government initiatives.

Other set of barriers related to concern about the reliability and effectiveness of the system. Trust in the installers was critical here to overcome householders' concerns. The provision of guarantees, assurances around system maintenance, and simple installations done with minimal disruption were also seen as important, as was the compatibility of the PV unit with the existing energy use patterns of the household,

Finally, lack of knowledge was identified as a barrier to uptake. Information or education could help overcome this, such as sharing of experience from peers with PV systems[12].

12 See Table 2 for summary of key points, and Appendix A for the bibliography.

TABLE 2: KEY LITERATURE REVIEW SOURCES (LISTED ALPHABETICALLY) ON ADOPTION OF PV AND OTHER RENEWABLE TECHNOLOGIES

| Author | Year | Title | Sample | Country | Key findings |
|---|---|---|---|---|---|
| Allen et al. | 2007 | Prospects for and barriers to domestic micro-generation | (Review) | UK | Local government initiatives have led to clusters of PV installations in Kirklees and Woking |
| Bahadori and Nwaoha | 2013 | A review on solar energy utilisation in Australia | (Review) | Australia | • Australia has highest solar radiation per square metre of any continent but PV accounts for only 2.3% of power generation<br>• Solar radiation falling on Australia is 10,000 times annual energy consumption<br>• Solar energy use is projected to increase by 5.9% per year in 2029-2030<br>• Commercial scale is possible but technology cost is still relatively high, therefore higher risk for investors<br>• Small scale PV arrays are currently suited to remote and off-grid locations<br>• Larger scale are dependent on research and government funding to be viable |
| Design Innovation Group (DIG) | 2007 | Consumer adoption and use of household renewable energy technology | ~400 (28 interviews) | UK | • Top drivers for uptake of PV were, environmental concern (56%), funds available (43%), and saving energy (31%)<br>• Top barriers to uptake of PV were that it was too expensive (85%), that the likely fuel savings not worth cost (40%), or insufficient electricity from system (28%)<br>• Ideas and policies<br>o Lower cost systems (80%)<br>o System designed to give user feedback on savings (46%)<br>o Guaranteed reliability, durability and payback (46%)<br>• Trust in installers is vital for householders considering PV technology or other renewables<br>• Older environmentally concerned consumers (the 'greygreens') are a group especially likely to be early adopters |

| Author | Year | Title | Sample | Country | Key findings |
|---|---|---|---|---|---|
| Faiers and Neame | 2006 | Consumer attitudes towards domestic solar power systems | 1100<br>(10 interviews) | UK | • Primary motivations for adoption focused on financial or environmental aspects, or a desire to live sustainably<br>• Visual attractiveness of PV was a 'neutral' factor for early adopters, but negative for the 'early majority'<br>• All respondents thought that the payback time was too long<br>• Interviewees indicated that they had a surplus of disposable income and were considering long-term benefits of energy efficiency on their future financial position<br>• Seeing PV in popular use was an important factor for a lot of people, especially older age groups<br>• The early majority need convincing:<br>o That the systems are not too visually intrusive,<br>o That they are maintenance free,<br>o That they may add value to a property,<br>o That the installation of a system does not affect the visual landscape<br>• That the installation process is simple and with minimal disruption. |
| Faiers et al. | 2007 | The adoption of domestic solar-power systems: Do consumers assess product attributes in a stepwise process? | 1100 | UK | Systems need to be compatible with what it already owned |
| Fox and Littlewood | 2010 | The public (UK) attitudes toward the implementation of renewable energy technologies in dwellings | 300 | UK | • More aesthetic acceptance of PV on detached houses (compared to non-detached)<br>• More acceptance of roof mounted solar 'collectors' than roof-mounted or freestanding wind turbines |

| Author | Year | Title | Sample | Country | Key findings |
|---|---|---|---|---|---|
| Islam and Meade | 2013 | The impact of attribute preferences on adoption timing: The case of photo-voltaic (PV) solar cells for household electricity generation | 298 | Canada | • Expected utility decreases as cost of installation increases; increases as energy cost savings increase; increases as emission savings increase<br>• Shorter payback times preferred; grant is preferred to refund; higher export reward is preferred; higher fossil fuel inflation preferred<br>• Other drivers:<br>o Awareness of technology<br>o Location efficiency<br>• Expect imitation effect after 3% household penetration |
| Keirstead, J | 2007 | Behavioural responses to photovoltaic systems in the UK domestic sector | 118 (63 interviews) | UK | • Despite environmental concern and high incomes, the interviews found that the cost of PV was still an obstacle to many respondents |
| Kim et al. | 2014 | An integrated adoption model of solar energy technologies in South Korea | 1647 | South Korea | • Factors determining public attitudes towards solar technologies:<br>o System quality<br>o Perceived benefits<br>o Perceived trust<br>• Factors determining intention to uptake solar technologies:<br>o Satisfaction<br>o Public attitude<br>o Perceived cost |

| Author | Year | Title | Sample | Country | Key findings |
|---|---|---|---|---|---|
| Mills and Schleich | 2009 | Profits or preferences? Assessing the adoption of residential solar thermal technologies | 12,311 (and review of other sources) | Germany | • Higher number of floors in a building results in households being less likely to adopt solar hot water due to access to roof space and additional cost of piping. Stand-alone detached houses more likely to adopt<br>• Expenditures on solar thermal are expected to decrease with solar radiation and depend on geographic suitability<br>• Evidence of regional clustering in adoption of water heating systems (even after controlling for geographic suitability). Observed clustering may stem from information spill-over associated with solar water adoption or from differential state-level subsidies to promote diffusion<br>• Suggestion that more floor space results higher energy consumption and therefore greater interest in energy saving technologies<br>• Renting rather than owning the residence has been established as an important barrier to the adoption of residential energy-saving technologies<br>• Older household heads have been found to have lower level of knowledge of energy efficient technologies, weaker preferences for state-of-the-art technologies, weaker preferences for environmental preservation<br>• A number of studies have found household head education levels to be positively associated with adoption of energy-saving technologies<br>• Household income positively related to energy-saving investments |
| Sauter and Watson | 2007 | Strategies for the deployment of micro-generation: Implications for social acceptance | (Review of previous studies) | UK, Germany, Austria | • Lack of knowledge is a major barrier for PV investments, and accreditation schemes have a great influence on households' investment decisions (Oxera 2005, UK)<br>• Innovators feel more responsibility about environmental problems and have capital to take action (invest in renewable technology)<br>• Main motives for PV were: autonomy; interest in new technology; the wish to help the environment; and economic motives (Fischer 2004, Germany and Austria)<br>• Vast majority of public is in favour of renewable energy, but attitudes towards specific renewable energy technologies seem to be related to the knowledge about them. Greater awareness leads to greater acceptance (London Renewables 2003, UK) |

| Author | Year | Title | Sample | Country | Key findings |
|---|---|---|---|---|---|
| Scarpa and Willis | 2010 | Willingness-to-pay for renewable energy: Primary and discretionary choice of British households' for micro-generation technologies | 1279 | UK | • Renewable energy adoption is significantly valued by households, but not sufficiently (for most) to cover the higher capital costs of micro-generation |
| Zhai, P. | 2013 | Analysing solar energy policies using a three-tier model: A case study of photovoltaics adoption in Arizona, United States | Case study of existing data | USA | • Calculated amount of financial subsidies required to support targets of PV adoption<br>• States should make more effort on financial support programs to pursue PV adoption targets |

# 4. INTERVIEWEE CHARACTERISTICS

## 4.1 DEMOGRAPHIC INFORMATION

All interviewees lived in separate (detached) houses, and all but one owned the property. Just over half owned the property debt-free and the remainder had a mortgage. The majority planned to live in their houses long-term (i.e. were not expecting to move in the foreseeable future). Most interviewees felt they had relatively low energy bills, and had adopted energy saving measures in the home.

Interviewees were with participants across all age bands upward of 25 years. Compared to the national census data, there were fewer people under 35, and more in the 45-54 age range (Table 3).

### TABLE 3: AGE DISTRIBUTION

| **Age bands (years)** | **Blueskin interviewees** | **2013 Census national data** |
|---|---|---|
| 18-24 | 0% | 13% |
| 25-34 | 6% | 17% |
| 35-44 | 17% | 17% |
| 45-54 | 39% | 19% |
| 55-64 | 17% | 15% |
| 65+ | 22% | 19% |

Household incomes were not directly comparable to the National Census data as different income bands were used. Notably however there were more in the lowest income bracket and less in the highest (Table 4).

TABLE 4: HOUSEHOLD INCOME

| **Blueskin** | | **National census data** | |
|---|---|---|---|
| Income bands | Interviewees | Income bands | Census participants |
| Less than $29,000 | 28% | Less than $30,000 | 22% |
| $30,001 - $49,000 | 17% | $30,001 - $50,000 | 18% |
| $50,001 - $79,000 | 22% | $50,001 - $70,000 | 15% |
| $80,000-120,000 | 22% | $70,001 - $100,000 | 18% |
| Over $120,000 | 5% | Over $100,000 | 27% |
| Prefer not to say | 5% | Prefer not to say | - |

Five of the 18 interviewees had backgrounds in some form of engineering; another two had backgrounds as electricians. The interviewees also included an IT technician, and someone working in the building trade, a scientist, and two university lecturers.

## 4.2 EXTENT OF PV INSTALLATIONS

At the time of the interviews, three of the 18 interviewees had solar systems installed. Two had installed off-grid installations themselves, and one household had undertaken the installation through SolarCity (a national installation company with local providers).

> *M[13]: Mine's a reasonably simple system. I have 12V panels. I have about 440W worth, which isn't that much, charging up a pretty big battery bank, which I purchased second hand. That's at 12V of course. And then from the 12V I put it through an inverter – a pure sine wave inverter – and then 230V into the house.*

Another interviewee was in the process of doing his own installation that was intended to be connected to the grid as well as 'islandable'.

> *M: I'm in the process of getting it installed. I'll have a 3kW system. I am installing a hybrid system which is a grid connected system with a battery back-up... I have panels arriving next month from China. I already have three inverters sitting downstairs, so I have batteries sitting there, so that will be my system.*

A further five interviewees were currently researching and considering a PV installation. Most of these were in the process of building or extending their homes.

> *M: Yes, [PV is] something I'm vaguely considering. Because I'm building that sleep out over there... But it's going to cost me $2000 just to get the [network] cable running out there, so what can I do for less that $2000 as an alternative?*

The remaining interviewees, though interested in the technology, were not expecting to install PV in the short-term. This was largely due to the cost of purchasing and installing PV systems.

> *F: No, I don't have it installed. I have thought about it, and I didn't because it cost too much, basically.*

13 M = male interviewee; F = female interviewee; I = interviewer, MS = Male stakeholder

# 5. PERSONAL FACTORS RELEVANT TO PV INTEREST

This section describes interviewees' norms, material culture, and practices that appear to be relevant to their interest in PV. These are summarised in Figure 4 at the end of this section.

## 5.1 NORMS

Norms are people's expectations about how they should live their lives, as well as their aspirations for change. Norms typically reflect or are reinforced by people's beliefs about what is socially acceptable, which of course may differ between places, over time, and between social networks.

Most participants expressed a desire to live a sustainable lifestyle, which resulted in support for renewable energy generation, and, as part of this, aspirations to use solar power to generate electricity. People also lacked trust in their power companies, and this drove ambition for greater control over their financial outlay for electricity and over their future power needs, and this was similarly associated with a desire to be either completely or partially off grid. These aspirations are discussed more fully in the following sections.

### *5.1.1 ENVIRONMENTAL CONCERN*

Most interviewees mentioned environmental benefits as one of the factors positively influencing their interest in PV. That is not to say that these interviewees were driven to install PV systems for purely environmental reasons. Indeed, one interviewee with an off-grid system argued that it was actually less sustainable to install and use a PV system than it was to use grid electricity. Nonetheless, when asked directly about personal environmental attitudes, all interviewees wished to act in a sustainable manner as much as possible, and some clearly held deep environmental beliefs.

> *M: Environmental issues are important to me. We grow most of our own vegetables. We are largely self-sufficient in that particular mode, and would wish to be both more resilient and greener in our old age.*

> *F: People are a plague on the earth. And we need to buck up our act so we stop ruining the planet. Environmental concerns are very very important to me.*

### *5.1.2 SUPPORT FOR RENEWABLE ENERGY*

Interviewees generally supported renewable technologies because they envisage a future where oil and other fossil fuels become too scarce, or too risky, to use as fuel. It is unsurprising that the interviewees were generally supportive of renewable technologies, given their recruitment from a 'solar' contact list. Nevertheless, this long-term vision of the role of renewables differed somewhat from the more mixed personal reasons for interest in PV.

> *M: I definitely see it as possibly the only way forward for humanity in general, seeing as we're using so much energy at this point.*

*M: The more we can have, the better. I wouldn't call myself a greeny or a tree-hugger, but I know the importance of creating sustainable and renewable energy sources, if we can. It just kinda makes sense.*

*I: So what are your views on renewable energy or renewable technology generally?*

*M: I think it's the way of the future.*

*I: Why do you think that is?*

*M: Well, all the other power and energy is going to run out.*

Most people liked the idea that they would be harnessing the sun's energy, and saw PV as a clean source of electricity.

*M: To me, we've got to steadily shunt away from using petroleum resources, which are finite anyway, and will eventually collapse. And move to the point of view where we use non-finite resources. And the sun is the key issue there.*

However, a couple of interviewees acknowledged that they were not entirely confident that PV was a sustainable alternative to grid electricity as they did not know enough about the production process.

*F: Well, actually I don't know, because I don't know what it takes to make one, so it could be making a footprint in that way as well, so I can't actually say. I haven't looked into it that much, so I know how they're made and the process of it. And here I am saying I want it cheaper too: the cheaper you get something made, the labour comes from somewhere where they need more money than us. It could go on and on and on, you know? You don't want to think about it too much.*

*F: I'm sort of at a waiting phase where I don't actually have masses of money to invest in it right now, because I bought a second house. And I think I'm sort of interested in seeing what happens in Waitati with the wind turbine concept. Because if that's going to generate power then I think that's a better option than using photovoltaics, because photovoltaics require some earth resources to make the cells in the first place, right? That age old problem of: what do you use in resource terms to get what back?*

For most, however, PV remained a sustainable option. Reasons for this view – beyond the fact that energy was being generated from a renewable source - included:

- the 'destructive' power sources feeding the national grid;

  *F: We know that we're not draining electricity off the grid that has hydro-damming rivers or by burning coal up at Huntly or by whatever. So we've got green tendencies.*

- localising the power supply leading to increased efficiency and reduced line losses;

  *MS : Having local generation has got to be a good thing, regardless. Because you don't have the huge line losses… And that's a good thing, I think, isn't it? In New Zealand there are big line losses.*

- household generation and moving away from big energy companies being the necessary direction of travel for a sustainable future

  *M: If no-one adopts the technology, no-one experiments it's not really the technology that's this issue, it's the social and the legal and the political issues that surround doing all of this. If no-one pushes those things you will never get to the point where in twenty or thirty years time the issue is essentially solved.*

Most interviewees considered PV to be by far the most appropriate choice for micro-generation of electricity. Few interviewees had considered other kinds of renewable technology for their homes, but even when other technologies had been considered, PV was the preferred choice.

*M: I priced it up at the beginning, and looked at all of my different options: what sort of resources I had in terms of energy. There's (sic.) only three real options: wind, solar, water. I haven't got any running water I could use for that type of thing. The only other option was going to biofuel or hydrogen generation, or something like that. Or biomass - that's something I might look at in the future.*

*M: It's not windy enough here [for a micro-wind turbine]. It's pretty sheltered down here usually.*

However, the fact that panels were imported was actually a significant reason for not installing a PV system for one household.

*F: The fact that the actual equipment stuff has to be imported into the country is something that my husband struggles with... He would be much happier if it was locally made technology... If anyone started making these things in New Zealand that would make it more attractive, for sure.*

Solar hot water was discussed in several interviews as something that had either been installed already, or was at least 'on the radar' of interviewees, but will not be discussed further in this report.

Wind power was the next most discussed household-level technology, but was dismissed as a viable option by a couple of knowledgeable interviewees.

*M: I think he's [a friend] discovered that wind turbines are not a great deal of use on a household basis. In fact, I told him that years ago. It's ridiculous – you won't set up a household wind turbine for under $5,000 – probably more like $7-8,000 and it will take you 10 years to recover the costs from an energy point of view: the thing is only likely to last about 5 years! So you'll end up investing a lot of money in someone else, a manufacturer of wind turbines!*

*M: I'm definitely not a fan of domestic scale wind turbines. I think they're absolutely hopeless. I think they're a recipe for a lot of frustration and sadness. I don't think they're very good reliability, they have low output. Most people, particularly in New Zealand, think that they live in a pretty windy place – until they put a wind turbine up!*

*MS: Well I love it [micro-wind] and the problem is that it's too expensive. You need to be a pretty big enthusiast and you have to buy at the right time. I mean, my return is like in the bank, which is not a bad thing. The bank could go broke and I'd lose my money, but my return is roughly 4.5% on that. Then I have to take depreciation into account which I allow $200 a year for replacing parts of the turbine. As I said, roughly 4%, which is not great, but looking long term and looking at the utility, it's a great thing because you have it at night, so you don't have as much storage.*

Micro-hydro was discussed by a couple of interviewees, and was seen as a reliable source of power. Finding suitable location in which to install a micro-hydro system is a limiting factor.

*M: I've always been a fan of small hydro – whether that's microhydro or minihydro. But it's very hard to find a plot of land with a stream on it. And then when I looked at PVs versus wind turbines, PVs come out much ahead. And now that PV's come down in price, even more so.*

In sum, PV technology is seen as relatively reliable and price-accessible, and preferable to alternative forms of domestic generation. The decision for householders is therefore simplified to: installing or not.

### 5.1.3 DESIRE FOR GREATER FINANCIAL CONTROL

For some interviewees, the decision of whether to install PV was much more of a pragmatic financial decision around having greater control over financial outgoings. PV was seen as an economically sound option for some interviewees planning for their retirement. A few interviewees who were earning a salary, but were going to be moving onto a fixed income while still resident in their current home, saw investment in PV as a way of reducing future outgoings.

*M: If you are faced with a future where you are on a fixed income, it pays to organise yourself to minimise the costs that can be avoided.*

Some interviewees expressed their view that by making this investment and producing their own power they would be saving money in the long term.

*F: Why wouldn't you want to have an extra something that would make your [electricity] payments less in the future. You're creating your own power, and power's really expensive, so you can't go wrong. It's a saving for that person, so I can't see it [having PV installed] as a disadvantage really.*

### 5.1.4 DESIRE FOR INDEPENDENCE

A further motivation, expressed by a few interviewees, was to get away from being tied to energy companies. Continual price rises were a concern, and energy companies were also seen as the antithesis to the kind of community energy that interviewees wished to see.

*M: I don't trust those bastards. Bottom line is, you ask anyone here, they don't trust the power companies anymore. They make a sh*t load of money.*

For some, complete grid independence was perceived as a way of insulating against power price rises and not being tied to energy companies.

*M: It's nice to be off the grid. I actually find that my power supply is more reliable than the network anyway. So when I hear that my neighbours have a power cut, I haven't noticed there's a power cut, of course, because I live off the grid. And the other thing is, occasionally I'll read in the paper that the price of electricity has gone up every now and then. And even though it sounds selfish, it always makes me smile.*

Two interviewees were already fully grid-independent, and a number of interviewees stated that they would – ideally – like to live off-grid completely, if it were financially feasible.

*F: No, I don't have anything installed. I would like to. In the long term, at a minimal, I would like to have hot water. But eventually, I'd quite like to get off the grid.*

*M: ...if I could organise my life so that I was off the grid, that would be good, given that I already have my own sewerage system, I collect my own water, I grow most of my own food. With another couple of steps, I can make myself even more independent.*

*MS: It's more than economic stability or security, it's really about lifestyle. It's about stable state economy and low impact living, I would say.*

However, the interviewees with households owning off-grid systems suggested that these systems only really made financial sense given one of two conditions:

- If the cost of connecting a new property to the grid was very expensive, comparable to installing an off-grid system complete with battery banks (see Section 4.1 on new builds)
- If households use very little electricity (and therefore do not have to regularly rely on backup sources)

*M: I suspect that for most couples – if it's mum and dad and a couple of kids at home, forget it! It's not going to work for them. If you want to use the microwave, and the kids want to play on the computer and they want to have the heat pump going and normal household gadgets – forget it! It's way too expensive a system.*

However, grid-tied systems capable of islanding their electricity supply[14] were seen as capable of providing many of the benefits of full off grid systems, such as insulation from power outages or emergencies:

*F: I loved the idea of being self-sufficient in a crisis. In any sort of earthquake or terrible thing that might happen in the future.*

*F: ...if there's no power – if something happens, if something crashes, and there's no power – we can still be warm, we can still cook, we can still eat healthy, we can still boil water, you know, things like that. It's waiting for the inevitable disaster really. We're prepared, kind of thing. I guess that's a huge advantage.*

## 5.2 MATERIAL CULTURE

A number of aspects of households' material culture, including their buildings and technologies, appear to have relevance to interest in PV installation. These include home ownership, length of tenure, and site suitability, as well as aspects of the PV systems perceived as being beneficial to homes in the long term.

### *5.2.1 HOME OWNERSHIP*

As identified in the literature review (Section 3), home ownership is an important factor when considering PV purchase. It is understandable that few people would be willing to invest significant sums of money in a property that

14 This was perhaps a naive desire, as systems with the ability to switch between independent and grid-tied are more complex and more expensive than regular grid-tied systems.

they did not own. Indeed, the one interviewee who was renting their current house was interested in PV for a future property, not their existing residence.

Similarly, interviewees were – unsurprisingly – unwilling to install PV on a property in which they were not intending to live in for an extended period of time.

> *M: ... we didn't really want to spend money on the property that we weren't going to live in long term. It wouldn't benefit us, it would benefit the next people, but we don't feel we'd get the gain back – the capital gain that we'd put into it.*

Most interviewees, however, had bought or built properties with the intention of living in them for the foreseeable future.

### 5.2.2 SUITABLE BUILDING AND SITE

For retrofitting PV to existing buildings, certain building features are critical (e.g. orientation of the house, roof angle, solar radiation levels, shade, roof size), however very few interviewees even mentioned these aspects. This suggests that they were comfortable, at least at this point, that PV was a suitable and effective technology for their properties[15].

> *F: I felt that Otago was really good sunshine hours. We lived in [other location] for some time where there's three times the rainfall and it's often cloudy there. So we do feel like if you're going to be harnessing the sun's energy, then Otago would be a great spot to be using this kind of technology.*

Only one interviewee raised a concern that she might not have the space to install a system:

> *F: I was looking at what different systems were available and what would suit my rather restrained set up here. Where I would put anything for a start? But this is a very tight little ship here, there's not much room to do much.*

A few of the interviewees had built or extended houses recently, or were in the process of doing so, and PV considerations were part of their plans.

> *M: I think all I've done, realistically, about it, is make sure that the site and the way the building is constructed, is suitable for conversion to solar hot water and PV in due course. There's a nice north facing roof there at the right angle, and all the rest of it.*

> *F: It's not until you really feel like you can do it – you're actually going to build on or seriously change your house - that you really start to look at it [installing PV], you know? Like your whole energy use around your living space.*

### 5.2.3 PERCEIVED IMPACT ON PROPERTY VALUE

Some interviewees expressed their belief that installing a PV system would add value to the property, and therefore the cost (or at least part of it) would be recouped if they sold the property.

> *M: I hadn't really thought about [the impact on the value of the property]. I wouldn't have thought it would be an issue. Maybe, if anything, increase the value. The purchaser may be thinking 'it will save me money if we're producing electricity'.*

Other interviewees were not quite as convinced that a solar installation would have a significant influence on property prices, and thought it would very much depend on the prospective buyer.

> *F: I think it would depend on the buyer. I think some people that have always wanted to go solar, if they come in and something's already set up, they might be prepared to pay a bit more. But I'm not sure on a commercial valuation if they'd up it or not eh! It's up to the individual a wee bit isn't it?*

15 One of the stakeholder interviewees stated that nowhere in NZ had lower solar radiation levels than Germany, where PV has proliferated.

There was some agreement that fully off-grid PV systems posed more of a risk in terms of future value, with few buyers likely to be willing to purchase a property disconnected from the grid.

> *M: I do have some friends that we know ... and they've been off-grid for years. He's got a reasonably good system in. They've decided to sell the house, and they're putting mains [electricity] in because the real-estate people have told them that no-one's going to buy it with [an off-grid system] in there.*

However, as the majority of interviewees were planning to stay in their houses, it was apparent that any potential increase in property value was not a motivating factor for installation.

### 5.2.4 AESTHETICS

Interviewees generally liked the look of solar panels, or at least the look of the solar panels was not considered to be a barrier to installation.

> *F: I mean I've heard some people making rather critical remarks about the idea of things on their roof. But I don't think it matters, people stick those TV aerial things up. I think they're far more obvious than solar panels.*

> *MS: I haven't noticed it [aesthetics] being a big part of conversations, there are plenty of New Zealand houses that are ugly anyway!*

One interviewee described the appearance of PV panels as 'fabulous'.

While the aesthetics of solar panels was not seen as a barrier to installation, a few interviewees expressed the need for PV systems to be well-designed and not appear obtrusive.

> *M: I guess it depends on which way the house faces. If the house is like 'that' and the sun's 'there' then you're going to put them on at a weird angle, and it might look at bit out of place.*

> *M: It's one of my standing jokes! I can't believe that people spend $600,000 and build these amazing houses and then stick solar panels on the roof like a big pimple. It's like: 'why couldn't you get the architect to design a closed-in box, put the panels inside a roof cavity, so your roof looks flat?'*

### 5.2.5 CONFIDENCE IN THE TECHNOLOGY

The BRCT had distributed information about the process of installation, and participants were all reasonably aware of what the installation process would involve, and quite confident that it would be straightforward.

They did not see PV as 'cutting edge' or 'risky', but rather as a tried and tested technology. Most had been aware of its existence as a potential source of energy generation for a decade or more.

> *I: Can you remember how you first became aware of PV technology?*
>
> *M: A long time ago. Probably in the Apollo space programme, on the space craft. They used it.*

Furthermore, interviewees did not see themselves as the sorts of people who bought new things for the sake of it. Many said that they had few new appliances and lived relatively simply, while even some interviewees with technological backgrounds preferred older technologies and things they could fix, rather than up-to-date gadgetry.

> *M: I tend to wait until I'm reasonably secure that I know that this technology will work. You know, I'd buy my DVD player well down the track.*

> *M: Most modern technology items have a very short lifespan, so I have a 15 year old stereo system. I drive a car from the 90s because I know how to repair it, but anything younger than that you've got to take it to a garage every time you want to repair it.*

People without technical skills felt they could rely on a professional to do the installation for them.

> *M: The one thing that was different about using a company was that we didn't have to install it ourselves. Because it's pretty technical stuff. There's virtually a computer in our washhouse. And it was easier for it to be done and worked out that way.*

Maintenance did not present a major concern for interviewees either. Most were comfortable that PV systems would require little maintenance, beyond perhaps cleaning every so often.

This view was confirmed by interviewees who had already installed panels. Indeed, the fact that there were examples in the community had clearly helped to raise awareness that minimal maintenance was required.

*F: It doesn't sound like there would be a huge amount if it all gets installed properly. It depends, I suppose, if you've got the batteries or not, wouldn't it? Yeh, I'm sure there would be some maintenance, but it doesn't sound as if people would have to do too much.*

*I: You said, 'it doesn't sound like people would have to do too much', where have you heard that?*

*F: People that are running PVs and stuff.*

Although issues around longevity and guarantees on imported PV panels were raised on a couple of occasions, only one interviewee directly questioned the reliability of the technology.

*F: Definitely we would want to make sure that the new technology is reliable. I'm not convinced that it's totally reliable at present. Whether there are some dodgy panels coming into the country or whatever's happening I don't know.*

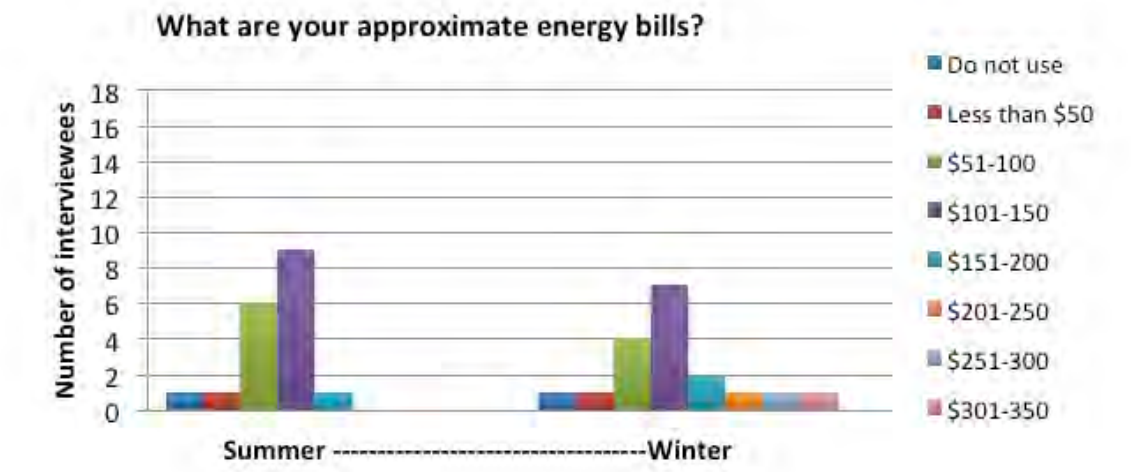
## 5.3 PRACTICES

Practices describe the actions, activities and processes undertaken by households that result in the consumption, production, or avoidance of the use of energy. Here we discuss how various household practices support households in the acquisition of PV, including actively seeking information about PV installation options, and hands-on involvement to reduce installation costs.

### *5.3.1 SMART ENERGY USE*

Most interviewees were careful about their energy use, and many had taken active measures to improve efficiency and/or reduce electricity consumption. Even in winter, the majority of interviewees are spending less than $150 a month on their primary energy bills (Figure 4).

FIGURE 4: APPROXIMATE MONTHLY ENERGY EXPENDITURE, FROM THE POST-INTERVIEW QUESTIONNAIRE




Interviewees were aware that their household energy use was low, and were pleased that this was the case.

*F: I don't use a significant amount of power. I'm a super low user. A lot of ... my hot water heating I do using a wet back on my wood fired oven up there. So it's almost like I almost don't need it [solar], you know?*

*M: We're alright here because we've got that [wood burner] and grow wood. So we've got that which heats the water. We've got pretty low power bills now anyway. But it would be good to get them even lower.*

While a few households limited their energy smart practices to things like turning lights off and recycling, nearly all utilised wood burners as their primary heat source as opposed to electricity.

Most households interviewed were also able to describe a wide range of energy saving activities that they undertook. Several had installed insulation and double-glazing[16], some had lined curtains or taken other steps to reduce drafts. People who had designed and built houses had taken into account the thermal properties of the house, taking steps such as orienting particular rooms or using bricks around the fireplace to absorb heat. One household had installed a wood chip boiler and radiators, while a couple reported doing some cooking on their wood burner to reduce their energy use.

Many interviewees were conscious that their international travel was a large component of their carbon footprint, but there was often some serious consideration of personal car use. Interviewees frequently reported visiting town as infrequently as possible, with some sharing rides and even hitchhiking. A couple of interviewees cycled as much as possible, despite the relatively unforgiving topography of the area. There was also very high awareness of (and interest in) electric vehicles and electric bicycles.

### 5.3.2 ACTIVELY SEEKING INFORMATION ON PV (HUNTERS AND GATHERERS)

Energy literacy refers to people's knowledge and understanding of energy issues and possible solutions, including their attitudes towards energy efficiency and conservation, and their intention to engage in energy efficient practices (DeWaters & Powell 2011). It was clear from the discussions with interviewees that their energy literacy levels were generally very high. Some interviewees had particularly strong technical knowledge about energy, including about different aspects of micro-generation systems. This is perhaps not surprising given the professional experience of some interviewees.

> *M: ... I'm a professional engineer. So I'm pretty confident I know what's involved. I've got a lot of experience in geothermal energy. I worked in geothermal energy [abroad]. I've done a lot in that sector as a whole, shall we say.*

> *M: I'm a mechanical engineer, so I followed all forms of alternative power for many years, and I have files and folders everywhere of it, so I love it.*

Notably, even those without a specialist 'energy' or 'technical' background were able to knowledgeably describe and discuss different energy generation options.

As well as being generally energy literate, all interviewees had worked to become well-informed about PV in particular. Network maps, drawn during the interview, showed where or from whom interviewees had gained information about PV. On examining the network maps it was evident that around half of the interviewees were active hunters of information, carrying out their own exhaustive technical research, and often then passing information on to others in the community. The others, while still well-informed, largely relied on learning from others' expertise. These are described in more detail below as 'hunters' versus 'gatherers' of information.

#### Hunters

'Hunters' often had a technical background as an engineer or similar and had undertaken a considerable amount of research to source information about PV, often of a highly detailed nature:

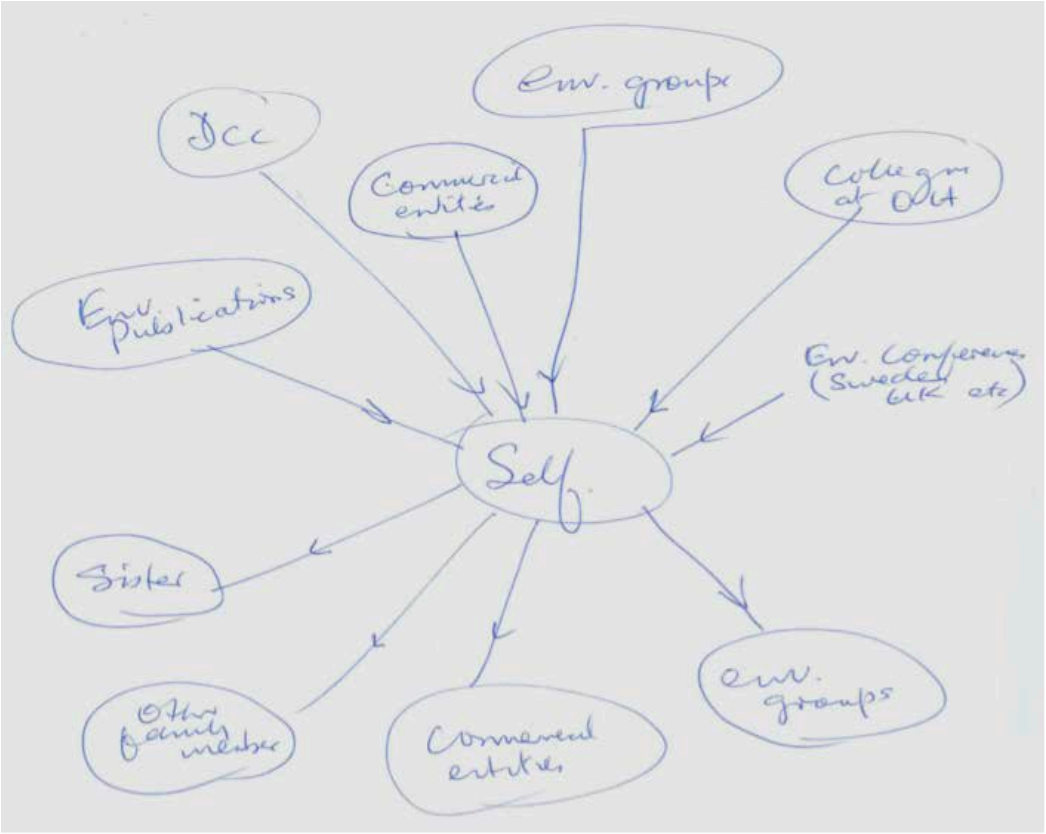
> *M: ...for many years I used to go to the library, and I used to look at books and things. But I think with the advent of the internet it allows people like me to do research. I talked about research papers, for example, I was looking at phase-changing materials as a latent heat source, and most of my research in that was basically downloading papers from people who had done research*

Figure 5 is an example of a hunter's network map, as drawn during the interview. This interviewee has sourced information on PV from environmental publications, commercial entities, environmental groups, international conferences, and colleagues at the University of Otago. In turn, he has passed on his expertise to other environmental

16 Even the person renting had installed solar hot water and insulated the property – and used plastic sheeting to double glaze the windows.

groups and commercial entities, as well as to family members. Interviewees 6, 7, 8, 13 and 16 could be classified as 'hunters'.

FIGURE 5: INFORMATION SOURCED AND PASSED ON BY A 'HUNTER'. SCANNED IMAGE OF A NETWORK MAP



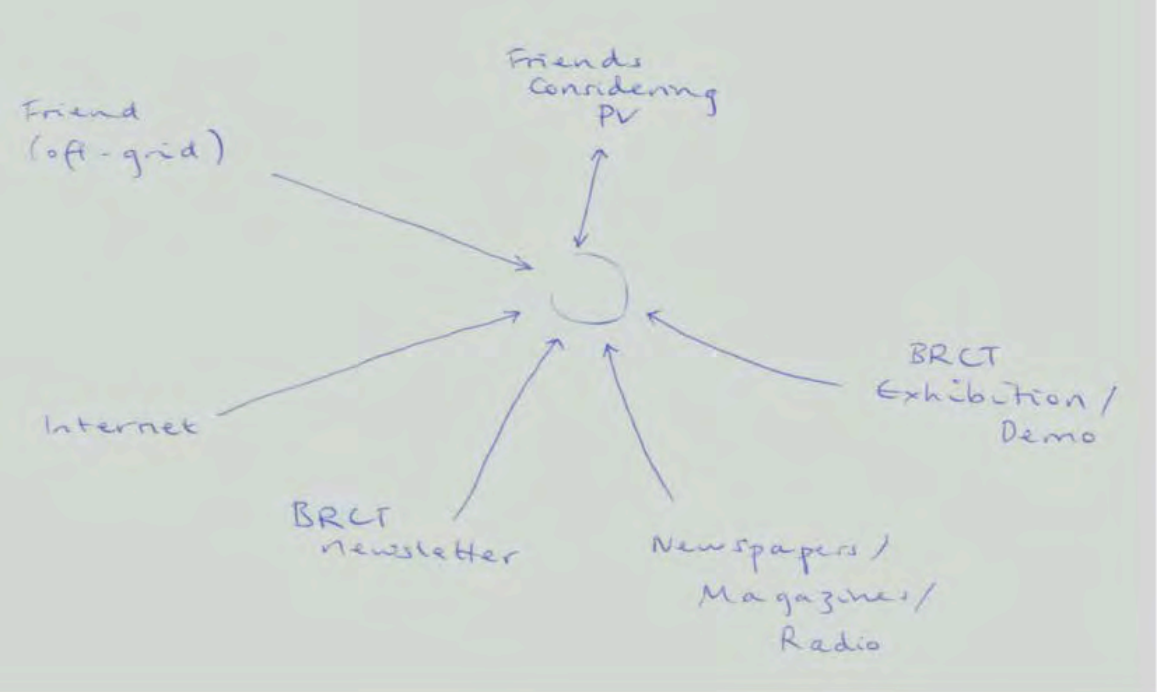

### *Gatherers*

Not everyone interviewed was spending their spare time researching PV, reading academic papers or attending conferences. Despite this, it was clear that interviewees had accessed a fair amount of information and could consider themselves well-informed about the topic. These interviewees had gathered information from a range of secondary sources, but these tended to be less technical. They also drew information from others in the community, more so than the hunters whose sources were more wide-ranging.

> *F: I've been to a couple of meetings down in the hall with the resilience trust here, and I'm on their email list. And I've rung up a few people to talk about it, I've discussed it a bit with Scott [at BRCT] and I've discussed it a bit with a couple of plumbers.*

Figure 6 is an example of network map of one of these gatherers. It shows that information has been gathered from the internet, media and conversations with a friend. Information distributed and exhibited by BRCT also plays an important role. This interviewee, as with many other gatherers, has shared information in conversation with other friends who are also considering PV installations.

FIGURE 6: INFORMATION SOURCED AND PASSED ON BY A 'GATHERER'. SCANNED IMAGE OF A NETWORK MAP




Interviewees 3, 5, 12, 17 and 18 could be classified as 'gatherers'.

### *5.3.3 TECHNICAL COMPETENCE*[17]

Several of the interviewees had 'technical' backgrounds, and it was often these interviewees who had also done considerable amounts of research (i.e. were 'hunters'), many becoming very credible experts in particular renewable generation topics.

> *M: I have taken a class in micro-hydro, so I do have some knowledge and have attended classes on different technologies.*

Some of the interviewees had designed and installed their own PV systems, and had the expertise to resolve potential issues.

> *M: As you're probably well aware, the solar panel system relies on the sun. So you get 90% of your generation in the day when you're not using it. So unless you change your wiring or the set up of your house to use that free electricity generation during that period, most of it's going to be fed back down to the lines company... What I am proposing is to have a small battery storage, which is calculated to absorb 80-90% of your excess from your day generation.*

> *M: I wired the house up, because it was a brand new house... I designed the electrical system for it to make it as low energy consumption as I realistically could.*

Those who work (or had worked) in engineering or other technical industries were also more likely to have friends and contacts who could offer expert skills and experience.

> *M: There is another bloke – a friend out on the peninsula... he's built a house, 15 years ago now, which was designed to make the absolute maximum use of resources. So he has two wind turbines, he has solar hot water heating, he's got photovoltaics, the whole scenario. In fact, he helped me put this unit [solar hot water] up here... He's technologically competent on a practical level, much better than I am really. And he comes from a TV/ Electronics background. He's been a source of information too.*

17 Technical competence differs from energy literacy in that a person may be very literate about different micro-generation options but not possess the technical knowledge or skills to set up a system.

Some interviewees were confident that they possessed the skills to take an active part themselves in the installation process.

> *M: Well, they're relatively straightforward as far as I'm concerned. And the way they can be set up now, that shouldn't be a problem. It certainly wouldn't be a problem for me: I've got enough technical knowledge to handle the most part of it.*

Though there was awareness that the process might require some effort and organisation on the part of the householder.

> *M: If I'm a cheapskate and say I want to do it as cheaply as I can, I've got to set aside a couple of weekends that will actually require me to reorganise the roof. You look at the roof and go – if I'm going to put PV on, I should paint it first. And I've got to wait until the summer. And, will I get it done this summer or not?*

The cost appeared to be seen as less of a barrier if the householder was able to take on some of the tasks of installation. Some of the more technically competent interviewees had enough knowledge and confidence to design systems, source components and install panels, thus not having to pay for as much outside support.

> *M: I think that hiring somebody qualified to do it... and once you have the funds to do it that would definitely be the best way to go. I think being a technical person I would try and be part of the process, to reduce costs as well.*

> *M: There's cost – the initial set up cost is exorbitant, but that's slowly coming down. And because I could design and install my own system I could do that at a lower cost.*

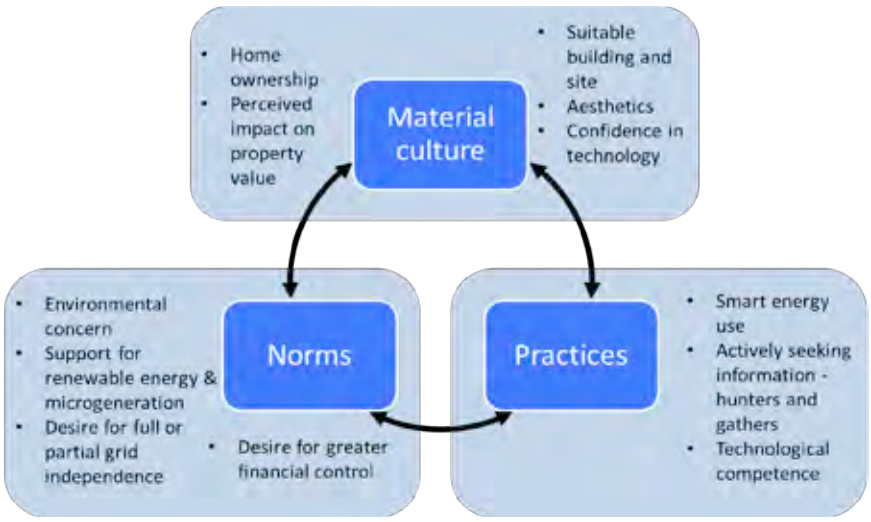
Of course, not everyone in the community had a technical background. While installation processes done by householders can make the whole process more affordable, it does not present a barrier if money is available to pay installers.

> *F: That's why if we do it, we've got to get someone in to set it all up. We don't have that knowledge and understanding and we certainly don't want to have to have a line-up of batteries and to have to be looking at meters and working out this and that. For us we've got to pay someone to do it to set it up and it's got to be a system that's very straightforward and easy.*

## 5.4 TYPICAL CHARACTERISTICS OF INTERVIEWEES' ENERGY CULTURES

It is clear that there were a number of characteristics that regularly appeared in the interviews that related to the norms, material culture and practices of the interviewees. These are summarised in Figure 7 below. It should be noted that many of these characteristics are strongly related, hence the arrows between norms, practices and material culture. For example, a desire for grid independence linked to the active seeking of information about PV, and in turn being better informed may increase or reduce the strength of the desire to adopt PV.

### FIGURE 7: TYPICAL CHARACTERISTICS OF THE ENERGY CULTURES OF INTERVIEWEES – NORMS, PRACTICES AND MATERIAL CULTURE



# 6. EXTERNAL INFLUENCES ON INTEREST IN PV

This section summarises the drivers (things that motivate people to want to install PV), barriers (things that prevent people from installing PV) and enablers (things that help people to overcome barriers to PV installation) that were evident in the wider context, and which were impacting on the interviewees' changing norms, material culture, and practices. These external influences are discussed below and summarised in Figure 8 at the end of this section in relation to the Energy Cultures framework.

## 6.1 DRIVERS

The key drivers of interest identified from the interviews were the rising cost of electricity and the decreasing cost of PV units. Each is discussed below.

### *6.1.1 RISING COST OF ELECTRICITY*

The ever-increasing cost of electricity was a key motivator.

> *M: Power prices have gone up 24% in three years, and they're going to go up more, now that they're selling them off. My philosophy is to be as sustaining and in control – as much I as can – of my own outlays.*

> *M: Thinking that electricity and future prices will probably continue to rise. It may not be economic today, but in the future it will become more economic, I believe. Just take a long term view and expect that prices will continue to rise at a few percent a year, and then in sort of 5 or 10 years time it will look like paying back.*

A couple of interviewees with PV installed had set up off-grid systems as part of their house building process. Their decision to go off-grid was explained as being driven by the cost of connecting the houses (in relatively remote areas) to the network. Installing an off-grid PV system was seen as a relatively comparable cost to connecting to the grid, and a more desirable set-up.

> *M: Because the cost of me designing and installing and putting my own off-grid system in was almost the same as having power put on site, the cost would have been the same. And I'd prefer to go down the route of generating my own power.*

> *M: I've always been interested in alternative energy, but what got me into it was – when I shifted to the house which I live in, I got a price for putting the connection onto the network. The price for the connection was quite dear, and that forced me to look at the alternatives.*

### *6.1.2 REDUCING COST OF PV*

The reducing price of solar panels was a significant driver of interviewees' interest in solar panels. They were aware that the price of solar panels had dropped significantly in the past few years.

*M: I'll give it to you straight. New Zealanders are tight fisted. They don't like spending money. It's a cost equation. Because there's a glut of PV panels on the world market at the moment, the price per watt is so low that it's economic for enough Kiwis to say 'yes, we can put this on the roof, the payback is right, it makes me feel good' – the feel good factor. If the panels shrink and then they stop producing them and panels go up another 30-40%, then you'll see the uptake of PV systems in New Zealand drop off again. It's an economic question.*

*MS: Because the price of PV has dropped so much, you can put in a system relatively cheaply and it will save money over time.*

*MS: I suspect that there are some people who are making the decision, and they are making it because there's the information and they're making it because it's relatively affordable and they can afford it and they're making it because there are trusted community members who they can go to - to either get materials or have installations.*

### 6.1.3 INCREASED UBIQUITY OF PV

The fact that PV was becoming more common and more visible was itself a driver as people saw that PV was in fact possible. Several interviewees mentioned that their experiences living or travelling abroad had led to increased exposure to PV technology.

*F: It's amazing when you go there [to Germany] and see what they have there compared to what we have here. Every house with a solar panel on its roof.*

*M: When I was in Australia, even within the last couple of years, the systems they've got over there – the photovoltaics run all their electricity and then when they're not using much electricity it's fed back into the national grid. And that seems like a good system to me.*

Within Blueskin Bay, the visibility of solar installations had also got more people thinking about the technology. It is well documented in behaviour change literature that people are more likely to uptake a new behaviour if they perceive that it is something that people 'like them' or around them are doing[18].

*M: When it's brought to your attention, when other people are doing it, and there are examples in your community of successful installations, you can't help but see things on roofs and go – I should do that!*

*F: So we moved to this area 10 years ago. We talked a lot about solar with our neighbours, about two years ago. That's right, that's how we first became interested in it. The house next door, they have solar, and they gave us the name of the guy on the peninsula that installed all the solar. And we talked a lot with them.*

*MS: I suspect the difference is building the momentum, and when the next lot go in in the next few months we will have a bit more momentum and I suspect that that will build a few more, and by that stage we'll have so many highly visible in the community that it will become self-fulfilling, we will just see install after install after install.*

## 6.2 BARRIERS TO PV UPTAKE

External barriers are those factors that may prevent people from installing PV. Predominantly, these were identified as the upfront cost of the technology, the lack of financial incentives, and the uncertainty about the future developments of the technology.

### 6.2.1 UPFRONT COST

Despite the improved affordability of PV, the initial financial outlay required to acquire a system appeared to be the only factor preventing most interviewees (those without existing systems) from immediately installing PV.

18 See for example, the Institute for Government's MINDSPACE report, available at: http://www.instituteforgovernment.org.uk/sites/default/files/publications/MINDSPACE.pdf

*M: I've been considering [PV] for many years actually. The environment and its degradation over the centuries, years, whatever, has concerned me for years. My background is in engineering... Now that I'm no longer earning an income, I'm only on superannuation, it's still out of reach financially, but I'd love to have one. A local power supply from the sun would be marvellous.*

While some interviewees had some doubts about other aspects, or may have lacked knowledge in certain areas, the strong interest expressed by interviewees indicated that these could be overcome or were not of significant weight to prevent an installation going ahead, if they could find the required disposable income.

Cost was a particularly big barrier for off-grid systems, due to the additional cost of battery banks and other equipment. This priced it out of reach for many households, despite considerable interest in independence from the grid.

*M: It's still, I think, the enthusiasts, the environmentally active enthusiasts are the ones [installing PV]. At the moment, even though the cost of photovoltaics is coming down, thanks to the over-supply in Europe, that's only part of it. You need to have your inverter, you need to have your battery system, and until they become more economic, you're still paying quite a lot of money just to get involved in it.*

Interviewees were asked to describe the kinds of people that might install PV. Some interviewees did not think it was possible to generalise, and saw PV (particularly since the drop in price) as something that anyone could install. Some felt that households that were better off and/or environmentally motivated would be more likely to install.

*M: [People] just interested in more alternative things. Some rich people do it. Well, you have to be rich to afford it. A lot of poor people would like to if they could afford it. More the greenies I suppose, would be interested.*

However, as noted earlier, the interviewees came from a wide range of income levels so lack of wealth was clearly not a limitation to being strongly interested in PV.

### 6.2.2 LACK OF FINANCIAL INCENTIVES

Financial incentives, such as feed-in tariffs or help covering up-front capital costs, were the most commonly cited ways that interviewees felt that the government could promote uptake of PV.

*M: Basically, I'm loathe to progress [with the PV installation] until I'm in a situation where I have a feed-in tariff. Otherwise I'm faced with either capital expenditure [on batteries] which is difficult to do, or a situation where most of the power that's generated, I can't use, because I'm away from the house most of the day.*

*M: The best thing that could happen from my point of view, is that the generators or the grid power people support electrical generation on the home front. There are two ways to do that. One is to provide a feedback tariff, so that any excess you get paid for. I believe that's starting now. The other thing that would be important to me would be if they supported it in terms of providing capital in some way, shape or form. Maybe that capital is going to be paid back out of rates, or some approach like that.*

*M: The biggest difference between here and other parts of the world is our FITS, our Feed-In Tariffs are shit. And our lines company, because they're private and they've got no government control, they have no motivation to support Feed-In Tariffs of a significant amount. So it makes it not really cost effective for the average person to have a grid connected system.*

A few interviewees suggested that government intervention should be used to encourage or require PV when building new homes.

*M: It should be almost mandatory, to a level, on new home builds.*

*F: I think all these new houses being built in Auckland, I actually don't know, but I'm assuming that they're not considering solar panels. And they should be. All new houses should be. I think that's the thing: if you've got a house, you may as well keep it as it is, but I think If you're going to build a new house, it {PV] should definitely be part of the building process.*

### 6.2.3 UNCERTAINTY ABOUT TECHNOLOGICAL ADVANCEMENTS

Though not an issue brought up by the majority, the speed of change in PV technology was a concern for a couple of interviewees, who were unsure if now was the right time to invest in PV.

> *M: Another question that people might ask is: is the technology going to be so much better in a few years time? So is it worth waiting a bit longer and saving up the money? Or is it worth putting the money into something else to save energy? It's all those little unknowns.*

One stakeholder mentioned that they thought that solar would become more economically viable as time goes on.

> *MS: As part of that I'd make sure I had a north facing roof and a wall somewhere and I'd put lots of solar panels up there too. And I would probably know that financially it's not going make sense, but I would do it from the ability of wanting to be a bit more independent, and thinking that electricity and future prices will probably continue to rise. It may not be economic today, but in the future it will become more economic, I believe.*

## 6.3 ENABLERS

Key enablers that were assisting interviewees to work past the barriers were tactics to improve affordability, increased ubiquity of PV, trusted information, facilitation of supplier/installer relationships, support to improve energy literacy and knowledge about PV, support to build technical skills and supportive social networks.

### 6.3.1 SUPPORTIVE SOCIAL NETWORKS

Social networks, through which people were learning about PV and energy generally, played a large role in developing their interest in PV and making the journey less daunting. This has been described in section 6 where people were encouraged to draw network maps of where they gained their information and support. Many interviewees also saw themselves as making PV more affordable through developing their own skills or using those of others in the area, so that the labour costs of installation could be reduced.

> *MS: We have a pretty good system going on here, with all the other guys in the village. They're helping each other putting them in…It's not that difficult – it's a bit of community work really.*

The support of the wider community was also crucial:

> *M: What also helps is sort of like a community sense. Like as in, a community getting interested. Like always when you're doing a job, you get sick of it, or something. When you're in a community, the community carries those dips of interest. Someone else comes along and it's just much easier to get ahead because things keep evolving, keep going.*

### 6.3.2 TRUSTED INFORMATION

Information from family, friends and acquaintances was a key source for many interviewees, and, as is very apparent in the network maps, they were actively involved in passing on information as well. Almost all interviewees were actively sharing their knowledge and discussing PV with family and friends, and in some cases with the wider public, interest groups or even commercial entities. Individuals in the wider Blueskin community appeared in the majority of network maps, and they (and BRCT) were regularly cited as the first 'port of call' for interviewees, if they were to have a question about PV. For many, this local information was a major reason that their considerations or installations had got as far as they had.

> *F: I'd still be thinking about [installing PV]. But it's definitely made it more accessible to get some information, because you know someone just down the road is focusing on it, and there's been quite a pool of people. So, it's definitely made it more accessible to try and get the information, and know that they're into it around here, and that it obviously can be done and that it works quite well. So that's probably helped a bit I think.*

The BRCT was also frequently shown on the network diagrams as a source of information, and this was also evident in the interviews.

*I: So in terms of information and keeping up with the technology then. What kind of sources of information do you use?*

*M: OK, I've been a bit lucky in that sense, because BRCT has had individuals researching the particular area, I've relied on that information. Otherwise, it would be web-based largely.*

BRCT information served to simplify options for households, meaning that they still had choice, but were not required to undertake extensive or complicated research. Exhibitions and meetings run by the BRCT also acted to demystify some of the processes.

*F: I think for a lot of people, that [BRCT solar] brochure has been really useful for them, because it tells you exactly where to go to get stuff installed, and to compare prices.*

*M: Yeah I went to one [meeting]. A couple of businesses brought out their systems and showed us how they were hooked up on the roof. That was interesting. It's very simple the way they are done.*

Even 'hunters', those conducting a lot of their own research, would speak to BRCT or others in the local area regarding some issues.

*M: I have found that if I'm looking for an electrical or electronics style stuff, then I predominantly source experts in that field, like electricians. The processes – Scott is a good example of someone who is involved in the processes.*

*M: I discuss [alternative energy systems] with my neighbour. My neighbour has solar and a very small hydro system.*

*M: The knowledge is easily findable. I could hook [a PV system] up if I need to. But the easiest way is to talk to other people in the village who have done it already and run systems.*

The kind of information provided by BRCT and local residents is not necessarily easy to access elsewhere.

*M: I can completely understand how baffling it is for non-technical people to try and wade their way through the internet to try and work out what sort of regulator to match with the type of batteries that they've got. Or what sort of regulator to match with their sort of solar panels, and what sort of inverter. And even inverters there's so much choice, whether you order: square wave, a modified sine wave, pure sine wave. What sort of rating? What sort of constant power rating? What sort of surge rating you require?*

### 6.3.3 SUPPORT TO BUILD ENERGY LITERACY

As part of its activities over the past 5 years or so, BRCT have made deliberate efforts to collate and disseminate information about energy efficiency, energy conservation and energy generation. Increasing energy literacy is an explicit aim of BRCT, with the website stating:

*"Our vision is to facilitate a positive, healthy, secure and resilient future for the communities of Blueskin Bay. This process has had three broad elements:*

*1. increase energy literacy (2007 - )*

*2. home energy effectiveness (2009 - )*

*3. renewable generation (2009 - ) BRCT website"*[19]

BRCT has offered free energy advice to members of the community, has run a series of energy audits, and distributes information via a regular newsletter. As well as this there is a well-developed and well-known project to establish wind turbines in the area. All of this has contributed to the energy literacy of the community. Discussions about PV are just part of the broader awareness-raising about different aspects of energy that result from the activities of the BRCT.

*F: ... I got insulation in my house all over, and the guy that was selling that was actually asking me about [PV] as well and gave me some information on it. So it went from there. And then the Resilience Trust.,. they mentioned it as well. It just keeps getting mentioned, really. Everyone's talking about it. And installing it. They had a course out here that was for installers as well.*

19 http://www.brct.org.nz/our-projects/community-energy-advice/past-present-future/

*MS: This is just an intuition, but I think if we'd tried to promote solar seven years ago we would have reached about three people. But what's happened since then is there's been an increase in energy literacy – a greater awareness of energy issues in the community.*

### 6.3.4 SUPPORT TO BUILD TECHNICAL SKILLS

BRCT also held meetings and workshops that aimed to increase the technological capacity of community members and thereby help them reduce the costs of installation. One meeting focused on how households can install their own systems. A SolarCity information/training workshop was also held in Waitati Hall to prepare local people to become qualified installers.

Running a training/information workshop led to an increase in solar literacy and expertise. Course participants were able to advise others in the community on different aspects of PV, with their greater knowledge around installation procedures to finance options. One participant became the main Blueskin solar installer.

*F: He's a solar installer... I know he did that course, and me and him talked about another way to finance solar.*

This level of technological learning does not appeal to all community members, however. One interviewee was actually put off from pursuing an installation in part, because of the perceived level of technical proficiency required.

*F: ...and then listening to the meeting, there were people there who were very knowledgeable and who knew what they were doing, but we didn't. We kind of felt that we didn't have enough knowledge. And apart from the money aspect as well, we didn't feel ready to commit ourselves*

### 6.3.5 FACILITATION OF SUPPLIER/INSTALLER RELATIONSHIPS

Although the BRCT was not itself actively involved in PV installations, it had done a great deal to facilitate awareness, affordability and ease of installation. Through information provided by BRCT, residents of Blueskin Bay had been made aware two initial installation options, both of which could make the installation of PV more affordable: bulk purchase of panels, or a special arrangement with the supplier/installer SolarCity[20].

BRCT also, importantly, made people aware of the costs involved, filling an information gap. So rather than residents assuming that PV was unaffordable, they were presented with the reality of how much it would all cost.

*F: They had a very good exhibition that they set up and moved through the various suburbs. And without commitment you could find out what you would be able to afford.*

*M: They've [BRCT] just made everybody a lot more aware of it. Before I talked to them, I thought it was just totally out of reach.*

*I: So what's been said that's made it feel more achievable?*

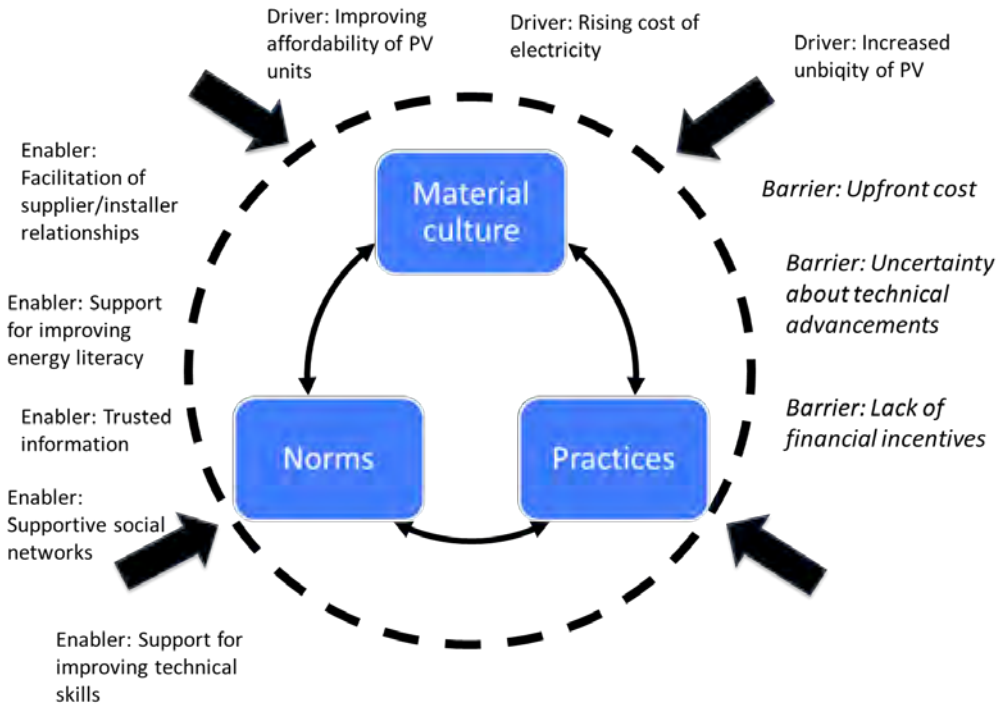
*M: Well there's been talk about the price coming right down, and the technology sounds like it's improving a little bit.*

## 6.4 SUMMARY OF EXTERNAL INFLUENCES ON UPTAKE

These drivers, barriers and enablers can be seen as a set of external influences on the energy cultures of the interviewees. For some, the barriers were still preventing them from taking up PV, but for others the enablers were assisting them to overcome these.

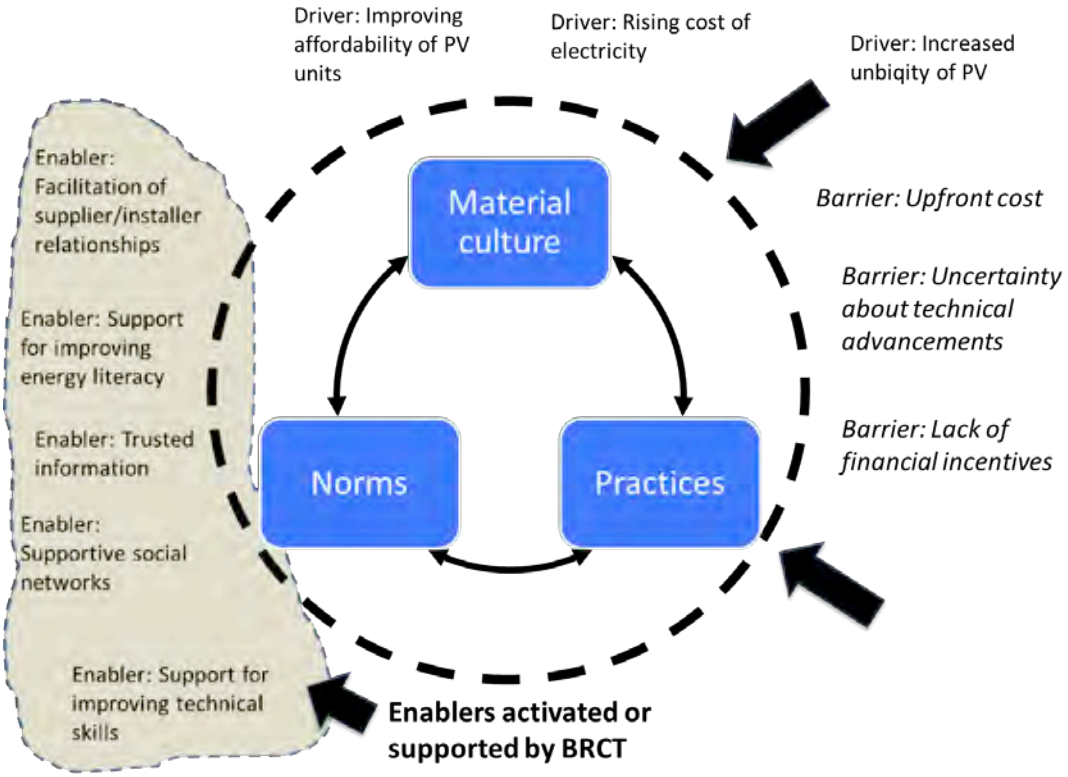
20 It is worth noting that only one household interviewed had sourced solar panels through either of these schemes, possibly because of timing – the BRCT flyer was produced in May 2013 and the opportunities for bulk purchases and the establishment of a local SolarCity installer began after this, and interviews were in December 2013. All other interviewees with PV installed had acquired panels from elsewhere prior to this, and had installed the systems themselves.

FIGURE 8: EXTERNAL INFLUENCES IN RELATION TO ENERGY CULTURES FRAMEWORK




Importantly, through its activities over time, the BRCT had positively influenced a number of the enablers, playing a key role in creating an ideal climate for the uptake of PV. Figure 9 below indicates the enablers in which the BRCT played a key role in establishing or supporting.

FIGURE 9: THE ROLE OF THE BRCT IN ESTABLISHING OR SUPPORTING ENABLERS



## 7. STAGES OF ADOPTION

Rogers's diffusion of innovation theory, touched on in section 1, would suggest that households would move through stages from not knowing about PV, to gaining initial knowledge, to forming an attitude toward the innovation, to a decision to adopt or reject, and to implementation.

In terms of these stages, those selected for interview had already indicated an interest in PV so were already aware of it as a technology (Stage 1). In terms of Roger's 'receiver variables', interviewees expressed desire for change and perceived that they may have a need for PV. His 'social system variables' were also supportive, with positive social norms relating to PV, and excellent communication channels. Positive Influences on attitude formation (stage 2) were also evident, including communication, perceived advantage of PV, observability of PV in the community, and sufficient information and support that PV was seen as not too complex. While PV was not directly trialable, community members could see PV being installed and in operation at the houses of others in the area.

The ongoing interpersonal engagement through BRCT and other social networks, including sharing information and technical assistance, supports positive outcomes for Rogers' stages 3 (decision to adopt) and 4 (implementation). Overall, in relation to Rogers' theory, the situation in Blueskin provides an ideal set of conditions for PV adoption.

## 8. CONCLUSIONS

We can learn a great deal from the Blueskin case study about the factors that support strong interest in and uptake of PV. Of the face of it, the Blueskin area does not seem to be particularly suited to PV – the households are not particularly well off, the climate is not particularly sunny, and there are no subsidies or other direct incentives for uptake. However the interviews (and subsequent evidence of a far higher level of uptake in this area than elsewhere in the local electricity network) show that these are not barriers to adoption.

The interviewees' energy cultures – their norms, material culture, and practices – may have predisposed them to be early adopters of PV. Additionally, external influences, which could have created a low interest in PV, were made less daunting by local collective action. Where technologies are new to a market, their uptake can be low because of lack of knowledge, but this barrier was addressed through the information 'hunting' and 'gathering' activities of the interviewees, aided by the work of the BRCT. Other barriers such as affordability and uncertainty had also been addressed in innovative ways through the activities of the BRCT and other community members. This combination of circumstances created an ideal setting for driving interest in PV adoption in the Blueskin community, but may be replicable to other situations where there was a desire to stimulate uptake of PV. These are summarised in Table 5.

TABLE 5: ENABLERS TO IMPROVE UPTAKE OF PV

| Factor | Barriers | Enablers |
|---|---|---|
| The technology | • Perceived as unsuitable compared to alternatives<br>• Installation and maintenance seen as time consuming or costly<br>• Technology advancing quickly, causing households to want to wait | • Perceived as a suitable, reliable and effective option<br>• Installation and maintenance seen as easy and inexpensive |
| Upfront cost | • Upfront costs too expensive | • Upfront costs reduced through bulk purchase or paid back over time<br>• Householder involvement in installation |
| Information | • Lack of accessible information<br>• Decisions too complex | • Plenty of information available – in an understandable format<br>• Options simplified |
| Social norms | • No one in the community with PV systems<br>• Solar installations not seen as 'normal' | • Visible examples of PV within the local community<br>• Solar installations seen as 'normal' and desirable<br>• PV discussed in social networks |
| Energy literacy | • Low understanding of energy issues and renewable generation<br>• No exposure to alternative energy systems | • Good understanding of energy issues and renewable generation |
| Independence | • Content with current electricity source<br>• Little concern about future energy bills | • Evidence that PV can reduce direct costs of electricity<br>• Household electricity generation seen as realistic |
| Technological competence | • (Not a barrier, but can be an enabler if householders want to reduce costs by installing themselves) | • Provision of opportunities to increase skills and knowledge<br>• Strong support networks |

# APPENDIX A – BIBLIOGRAPHY

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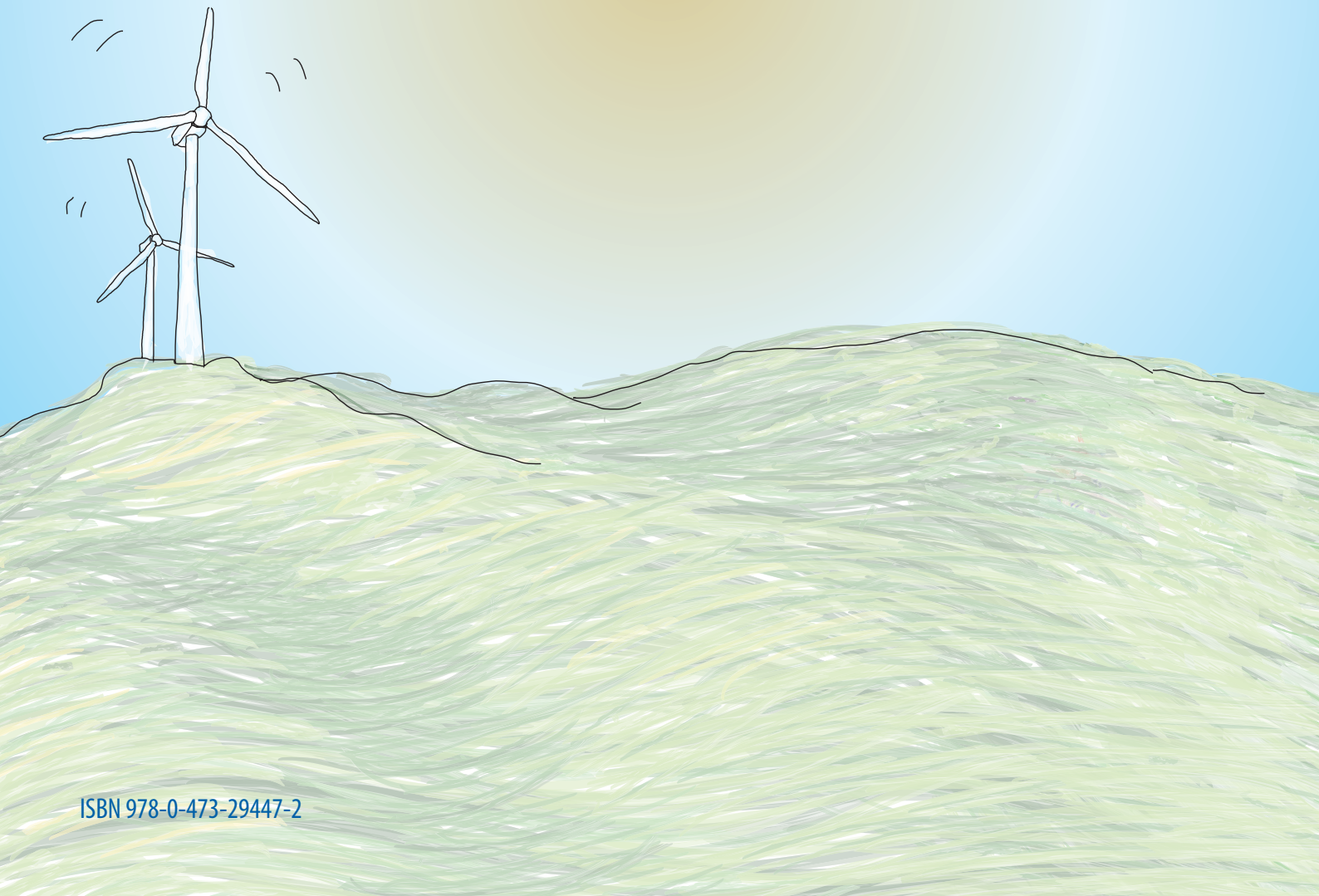

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