THE UNIVERSITY OF NEW SOUTH WALES

SCHOOL OF PHOTOVOLTAIC AND RENEWABLE ENERGY ENGINEERING

AN INVESTIGATION INTO CUSTOMER CAUTION IN PHOTOVOLTAIC MARKETS

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Abstract
In NSW at present there is no government subsidised feed-in tariff for electricity generated by photovoltaic systems. However photovoltaic systems emerge as cost-beneficial investments to owners who may use them to defer electricity purchase from the grid. This process requires a household to understand its own electricity consumption pattern as well as the generation profile of photovoltaic systems.

Issues arise as basic principles regarding electricity are not commonly known. End users do not understand the electricity purchase mechanism nor how they can choose the best photovoltaic product for them. End users who lose their sense of control in the purchase process disengage from the purchase process.

This report shall explore this issue and potential solutions. The results of this report indicate that consumers who have specific information concerns 'switch off' from dialogue in other areas. This implies that any retailer which does not identify the key information concerns of consumers significantly limits the technology education process.

Close to the completion of our report, data was released by the Renewable Energy Certifiers Agents Association which indicate that per-capita penetration of photovoltaic technology is twice as high in rural Australia as in capital cities. This data opposes the assumption that in 2012 the primary means of consumer education when buying technology products is internet based research. The report did little to explain the cause of this phenomenon.

This correlates with our study, which probed the impact of information deficit on the photovoltaics market. We concluded that information issues in the photovoltaics market are bi-directional. Consumers' poor understanding of technology issues is matched by a lack of shared information among industry organisations about the real and perceived needs of consumers. With no common industry solution, the overall market will remain constrained by a common inability to communicate the technology product to its potential purchasers, and the cost-beneficial finances of the technology shall remain largely unrecognized. A solutions strategy is tested and a method is proposed for future

direction.

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Summary of key findings:

Our first hypothesis, that lack of information is contributing significantly to customer caution and this is limiting uptake of solar energy systems, was supported by our data as true. Our second hypothesis, that current solutions-based customer information is penetrating slowly because priority has not been placed on addressing pre-existing motives of consumers, was supported by our data as true. Our third hypothesis, that the situation may be resolved if photovoltaic technology products are described in terms within a non-technical end users frame of reference, and thus their comfort zone, was supported by our data as true.

We attempted to determine a condensed yet comprehensive set of the information requirements of photovoltaic technology purchasers. We refer to these information criteria as our 'indicator set' We presented the indicator set to a young and highly educated sample group of 142 respondents.

- 65% of respondents indicated that our information set was an above average representation of their information requirements
- 8.9% of respondents indicated that our information set was a below average representation of their information requirements
- Respondents indicated that their satisfaction levels with all of the information indicators were poor
- Respondents indicated that if their satisfaction with information was low they would probably not purchase photovoltaic technology
- Certain issues appear to be 'barrier issues' - if information is not provided on these issues, respondents would not engage other relevant topics to the technology.
- We compared our results with a recent report indicating penetration of photovoltaics in regional areas appears to be approximately double that of penetration in Australian capital cities.
- We concluded that:
    1. a lack of suitable information limits the value of internet based research to consumers seeking to self-educate; and
    - a lack of knowledge about the real and perceived needs of consumers inhibits marketing strategies of the photovoltaic industry.

1 - Literature Review

1.1: Photovoltaics have passed a profitability barrier

The 2010 annual report of the Australian Photovoltaics Associations (APVA, 2011) predicted that electricity generated from photovoltaic systems would soon be cheaper than electricity from the NSW grid. Figure 1 below, drawn from the APVA report, gives visual representation of this prediction.

The latest report of the Australian Energy Market Commission (2011) on electricity price movements from 2011 to 2014 predicted the residential price of grid electricity shall rise to 31c/kWh in Sydney by the end of financial year 2012/13.

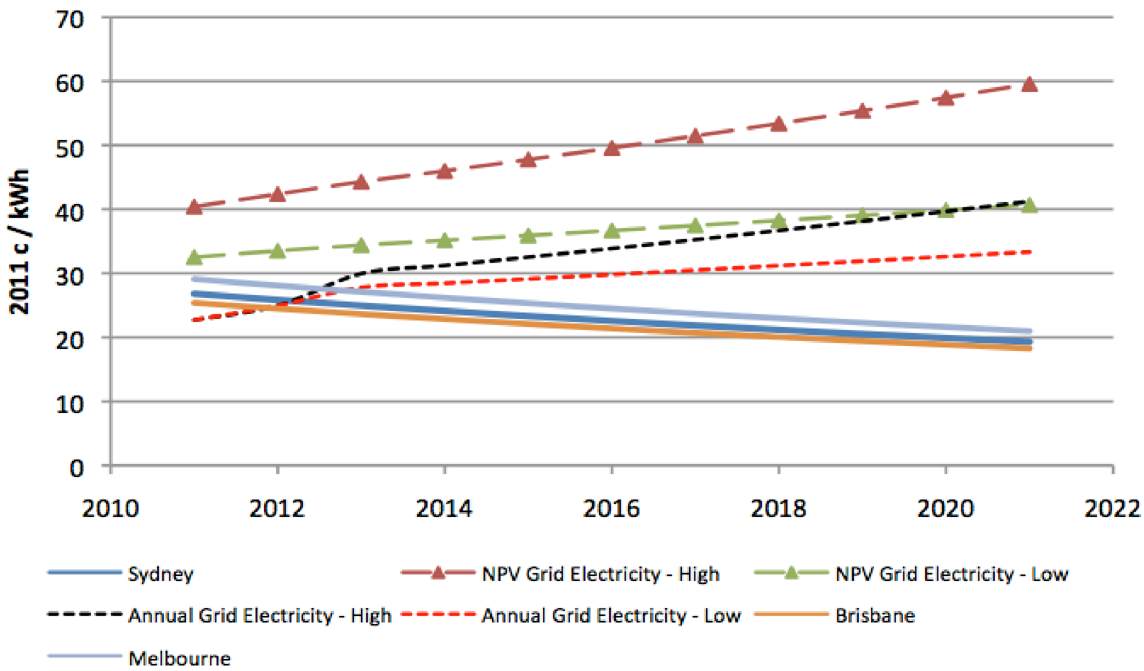


Figure 1 - APVA predictions of cost of electricity from photovoltaics vs cost of grid electricity

We note that a 31 cent price is in line with the APVA's "Annual Grid Electricity - High" case scenario, implying this shall describe NSW electricity prices in coming years. As photovoltaic module manufacturing costs continue to fall, the economics of residential photovoltaic systems are therefore already positive and only set to improve.

Simultaneously, the ongoing fall in photovoltaic module manufacturing costs continues. Bazilian et. al (2012) observed "The PV industry has seen unprecedented declines in module prices since the second half of 2008. Yet, awareness of the current economics of solar power lags among many commentators, policy makers, energy users and even utilities."

Promises of low-cost photovoltaic electricity are not limited to the theoretical. Advertisements for 1.5 kW photovoltaic systems include complete quotes of $1500.

Assuming a 1.5 kW photovoltaic system in Sydney produces 1700 kWh p/a and the AEMC price predictions hold true, such a system could have a payback periods of 3 or 4 years. The potential is extremely promising. Photovoltaic technology may help common households avoid rising electricity costs while promoting carbon-free electricity generation.

As a result of the improved finances of photovoltaic technology, potential end users increasingly include households operating for profit reasons who may have:

- little interest in or awareness of photovoltaic technology
- little interest in climate change
- little sympathy for a product which does not meet their personal needs.

This market is likely to require a higher level of product knowledge than households who invest for nonprofit reasons. Reaching this market will require an improvement to the existing information transmission regime.

1.2 Diffusion of Innovation

Several studies have considered Everett Rogers Diffusion of Innovations (2003) when studying the rate of uptake for photovoltaic energy systems. In his summary of Rogers work Nutbeam and Harris (1998) gave the following definition of diffusion and innovation.

Diffusion is defined as the process by which an innovation is communicated through certain channels over time among members of a social system. Innovation is defined as an idea, practice or object perceived as new by an individual.

Rogers classifies adopters according to the time it takes for adoption to occur. Innovators 2.5% of the population are the quickest to adopt new ideas and are usually young, of high social status, have high disposable income, sociable, highly educated and are risk takers; early adopters 13.5% of the population that are more mainstream but are the most accepting of change and have the means to adopt the innovation (these typically have the highest degree of opinion leadership – the gatekeepers); early majority 34% of the population have become persuaded of the benefits of accepting the innovation; the late majority 34% of the population are reluctant until the benefits have been clearly established; the final 16% who are the most conservative or resist uptake of new ideas.

Rogers suggests that the innovation process is essentially an information-seeking and information-processing activity in which the individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation. He identified five main steps in the process: knowledge, persuasion, decision, implementation, and confirmation, and placed prime importance on the role of knowledge as the means to persuasion.

Rogers states that different innovations can take very different time periods to reach the majority of the target population and emphasizes the important of the change agents (gatekeepers) who facilitate the adoption of change in communities.

Several studies have explored the application and relevance of the Diffusion of Innovation theory to explain uptake of photovoltaics.

A study by Abram Kaplan (1998) found that among the utility sector the decision process for the groups which took up pv technology and those which did not was different. Whilst technical knowledge and information was sufficient for the 2.5% of the population classified as innovators, these were insufficient as a sole or primary precursor of interest among the remaining 97.5%. Kaplan argued that something called ‘familiarity’, defined as how confident and comfortable one feels about something, has an important role to play in adoption of new technologies, and proposed a revised conceptual model to help potential utility adopters reach a positive decision about solar electricity.

A more recent literature review by Negro et al (2011) of renewable energy technologies notes their very slow penetration worldwide despite many years of public efforts and government investment. The study observes that government plays a dominant role in stimulating transformation in order to reach societal goals and bring about transformative change. Policy makers lack technological knowledge and entrepreneurs lack the ability to formulate uniform messages about what supports they need from governments.

One hypothesizes that consumers also lack technological knowledge and pv retailers lack the ability to formulate uniform messages about how pv can benefit the consumer.

Tapaninen and Seppanen (2008) investigating slow uptake of adoption of wood pellet heating in Finland conducted a study of 154 people attending a housing expo which indicated that customers' knowledge and personal attributes do matter in promoting demand for new technology. They found a clear variation in knowledge of pellet wood heating among potential consumers and recommended that managers give more consideration to knowledge as a first stage in the innovation decision process.

1.3: Economic assumption of rationality

A reasonable assumption may be made by government policy makers as well as manufacturers of photovoltaic system components that - should a photovoltaic system be produced that is economically viable, a market should exist for the product. Barriers exist with this assumption.

Au & Koffman (2003) discussed a model for technology adoption and investment, specifically focussing on the Rational Expectations Hypothesis. Specifically; "rational expectations and adaptive learning assume that decision-makers are able to utilize all available decision-relevant information efficiently and can learn the true value of a prospective investment over time". It is an essential point that at present, common household decision makers are not able to utilise all available decision-relevant information.

This information is possessed by technology salespeople. There is no reason why the salesperson with the highest understanding of products should be the salesperson with the most competitive product.

A household decision maker may remove sales representatives from the technology education process in order to gain impartial understanding of photovoltaic technology. The time and effort involved in the process may be considered part of the upfront investment cost of photovoltaic technology.

Alternately a household decision maker may be educated by a salesperson in such areas as the sales representative chooses to provide education. It is possible to purchase a photovoltaic system by being guided by a single sales representative who possesses all relevant knowledge. A technology purchaser who uses this method inherently loses all marketplace mobility.

The assumption that customers should purchase photovoltaic systems if such systems are truly cost-beneficial investments is thus invalid.

1.4 An information vacuum

In order to help keep readers up-to-date in the field, each issue of the scientific journal 'Progress in photovoltaics' contains a literature survey highlighting key advances in the field. The survey includes journals from IEEE Transactions on Electron Devices, Journal of Applied Physics, Applied Physics Letters, Progress in Photovoltaics, and Solar Energy Materials and Solar Cells. The scholarly articles discussed are mostly technical papers discussing advances in manufacturing processes.

Of 6 literature reviews in 2012, only one paper discussed end user education or diffusion of innovation. The paper by Mani & Shringra (2011) discusses lessons from successful technologies such as mobile phones or intel computer chips. An interesting comment is included in the conclusion of this paper under the heading of "key recurring themes". The advice given to PV manufacturers is to "Communicate to the customer’s customers", that is, the public.

In many cases the only companies large enough to resource customer awareness programs shall be the module manufacturing companies. It is therefore interesting that the only author of a paper on diffusion of innovation strategy able to make the 2012 cut of the literature survey of a key industry journal sought to highlight the need for manufacturers to pay attention to final end users of photovoltaics technology products.

Research into customer caution barriers has occurred. However because this research has occurred commercially rather than academically, the results are not publically available. For example - Drury et. al (2011) discussed how a lack of customer education could be overcome using third-party ownership utilities. Drury highlighted that "Third-party companies can also reduce or eliminate technology risk and complexity, which is frequently found to be a primary concern for potential customers (SolarTech, in preparation)" The reference paper referred to by Drury exists. However this paper is not listed on sciencedirect or scopus, and the URL access link to the paper is by SolarTech authorised access only.

1.5 Security and engagement

Avoiding fear, including fear of the unknown, is a basic human drive, as categorised by Maslow (1943). As indicated in Figure 2, human operation may be simplified into the fulfillment of various drives with priority given to lower-order requirements.

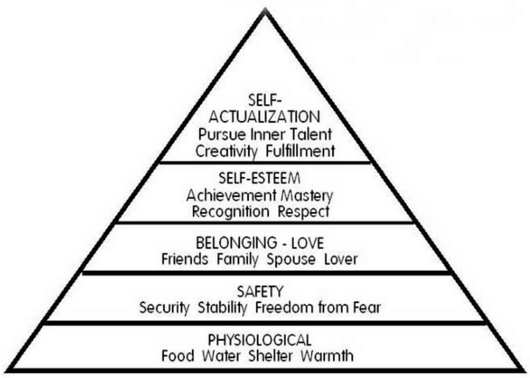


Figure 2 - Maslow's hierarchy of needs

It can be safely assumed that for most end users, exploring means to lower electricity bills shall receive less psychological weight than ensuring safety and security. An end user must perceive that the disorientation discomfort of engaging new technology will be sufficiently offset by the effectiveness of the technology.

1.6 Impacts of Ambiguity & Risk

Barham et. al (2012) highlights ambiguity as a separate concept to risk. Barham highlights "We define uncertainty to be made up of two components, risk and ambiguity, distinguishing between risk and ambiguity aversion as do Klibanoff et al. (2005). Risk aversion is the aversion to a set of outcomes with a known probability distribution. Ambiguity aversion is the additional aversion to being unsure about the probabilities of outcomes. In addition to risk aversion (Pratt, 1964), ambiguity aversion (Ellsberg, 1961), (Halevy, 2007) also appears to be a common characteristic of economic behaviour."

An uneducated individual considering a photovoltaic system without sufficient technology research would surely feel ambiguity about many criteria of the system. Indeed, turning this ambiguity into risk would be one of the primary achievements of successful customer education. A customer who then felt that these well-defined risks were acceptable and that the technology is cost beneficial for them is likely to purchase the technology product.

However research effort is also involved, and this presents a separate barrier. In The Effects of Effort and Intrinsic Motivation on Risky Choice, Kivetz (2003) tells us "when rewards are contingent on complying with an effort stream, consumers' preferences shift in favor of sure-small rewards at the expense of large-uncertain rewards. It is important to note that these results were obtained regardless of whether or not a no-choice option was available."

This correlates with commentary made on the photovoltaics sector by Faiers & Neame (2005). Faiers & Neame proposed evidence that creating positive economics for photovoltaic systems by no means assured customer expectations should follow this expectation. They found that "Solar power is an innovation in the UK but the current policy of stimulating the market with grants is not resulting in widespread adoption. . . if consumers cannot identify the relative advantage of solar power over their current sources of power, which is supplied readily and cheaply through a mains system, it is unlikely that adoption will follow."

Reddy & Painuly (2004) undertook a 2 year study with intent to "provide evidence of how the consumers receive RET information and make decisions using their limited analytical capabilities. The analysis is used to enhance the knowledge by introducing ideas based on behavioural theory. Not only do these ideas help understanding the consumer perspective, they also help develop policy interventions. The aim is to define each barrier and describe its mode of influence that will help to develop policy measures for the removal of each barrier."

The threat of disoriented end users disengaging from technology products applies to photovoltaic technology and must be addressed.

1.6 Existing solution - Display Systems

Display systems, referred to as DT's (display technologies) are a solution used in technology development to promote awareness among various key stakeholders of emergent technology. However, this process is far from being an organized concrete process and depends inherently on the awareness of project planners upon the conception of the project.

When Hendry, Harborne and Brown (2009) undertook an organized evaluation of display technologies (DTs), the authors commented on the limited literature in this field, indicating "such an analysis has rarely, if ever, been attempted." The authors criticised other works which had been published academically on the topic indicating "Evaluation is more typically concerned with the perspective of the funding agency.. Public evaluation of European programmes in PV typifies this shortcoming."

Importantly, the authors found a "need for a clear separation between technical experimentation and promoting market diffusion and commercialisation". This is relevant as the aims of DT systems must be determined ~before~ the Display Technology is implemented.

When we consider the commentary of Brown & Hendry (2008) that "Many innovation studies have examined processes at the early research and development stages, but little attention has been given to the ‘preview’ phase when users and support systems interact with emergent products, to refine the commercial offering". we see an information vacuum at the commercialization stage.

Thus, to be effective a Display Technology project must be well informed at its conception regarding the deliverable outcomes the project must have - such projects thus cannot be relied upon solely as a vector to enhance the education of the industry and the public. Information must be collected and presented in an organised manner such that Display systems and R&D may proceed in effective and co-ordinated partnership.

1.7 Existing Solution - Third party ownership

Drury et. al (2012) examined third party ownership companies as a means of resolving end user technology awareness issues. Companies operating in california assisted technology penetration by " reduce or eliminate up-front adoption costs and obviate the need for customers to acquire project financing. Third-party companies can also reduce or eliminate technology risk and complexity ... by monitoring and maintaining PV performance

Drury found that "the entrance of third-party business models in southern California residential PV markets has enticed a new demographic to adopt PV systems that is more highly correlated to younger, less affluent, and less educated populations than the demographics correlated to purchasing PV systems. By enticing new demographics to adopt PV, we find that third- party PV products are likely increasing total PV demand rather than gaining market share entirely at the expense of existing customer owned PV demand."

An interesting sidenote found in this study was that "mean population demographics are good predictors of third-party and customer owned PV adoption, and mean voting trends on California carbon policy (Proposition 23) are poor predictors of PV adoption."

These papers indicate the presence of information barriers obstructing photovoltaic technology penetration - thus the comment on poor correlation between support of anti-carbon initiatives and photovoltaic technology adoption is interesting.

1.8 Theory of Consumption Values

Finally one explores why consumers make the choices they do. Seth et al (1991) offer a theoretical framework which identifies five consumption values influencing consumer choice behaviour and is applicable to choices involving a full range of product types including industrial goods.

The paper suggests that consumer choice is a function of five independent, multiple consumption values; and that these make differential contributions in any given choice situation.

Functional: value through capacity for functional, utilitarian or physical performance.

Social: value through association with one or more specific social groups.

Emotional: value through capacity to arouse feelings or affective states.

Epistemic: value through capacity to arouse curiosity, provide novelty and/or to satisfy a desire for knowledge.

Conditional: value as a result of a specific situation or set of circumstances facing the choice maker.

It is important that the photovoltaic industry better understands consumer choice behaviour and what motivates consumer choice so strategies can be developed that satisfy real and perceived needs of the market.

2 - Proposed solution strategy:

Buying a television or car is a common process. It is common to ask what safety features a model of car possesses, or how many pixels per square inch a digital screen holds.

A customer in a marketplace who possesses the correct questions has a powerful tool. If a customer has sufficient confidence that they are asking the right questions, and that a retailer will exist who can prove their product meets the expectations of these questions, it is probable the customer will acquire a product that meets their needs.

This principle could play a very effective part in assisting information transmission in the PV marketplace. A unified information framework may be built by simply informing consumers of a set of effective and valid questions with which to compare the quality of different suppliers. This question set may become the most efficient information transmission model.

3 - Method:

This study developed through the investigator's association with a leading photovoltaic module manufacturer. The company had offered the university a partnership opportunity for five undergraduate students to perform their honours thesis.

The company had identified fifty questions that were frequently asked by potential technology purchasers to it's customer service department. One purpose of the association was that the undergraduate students would write a series of technical papers to address consumer concerns; another was to provide opportunities for the students to explore issues identified in the list of questions.

The investigator of this work themed the questions according to expected customer motivation and six categories (indicators) worthy of further exploration emerged.

The six indicators were presented to 15 people outside the industry who represented potential consumers to test whether they represented a valid and comprehensive description of information requirements that reflected the issues and concerns that potential customers may hold.

Based on this feedback, a formal research protocol was designed in consultation with university and industry supervisors.

The main aim of this study was to test the following hypotheses:

- Lack of information is contributing significantly to customer caution and this is limiting uptake of solar energy systems.

- Current solutions-based customer information is penetrating slowly because priority has not been placed on addressing pre-existing motives of consumers.

- The situation may be resolved if photovoltaic technology products are described in terms within a non-technical end users frame of reference, and thus their comfort zone

When developing the research protocol, it was planned to work with 40 people who had expressed an interest in potential purchase with the company. The six indicators would be presented to them along with solutions papers addressing the issues associated with the six indicators. It would then be noted whether access to this material affected their opinion of their potential purchase behavior. Participants would benefit from access to detailed purchase information.

A survey was designed to measure:

- basic demographic information;
- whether participants had already purchased the technology and if so why;
- if people had not purchased what issues were relevant and whether information on these issues was readily available;
- financial and information barriers to potential purchase
- the effectiveness of the six indicators in identifying the concerns of participants with regards to potential purchase of photovoltaic technology.

The survey was pre-tested on 6 volunteers known to the investigator and amended in line with feedback. An application to the UNSW Ethics Committee (Panel H) was written and submitted on 30 May 2012 for the meeting on 10 June 2012. Acknowledgement that the study was approved, subject to some minor changes to the participant information sheet, was received on 29 June 2012.

During the early progress of the research, advice was received from the company that access to potential purchasers was not possible and given the time constraints required for the thesis deadline, the study protocol was adapted. The research base for the survey was expanded to the general population which included people who were not at the contemplation or action stage of purchase of a solar system. In addition the investigator observed from interaction with early research participants that the general public, not being as interested in the topic as an active customer, was not willing to allocate time to read papers and discuss issues. The general public has little awareness of photovoltaic technology and the unusual and technical nature of the subject causes many respondents to feel unfamiliar, tense and thence disengage. As compensation cannot be provided for involvement, the survey practice had to adapt to reduce time intensiveness.

At this time, it was also determined appropriate not to pre-empt the findings of the study by writing solutions papers until there was greater clarity regarding the issues being investigated by the study.

Survey forms were printed and distributed to family, friends and work colleagues of the investigator. In addition the investigator approached members of the community at three public locations in Sydney: Circular Quay, Kirribilli and Parramatta. The survey was entered into the web-based survey client “Survey Monkey” and also uploaded onto a facebook site for a two week period. There were no incentives given to participants to participate in this research.

95 survey forms were collected by paper and a further 70 responses were collected electronically. 23 of these were determined invalid because the responses were more than 50 percent incomplete. Responses were entered into the “Survey Monkey” program in order to collate the data in one pool for analysis.

Research questions to test the 3 hypotheses were:

1. Does customer caution exist?
2. To what degree is this finance related?
3. To what degree is this information related?
4. Are other factors present?

It is assumed that, for research questions 2, 3 and 4 respondents self-reported opinions are an accurate reflection of the real impact of these factors.

Research question 1 (by definition) asks respondents about a topic on which they may have limited or no knowledge. Therefore a self-reported opinion is a poor test measure. Research question 1 is therefore tested using compared results from a range of indicators more suited to self-reported reponses arising from a direct single stage survey.

To resolve research question 1 it was decided that the following approach should be used:

The first requirement of a proof is a definition. In this case, customer caution shall be defined as any circumstance in which a potential product purchaser indefinitely defers purchase of a product as a result of a specific range of solvable concerns - which, if addressed, shall result in the purchase of the product.

Resolving this requires
- Definition of a potential product purchaser
- Definition of the purchase process
- Definition of the barriers to purchase, and the severity of each.

A potential product purchaser shall be defined as a person who
- Can finance the purchase of the product
- Has the facility to make use of the product
- Will sufficiently profit from the product to justify its purchase

The definition of the purchase process is that the consumer must take the following actions:
- Determine that the benefit of the purchase shall outweigh its cost
- Determine that the benefit of the purchase shall outweigh competing investment options
- Allocate finance for the purchase

However, as stated above in Background 1.1, the finances of photovoltaic technology are quite positive in Sydney NSW at present. For any marketplace in which photovoltaics are a rational investment decision based on deferring electricity purchase, the potential sources of customer caution must logically be the process of information gathering, information comparison, and finance.
We have defined potential product purchasers and the purchase process. We must now define what 'specific range of solvable concerns' might constitute barriers to purchase. The list of barriers to purchase must meet the following criteria:

- Each indicator must be unique.
- Each concern must be sufficiently significant that it may present a barrier to purchase.
- The list must be comprehensive.

It is noted that customer queries directed to a photovoltaic module manufacturer represent an attempt by customers to check their limited and potentially incorrect perception of photovoltaic technology against the advanced education of the photovoltaic module manufacturer. It is also noted that these queries highlight that technology purchasers have demands for a minimum level of technology awareness necessary for investment in the technology.

Customer service FAQ lists represent a validation of several of these queries by the highly educated manufacturer as effective queries which efficiently guide customers toward important and relevant information. The FAQ lists represent recognition by photovoltaic module manufacturers of the customers need for information - as well as a commitment by the manufacturer to provide this information.

Therefore the list of six indicators are presented as a comprehensive set of customer concerns. The survey results will test this assumption.

The six indicators which described all 50 FAQ queries were:

- "I want to access transparent and trustworthy information I need for a cost-benefit decision."
- "I want to know what key criteria I should use to compare suppliers."
- "I want to know how likely it is my system might not deliver promised output."
- "I want to understand the risks and/or benefits a solar system will have on my house"
- "I want to understand my legal protections as a consumer"
- "I want to have all the technical information I require."

4 - RESULTS & DISCUSSION

4.1 Demographics

Approximately a thousand people were approached with this survey. Of this, 160 people began the survey. 142 of these respondents completed the survey paper. The demographic of the respondents was young, highly educated and wealthy. Of the 138 Australian respondents all but 5 lived in Sydney. The postcodes showed a concentration in the inner city and inner west. 17 respondents had purchased photovoltaic systems.

42 respondents were identified as 'decision makers' - who own or pay the mortgage on their residence and who live in houses or semi detached houses, and thus could choose to invest in photovoltaics if convinced of the value of this technology investment.

4.1-1: Age category of respondents

Category:	18-24	25-34	35-44	45-54	55-64	65+
Distribution:	28.0%	30.4%	10.6%	17.4%	11.8%	1.9%

Table 1 - Age

Table 1 indicates 58% of respondents were below the age of 35. The youth of the sample size, implies that many of the respondents who fail the above criteria - that is, they could not at present make the decision to purchase photovoltaics - possess the potential to become decision makers in future.

4.1-2: Education level of respondents

Category:	School certificate	Higher school certificate	Trade qualification	Bachelor degree	Post-graduate degree
Distribution:	3.2%	23.4%	12.0%	44.3%	17.1%

Table 2 - Education

From table 2 we observe 61.4% of respondents had a university level education. This was expected as diffusion of innovation theory presents photovoltaic technology in the domain of innovators with potential to expand to the early majority. We would expect people with higher education levels to engage surveys on this sort of topic. The investigators family and their workplace associates also tend to be tertiary educated.

4.1-3: Sex

The survey was attempted by 87 female respondents and 76 male respondents, of which 78 female respondents and 68 male respondents completed the survey. Of this number, 67 female respondents and 63 male respondents reported they had not yet installed a photovoltaic system. 11 female respondents and 6 male respondents reported they had already installed a system.

4.1-4: Household income of respondents

Category:	$0-$25,000	$25,001-$45,000	$45,001-$65,000	$65,001-$85,000	$85,001-$105,000	$105,000 and up
Distribution:	17.8	14.5	16.4	11.8	11.8	27.6

Table 3 - Income

The household incomes of respondents were also fairly high. More than 50% of respondents indicating household incomes in excess of $65,000 as indicated in table 3. This may be a corollary result of the education levels of respondents. This result also indicates that at present those households on lower incomes may not perceive photovoltaics as an effective cost-saving technology - or that these households are risk averse and do not wish to invest heavily in technology perceived as uncertain.

4.1-5: Property ownership

Category:	Rent	Mortgage	Own	Living with family/ friends
All respondents:	30.1%	21.5%	17.2%	31.3%
Have photovoltaic systems	5.9%	5.9%	17.6%	70.6%
Without photovoltaic systems	31.5%	25.4%	16.9%	26.2%

Table 4 - Property ownership

As the response was only presented to adults, very few respondents were expected to be dependants. On this basis it was assumed that respondents who did not 'live with family or friends' had a role in paying rent or the mortgage of their home. From table 4 we note 70% of the respondents who had photovoltaics installed on their home are 'living with family/ friends' and therefore most likely excluded from the decision making process. Figure 3 visually depicts the breakdown.

We therefore focus our attention upon those respondents who have not yet had photovoltaic systems installed upon their residence and note that 38.7% of respondents would be expected to be contributing to the rent or mortgage or were property owners. It is important to note a further breakdown of this data.

4.1-6: Dwelling

Figure 3 - Property ownership (no PV)

Category:	Free standing house	Semi-detached house	Villa/ duplex	Apartment
All respondents:	55.6%	6.3%	6.3%	31.9%
Without photovoltaic systems	47.7%	7.0%	7.8%	37.5%

Table 5 - Dwellings

The two major housing types demonstrated in the results of table 5 were free standing houses and apartments. One of the key unexpected results of this survey was the impact of apartment dwellings upon photovoltaic technology uptake. A number of respondents indicated in open feedback sections of the paper a frustration at a lack of ability to explore photovoltaic technology because of equity and strata issues.

The following three demographic notes are relevant as they highlight the opinion-value of non-decision makers surveyed, based on the overall youth of respondents and the potential of respondents to transition to become potential technology purchasers in future.

4.1-7: 'Living with friends/ family' demographic comment

Age:	18-24	25-34	35-44	45-54	55-64	65+
Distribution:	30	17	0	2	2	0

Table 6 - Age of 'living with family/friends' demographic

When we extract the 'living with friends/family' demographic as per table 6 we observe 92% of respondents in this category are in the lowest two age demographics with twice as many respondents in the 18-24 bracket as the 25-34 bracket. Therefore in the next 5-10 years most of the existing respondents 'living with family/friends' are expected to transition toward property ownership, and be potential decision makers.

4.1-8 Apartment demographic

Age:	18-24	25-34	35-44	45-54	55-64	65+
Distribution:	16	18	6	7	4	0

Table 7 - Age of apartment residents

The overall trend the survey sample toward young respondents extended to apartment dwellers. Table 7 above and table 8 below tabulate the age and property ownership of apartment dwellers. 70% of respondents living in apartments either rent or 'live with family/friends' indicating the three categories share a single group of respondents.

Table 8 - property ownership of apartment residents

Category:	rent	mortgage	own	live with family/ friends
Property ownership (number):	30	13	2	6
Property ownership (%):	58.8%	25.5%	3.9%	11.8%

4.1-9: Dwelling type of respondents who rent

Table 9 indicates that 62.5% of respondents who rent live in apartments. In combination with previous results this indicates that of our response sample, the apartment dwellers, rent payers and dependents formed a set which frequently overlapped.

Table 9 - Dwelling types of rent-payers

Residence Category:	Free standing house	Semi detached house	Villa/duplex	Apartment
% of renters living in this category of residence:	25.0%	8.3%	4.2%	62.5%

The connection of these groups will be discussed later in reference to statements made by apartment dwellers that they were interested in, but unable to explore, photovoltaic technology.

4.1-10: Country

Figure 4 - Country of residence

136 participants who began the survey were Australian and 18 international respondents used the facebook electronic survey to submit responses. Figure 4 highlights the distribution of country of residence among international respondents. None of the international respondents had already purchased photovoltaic systems.

4.1-11: Postcode

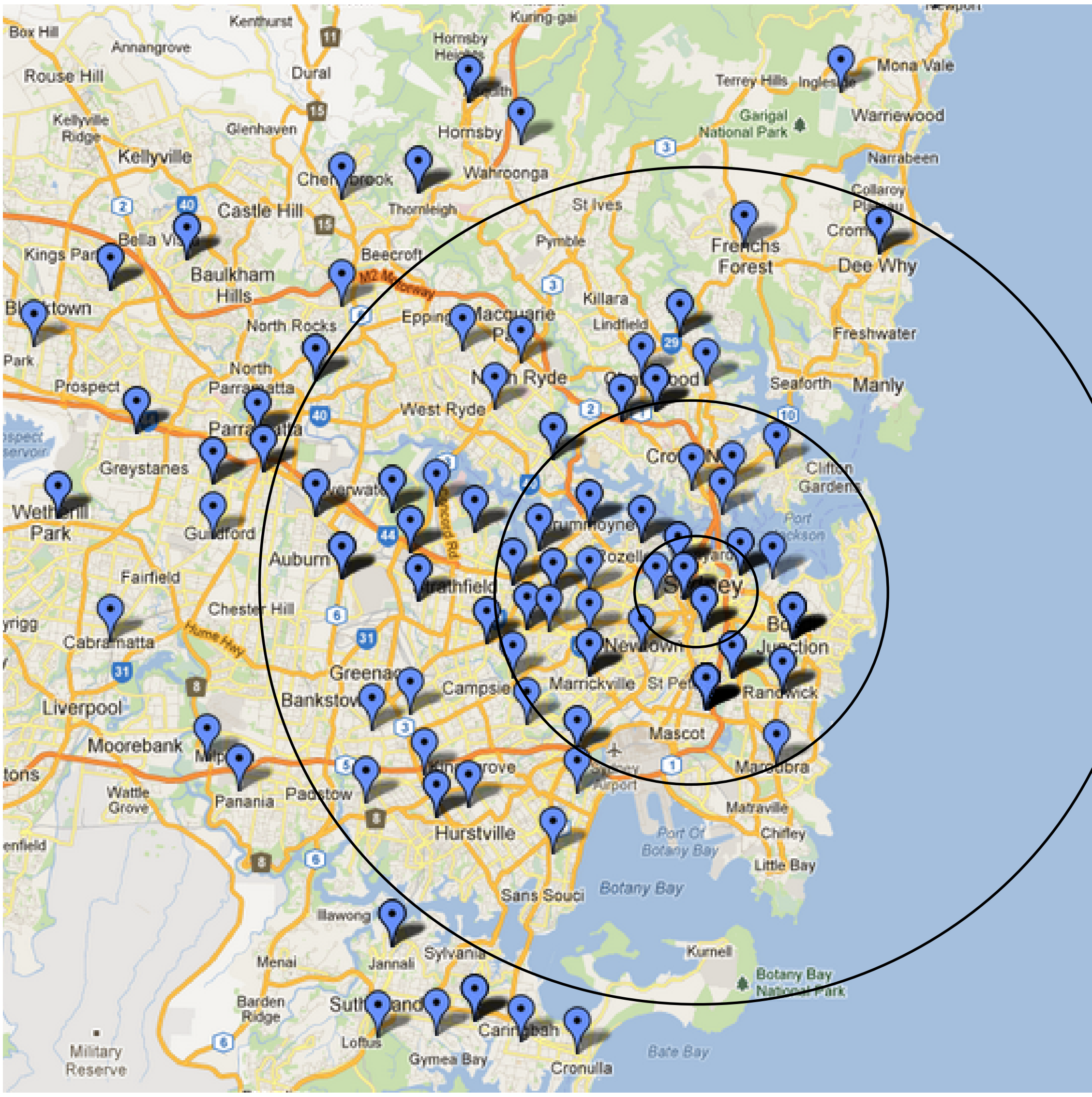


Figure 5 - Postcode

The postcodes of respondents represented fairly even coverage of the city, with increased concentration in the inner city and inner west. The evenness of the distribution in figure 5 suggests that the limiting factor of the data shall be the sample size of participants rather than geographic impacts on opinion.

4.2 Key results

The survey was designed to make sense to a respondent, and questions were presented in that order. However this is a different order to that of the methodology outlined in section 3 of this thesis, which presents a more effective order for a productive discussion. Our objective is to discuss the survey results in relation to the research questions.

The survey form presented separate sections to participants who had already purchased photovoltaic technology and those who had not. 88% of respondents filled the latter category of the survey, and as this sample size produces meaningful results it is here that our discussion shall focus. The discussion shall follow in a series of statements that constitute the logical discussion of research question 1 – 'does customer caution exist?'

4.2-1: The six indicators are relevant in the eyes of respondents

The six statements in the following table reflect the six indicators generated from the Suntech FAQ list. In reference to each statement a query was presented; 'If considering the purchase of a solar system - to what degree is the statement relevant?' Table 10 presents the responses.

Table 10 - Perceptions of the relevance of key indicators

	% Distribution					
						Mean
"I can access transparent and trustworthy information I need for a cost-benefit decision."	3.3	3.3	32.5	32.5	31.7	3.83
"I know what key criteria I should use to compare suppliers."	6.9	6.9	25.9	41.4	25.9	3.68
"I know how likely it is my system might not deliver on promised output."	4.2	7.6	32.2	37.3	22.9	3.64
"I understand the risks and/ or benefits a solar system will have on my house"	3.4	6.7	18.5	42.9	31.9	3.90
"I understand my legal protections as a consumer"	6.0	6.8	28.2	35.0	29.9	3.72
"I have all the technical information I require."	10.7	8.0	28.6	40.2	23.2	3.52

In all six queries tabulated on table 10 the lower two rating brackets of the Likert scales receive less than 20% of responses. The upper two rating brackets receive a minimum of 57% of responses in every case. The results of table 1 indicate that these generalizations are a successful generalization of the information factors relevant to potential purchasers of photovoltaic technology.

4.2-2: The six indicators form the basis of a comprehensive set of the concerns of respondents

Having confirmed that the set of six indicators are valid to the process of purchasing a photovoltaics system, we consider figure 6 and figure 7. These graphs display the output of the final query of the survey which asked - in reference to the 6 statements tabulated in Table 1 - 'How thoroughly do the above statements reflect your potential concerns?'

'How thoroughly do the above statements reflect your potential concerns?'

Figure 7 - Perception of thoroughness (Target)

Figure 6 shows the results from all respondents. 66% of respondents rated the set of statements as a reasonably thorough description of their information requirements. 8.9% of respondents indicated that the set of statements was a poor reflection of the concern[illegible]voltaic system.

Figure 6 - Perception of thoroughness (All)

Figure 7 demonstrates filtered results including only those respondents who own their own home or have a mortgage and live in a house or semi-detached house. This group represents the respondents who would be capable of making the decision to install photovoltaic systems in their residence. We observe that only one respondent meeting these criteria rated the query set as a poor reflection of their concerns if purchasing a photovoltaic system.

The above data indicates that not only are the queries in this set relevant in the eyes of potential technology purchasers. The query set is also reasonably comprehensive. The inference is that if a potential technology purchaser is simultaneously satisfied that all six of these statements are true, they are likely to proceed with engagement with the technology and therefore more likely to purchase the technology. Table 2 highlights a barrier.

4.2-3: Respondents rated their satisfaction with the information fields of the indicator set poorly

The results of the survey indicated that the set of six indicators were relevant to the purchase of the technology and approximate a comprehensive set of the information required.

A logical implication of these six indicators being relevant to the purchase of photovoltaic technology is that potential technology purchasers must fulfill minimum expectations of awareness of the information referred to by these indicators. Table 11 shows responses to a query 'If considering the purchase of a solar power system - To what degree is the statement true'.

Table 11 - Perception of the truth of key indicators

	% Distribution					
						Mean
"I can access transparent and trustworthy information I need for a cost-benefit decision."	8.1	23.6	47.2	17.9	3.3	2.85
"I know what key criteria I should use to compare suppliers."	30.9	29.3	26.0	12.2	1.6	2.24
"I know how likely it is my system might not deliver on promised output."	28.5	18.7	30.9	17.9	4.1	2.50
"I understand the risks and/ or benefits a solar system will have on my house"	20.0	17.6	31.2	22.4	8.8	2.82
"I understand my legal protections as a consumer"	34.4	22.4	27.2	8.0	8.0	2.33

"I have all the technical information I require."	37.6	24.8	21.6	11.2	4.8	2.21

Assuming satisfaction is reflected by a response in the upper two categories of the Likert scale, and dissatisfaction is reflected by the lower two categories we may simplify Table 11 with the satisfaction rating respondents gave for each statement.

Table 12: Satisfaction rating of key indicators

Statement	Dissatisfaction rating (%)	Satisfaction rating (%)
"I know what key criteria I should use to compare suppliers."	60.2	13.8
"I understand my legal protections as a consumer"	56.8	16
"I have all the technical information I require."	62.4	16
"I can access transparent and trustworthy information I need for a cost-benefit decision."	31.7	21.1
"I know how likely it is my system might not deliver on promised output."	47.15	21.9
"I understand the risks and/or benefits a solar system will have on my house"	37.6	31.2

In every case on table 12 statements received more negative ratings than positive ratings. The worst assessment of respondents was the issue of supplier comparison.

However as each of these criteria were shown to be relevant for a person considering the purchase a photovoltaic system (See table 10) the negative ratings of all these indicators is relevant. These three results together indicate a significant information concern must be present.

To recap, thus far we have observed that the set of six indicators are shown to be reasonably thorough as a reflection of respondents information requirements. We have also observed that respondents report poor satisfaction on these indicators.

4.2-4 Respondents indicated that improvement in these indicators would cause an increase in the probability of technology purchase

Table 13 further develops our awareness. Table 13 tabulates the response of the query "If this statement were 100% true how would this affect your decision to purchase solar energy" for each of the six indicators.

Table 13: 'Trigger factor' - degree to which fulfillment of this criteria would motivate decision to purchase

	% Distribution					
						Mean
"I can access transparent and trustworthy information I need for a cost-benefit decision."	4.2	5.1	18.6	40.7	35.6	4.11
"I know what key criteria I should use to compare suppliers."	4.2	7.6	15.3	49.2	28.0	4.02
"I know how likely it is my system might not deliver on promised output."	8.9	7.1	23.2	42.0	27.7	3.99
"I understand the risks and/ or benefits a solar system will have on my house"	3.4	4.2	21.0	35.3	39.5	4.13
"I understand my legal protections as a consumer"	7.8	7.0	28.7	35.7	28.7	3.94

"I have all the technical information I require."	8.8	7.9	24.6	43.0	24.6	3.93

We observe that for every statement the highest two response ratings of the Likert scale receive between 64% and 77% of responses. This highlights that raising public knowledge of the subject areas of the indicator set should expand the potential market for photovoltaics technology.

4.2-5: Awareness of supplier comparison criteria may provide a critical role in photovoltaic marketplace engagement

Figure 8 tabulates responses to survey question 11 "Please tick any information concerns you consider a barrier to purchasing a solar energy system". We observe that 52% of respondents indicated that a lack of awareness of the criteria to compare suppliers and deals constituted a barrier to purchase. This was followed by 41% of respondents indicating they would not purchase photovoltaics until they understood the finance model.

A plateau occurred as approximately 30% of respondents indicating bias of supplier information, inability to compare results or sparse information would all prevent the respondent purchasing photovoltaic technology.

To observe this information plateau, we tabulate in Figure 9 the responses of those participants who indicated 'information from companies is too sparse'

Figure 9 shows us that the respondents who indicated 'information from companies is too sparse' represent less than half the respondents who indicate 'information from companies is biased'.

Figure 8 - Information concerns

Logically the similar frequency of responses on these areas has not been caused by a common group of respondents indicating concern in many areas. The implication is that a random distribution effect has occurred.

This result implies three levels of engagement with this topic.

It is proposed that participants with a low level of awareness on the issue comment a lack of awareness on criteria to compare suppliers and deals, and participants with increasing level of knowledge have a probability to take interest in points of concern.

We believe this data implies that an awareness of criteria by which a person may compare photovoltaic technology suppliers is fundamental to creating interest (and therefore awareness) of other marketplace issues.

For example, a person who has a high awareness of criteria to compare suppliers may feel less threatened by perceived bias from photovoltaic technology manufacturers, as the person will be able to navigate any bias which is present.

4.2-6: Awareness of the rebate/ power purchase system may play a critical role as an initial platform for photovoltaic technology engagement

Figure 9 - Filtered responses - respondents who indicated 'information too sparse'

Figure 10 - Financial concerns

Figure 10 tabulates responses to survey question 10 "Please tick any financial concerns you consider a barrier to purchasing a solar energy system". We observe that a lack of understanding of the rebate / power purchase system presented a purchase barrier for 43% of respondents, followed closely by respondents expressing they do not understand how the systems make money.

We then observe a clear plateau in concerns of uncertainty in electricity price, lack of usage requirement (low electricity user) and the ability of photovoltaic technology to outperform the grid. Again, we attribute this plateau to the different categories of respondents upon the Diffusion of Innovation scale.

It is proposed that this result highlights that awareness of the rebate / power purchase system is an essential first step in orientation for people new to photovoltaic technology. This result correlates with our existing awareness that this mechanism play a central role in giving people fundamental understanding of how photovoltaic technology delivers key outcomes to technology users. We are also aware of the complicating factor of deferred demand as the cost effective model by which residential photovoltaics may achieve rapid payback periods.

4.2-7: The highest scoring financial concerns were information concerns

An important comment must be added regarding Figure 10 (Previous page). It must be noted that in investigating financial concerns respondents might have regarding photovoltaic technology, the three highest scoring categories were actually all information categories:

- 'Don't understand how the rebate/ power purchase system works'
- 'Don't understand how solar systems make money'
- 'The cost of electricity is an unknown determinate'

Three respondents used the 'Other' box to comment they had concerns of high upfront investment costs, which was the only relevant feedback regarding financial concerns.

4.2-7: The indicator set receive relatively little attention or focus

We previously observed that the indicator set was rated as highly relevant and as an area of poor satisfaction for technology purchasers. However as we observed from table 14, when four of the six indicators are placed in comparison to broader and more commonly understood issues the indicator set were rated as lower priority concerns. Environmental concern, government support or upfront costs all received higher rating as relevant issues in technology purchase.

We note that the indicator set was generated from FAQ queries made by customers to a leading manufacturer. These queries would have been generated by members of the public who had become motivated to action a purchase yet sought to resolve an information concern before proceeding - or alternately, had purchased the project and wished to resolve a concern. We observe from this that while a person who understands the topics of the indicator set is more likely to purchase photovoltaic technology, information on the subjects of the indicator set will not inspire interest in the subject of photovoltaic technology. A separate awareness of motivating factors driving customer interest in PV must be established. This can operate in tandem with the results of this study, highlighting factors of customer caution.

Table 14 - Purchasers responses - significance of relevant issues

	% Distribution[2]					
	IS	MS	So-so	QS	ES	Mean
Environment	1.5	2.3	13.0	40.5	42.7	4.2
High start up cost	3.8	3.8	10.8	45.4	36.2	4.1

[1] [2] The rating scale used was IS = Insignificant. MS = minor significance. So-so = So-so. QS = Quite Significant. ES = Extremely significant.

Government rebate offers	3.8	6.2	23.1	43.8	23.1	3.8
There is a risk that a system will not work as promised	9.9	19.1	24.4	35.9	10.7	3.2
Legal & warranty process uncertain	10.9	21.7	31.8	22.5	13.2	3.1
Information about solar energy is too hard to find	11.5	23.7	32.8	25.2	6.9	2.9
Impact on other risks, e.g. house fires	19.8	21.4	27.5	20.6	10.7	2.8
Appearance of solar panels on roof	47.0	24.2	10.6	13.6	4.5	2.0

4.2-8: Respondent perceptions of self-efficacy were higher than expected

Figure 11 - Research efficacy

Figure 11 reports the results of a query respondents were given referring to the statements in Table 5. The query was “ Assuming you were motivated to seek this information, from 1-5 how confidant are you that you could seek the answers?’

We see that respondents reported unexpectedly high self-efficacy regarding ability to find information on photovoltaic technology [Assuming the respondent was motivated to do so]. We have previously observed the very poor satisfaction ratings which respondents expressed regarding the indicator set.

This is exaggerated by the results from figure 12. Figure 12 tabulates the results of the query (made in relation to the statements in Table 5) “If information was not available regarding the concerns raised above, from 1-5 how motivated would you be to seek the answers?”

Figure 12 shows us that respondents self-reported motivation indicators were slightly positive. It is counter-intuitive that respondents with strongly negative information satisfaction self-report high levels of efficacy and motivation.

Figure 12 - Motivation

It is proposed that the results of figure 11 and figure 12 – in addition to our previously observed result 3, that the satisfaction rating on the indicator set is very poor - indicate respondents had not considered these topics previously.

This would explain why a respondent with a high capacity to self-inform, who may be motivated to self-inform reports low levels of satisfaction on a research area to which their attention had not previously been directed.

This suggests that even though the statements of the indicator set are reflected as relevant to the purchase of photovoltaic technology, they are not commonly known to be relevant – which implies that these significant factors in effectively directing the attention of technology purchasers are not being effectively promoted.

It may also indicate that respondents were not ready to purchase at the time of completing the survey. If they progress to a point of purchase, however, they feel confident about sourcing information.

4.2-9: Respondents indicated that the existing information vacuum presented a major barrier to technology uptake

An additional result – in line with expectation though no less important or relevant as a result – is the degree to which an information vacuum constitutes a barrier to technology purchase for respondents.

Figure 13 indicates the responses of the entire survey sample- in reference to the statements in Table 14 - 'if the above information were not available, from 1-5 how probable is it you would buy solar?'

'If the above information were not available, how probable is it you would buy solar?'

Purchase probability - all respondents

Purchase probability - target group

Figure

Figure 14 tabulates a limited sample of the responses including only those respondents classified as 'decision makers' – those people who live in houses or semi-detached houses who also own the property or pay the mortgage.

We observe in both the entire response sample and among the decision makers that a lack of information constitutes a significant barrier to purchase. This reflects the first hypothesis of the thesis, that information barriers are having a significant impact on photovoltaic technology penetration.

4.2-10: Open feedback response 1 - apartment dwellers present a potential market

The following two pages are dedicated to unique or otherwise educational responses made by respondents in open-feedback sections of the survey. The most relevant open-feedback responses came from apartment dwellers. The responses indicated a frequency of interest in photovoltaic technology and a frustration at inability to purchase.

> "Equity committee of my body corporate is not interested because of equity issues related to energy use & splitting bills"

Equity issues were specifically highlighted as a barrier to purchase by two respondents. This indicates that their apartment building had considered the technology and discussed the project before encountering the issue of equity. We have observed in our literature review 1.7 that third party ownership companies may remove equity concerns from purchase. Therefore this issue could be solved by altering the technology business model.

> "I live in an apartment. For such a major expenditure, need 3/4 consent of a special meeding of the body corporation. Would be difficult to get as 1/3rd are retired on pensions + 1/3rd are rented out & the investors are reluctant to spend money / agree to a special levy. Would install if i were in a single dwelling"

A further six respondents highlighted the democratic difficulty of organising an apartment building to purchase photovoltaic technology.

> "As an apartment dweller more information is needed to persuade owners of the benefits on a solar system installed on common property such as the roof"

A further two respondents indicated concern with lack of information they could use to persuade *other people* in their building to purchase photovoltaic technology. The respondents appear to be a technology supporters unable to promote the product within the other tenants of their building.

> "People in rent being able to get it."

This issue was only raised by one respondent yet raises the question of whether business models which remove equity concerns can open a market for apartment dwellers who rent to purchase photovoltaic technology. That question is neatly answered by the following feedback response made by a respondent who had already purchased photovoltaic technology, asked about what could make the technology purchase process easier.

> "Provided by Landlord so N/A"

This indicates at least one apartment landlord has found it profitable or otherwise satisfactory to provide a photovoltaic system for tenants of the apartment. In reflection of this we observe the feedback statement

> "As I live in an apartment solar power is not an option for me however if i have an opportunity to move to a house I will seriously consider it"

Three open feedback statements expressed this fundamental interest in photovoltaic technology yet disempowerment regarding ability to purchase. As we note one respondent among the sample had a landlord who resolved this issue, this must be a solvable concern.

The above statements indicate that within apartment buildings, innovators exist who promote new technology and can use body corporate / strata meetings as a means to inform other residents. The model of common property could potentially be used to promote new technology, instead of impeding it.

A zero-equity business model could successfully solve the issues noted above and open a market for photovoltaics on apartment buildings of a similar nature to that suggested in literature review section 1.7. so long as the information required by innovators in apartment buildings could be generated and made available.

Facilitating such a business model would be a zero-cost method to improve renewable energy penetration, simply by assisting tenants of apartment dwellings with solving the concerns they face. A targeted business model could addressing the specific issues and concerns of landlords and strata / body corporate groups.

4.2-11: Open feedback response 2 - Concern with photovoltaic system retailers

Two relevant feedback statements highlight issues concerning photovoltaic system retailers.

> "When applying for a government rebate, the application process is far too complex and confusing. We were interested in installing solar and gave up because it was too disorienting and hard. Also, the jargon - what is "the grid?" It felt like we had to go through some kind of beaurocratic body? is that the government? too convoluted. The installer told us their only job is to install solar panels... they were not interested or able to explain any queries to us about how our solar panels could make money. Is somebody buying the electricity it makes? The installer told us nothing. we're not aware of how electricity companies work!"

The above quote only occurred once. However it must be noted that only a single-line dialogue box was presented to the respondent, indicating the respondent took some difficulty to contribute eight lines of text. The key quotation "The installer told us their only job is to install solar panels" stands out, in light of the common opinions of the response group.

> "I also concerned with companies that offer the system, they are not stable and can't/won't honour the warranty."

This sentiment was only expressed by one respondent. It is mentioned because of the wording - which is general across the photovoltaic industry. The respondent does not differentiate between stable and unstable corporations. This becomes relevant when we ask 'How could this issue be resolved?' and note that at present the relevant information does not appear to have been collected anywhere and is not accessible by the public.

4.2-12: Summary of results (participants who had not purchased)

For reflection, the assertions of the above discussion are presented together. The first four observations:

- The six indicators are relevant in the eyes of respondents
- The six indicators form the basis of a comprehensive set of the concerns of respondents
- Respondents rated their satisfaction with the information fields of the indicator set poorly
- Respondents indicated that improvement in these indicators would cause an increase in the probability of technology purchase

Indicate that the answer to research question 1 'Is customer caution present?' is that customer caution as defined by this paper is present and a significant concern to the market of photovoltaic technology.

We proceeded to note that:

- Awareness of the rebate/ power purchase system may play a critical role as an initial platform for photovoltaic technology engagement
- Awareness of supplier comparison criteria may provide a critical role in photovoltaic marketplace engagement
- Respondents indicated that the existing information vacuum presented a major barrier to technology uptake
- The indicator set are not motivators

These points describe key financial and information concerns highlighted by respondents, in line with those research questions 2 and 3

Finally the following observations explored other issues which may be present in the issue of customer caution in photovoltaic markets, to broaden understanding and examine feedback.

- Respondent perceptions of self-efficacy were higher than expected
- Respondents in apartment dwellings show interest in the technology
- Some comments highlighted concern with photovoltaic system retailers

4.3 Survey responses from respondents who had purchased photovoltaic technology

Below we observe data from the 18 respondents who had already purchased photovoltaic systems. We shall avoid drawing conclusions from this data. Our primary reason for doing so is that the sample size is too small to draw significant conclusion, and also the demographic of people who have already purchased photovoltaic technology are readily available to the industry for larger scale enquiries where relevant.

The data is presented on the basis that it was collected as part of the survey and in the spirit of complete reporting of data, we shall present the results. However we shall not draw upon such small sample size data as a platform for our conclusions.

We suggest for future work a survey of photovoltaic technology purchasers to confirm that these people may report more frequently that they found the technology education process easier than non-purchasers. While that trend is supported by the following data, the small sample size makes any observation inconclusive.

4.3-1: Date of purchase

Figure 15 - Year of purchase

A withdrawal of government support in 2012 (as indicated in background 1.1) impacted volume of photovoltaic system installations. Figure 15 indicated the competing forces of the growth of the industry creating frequent recent purchases and a fall-off in new systems installed so far in 2012. Further commentary is withheld due to small sample size.

4.3-2: Factors influencing purchase decision

The query 'Which factors most influenced your decision to buy?" drew the following responses. Table 15 displays the 17 responses to this query of the survey.

Table 15 Respondents expression of factors influencing purchase decision[3]

	% Distribution					
	IS	MS	So-so	QS	ES	Mean
To support renewable energy development	5.9	0.0	29.4	23.5	41.2	3.9
Current electricity prices	5.9	5.9	11.8	47.1	29.4	3.9
Expectation of future electricity prices	6.3	0.0	25.0	43.8	25.0	3.8
To protect the environment	5.9	11.8	17.6	29.4	35.3	3.8
To reduce personal carbon footprint	11.8	11.8	23.5	17.6	35.3	3.5
To be involved with new technology and progress	0.0	18.8	25.0	37.5	18.8	3.6

[3] The rating scale used was IS = Insignificant. MS = minor significance. So-so = So-so. QS = Quite Significant. ES = Extremely significant.

To encourage other customers to support renewable energy	12.5	18.8	6.3	37.5	25.0	3.4
To improve the sale value of the house	25.0	31.3	25.0	12.5	6.3	2.4

Interestingly, a general desire to support renewable energy development was the dominant factor behind respondents' technology purchase decision, and this took precedence to self interest [Electricity price concerns] though electricity price concerns took precedence over environmental concerns. Limited sample size undermines the value of conclusions from this data.

4.3-3: Respondent commentary on the purchase process

Figure 16 - Feedback on purchase process

Eleven of the seventeen respondents gave additional written feedback on means to improve the technology purchase process. Figure 16 indicates the categories of feedback and the frequency of comments on each.

While the sample size was severely limited we note that every category of the themed responses orients in some way around respondents seeking an impartial view of the product. As this feedback was presented by eleven out of seventeen respondents who had purchased the technology, this may be a worthwhile area for future research.

5 - Comment of two reports released by the RAA

On the 2nd October 2012, the researcher noted an article in the newspaper 'The Australian' titled 'Solar shines brightest in bush and mortgage belt'. The article highlighted the findings of the report 'REC Agents Association (RAA) Response to the Climate Change Authority's Statutory Renewable Energy Target Review' released on the 20th September (RAA, 2012). The data of interest came from an attachment to this report titled 'RAA Research Note 3 – Geographical analysis of solar systems under the Renewable Energy Target.' (RAA, 2012)

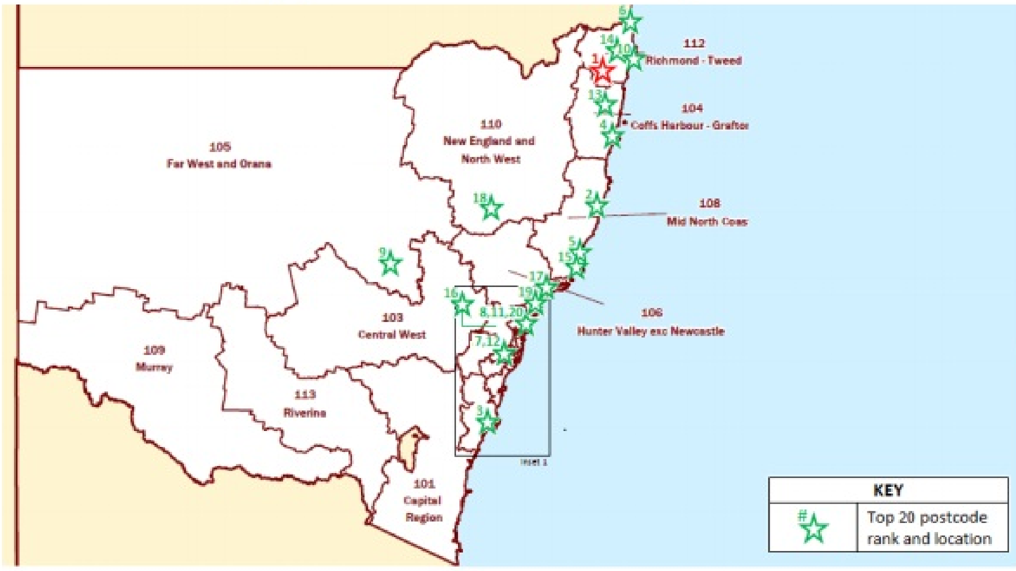
These reports were observed after this thesis project was effectively complete. It was noted that the data of these reports are highly relevant to the project of this thesis and that a key finding of the RAA report which does not appear to be discussed by the RAA report is explained by our findings therefore adds weight to our conclusions. This section shall be devoted to the synergy between our own findings and the findings of the two RAA reports.

We focus upon RAA Research Note 3. This survey indicated penetration of solar technology is twice as high in rural areas as it is in the major cities of Australia.
The report observed data from 1,418,478 systems (94.7% of the total of 1,497, 686 systems) across 8,747,741 dwellings (95.7% of the total 9,137,471 dwellings.

The study makes no discrimination between solar hot water systems and photovoltaic systems, with the two technologies having a roughly even mix of 754,000 solar PV systems (the report assumes an average system size of 2.5 kW) vs 744,000 solar hot water systems. Data on each of these technologies has been collected separately by the RAA yet was merged in line with the focus of that report. The merging of the two technologies will distort the outcomes of the report for our purposes as we seek to look at photovoltaic technology only. As the RAA possesses all the relevant data to repeat this study on photovoltaic technology alone, it may be wise to commission a second report from the RAA to check the validity of these trends to photovoltaics.

The report does not discriminate between grid connected photovoltaics and stand-alone photovoltaics, nor does it discriminate between historic and recent photovoltaics installations.

Mindful of the above, we observe the following data from RAA Research Note 3. Figure 17 indicates that 17 of the 20 postcodes in NSW with the most photovoltaic system installations are outside Sydney, even though Sydney holds 64% of the state population (Australian Bureau of Statistics)



Rank	Postcode	Suburb	Distance from CBD (km)	Total installations	Penetration (%)
1	2480	Bentley	595.2	7,673	38.8
2	2444	Blackmans Point	317.2	7,047	34.4
3	2540	Bamarang	131.1	6,117	25.6
4	2450	Boambee	430.7	5,750	33.6
5	2430	Black Head	236.4	5,198	34.5
6	2486	Banora Point	668.4	5,148	37.6
7	2560	Airds	42.1	4,685	18
8	2259	Alison	69.2	4,671	21.6
9	2830	Ballimore	284.9	4,522	28.9
10	2478	Ballina	600.4	4,425	34.7
11	2250	Bucketty	85.2	4,302	15.8
12	2170	Casula	29.4	3,776	11.5
13	2460	Alice	552.8	3,510	28.3
14	2484	Back Creek	644.7	3,317	41.7
15	2428	Blueys Beach	211.1	3,246	23.4
16	2153	Baulkham Hills	23.5	2,997	16.5
17	2324	Balickera	146.7	2,935	27.2
18	2340	Appleby	326.2	2,918	15.0
19	2283	Arcadia Vale	97.2	2,894	29.0
20	2261	Bateau Bay	59.6	2,833	11.8
Total top 20		*(21.6% of total installations)*		87,964	
Total other		*(78.4% of total installations)*		318,384	
Total				**406,348**	

Figure 17 - RAA Research Note 3 - Attachment 2

We also quote the first four outcomes of RAA research note 3:

- "Most solar systems (53%) were installed in regional and rural communities with only 43% installed in major capital cities
- "The level of solar penetration amounted to 13% in the major capital cities of Australia (representing 58% of households) and was 21% outside of major capital cities (60% higher penetration).
- "Of the systems installed in capital cities, those suburbs with the highest penetration (number of systems installed in suburb divided by the number of dwellings in that suburb) were typically in the outer metropolitan mortgage belt
- "There was a slight inverse relationship between average incomes and solar penetration levels"

Before discussing these findings we draw attention to figure 18 drawn from the APVA 2010 annual report. Figure 18 shows the cumulative growth of photovoltaic system installations:

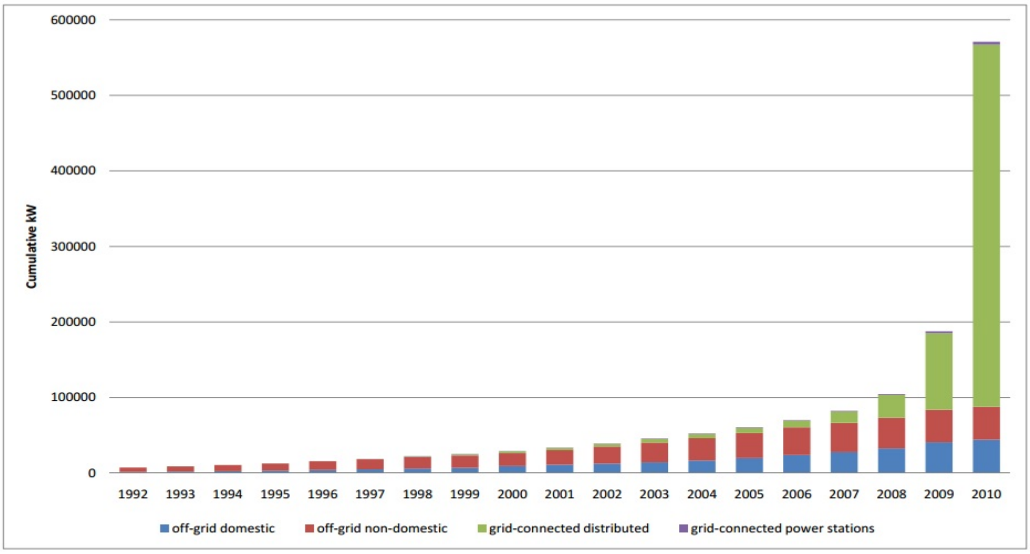


Figure 18 - APVA annual report 2010 graph of cumulative installations by market type

Assuming the installation trends have continued – that is, exponential increasing growth and grid connected system installations account for approximately 99% of new installations – the dominance of rural systems cannot be explained by the rural presence of grid connected systems or by presence of historic installations built up over time.

The conclusions of the RAA report - that most systems installed to date were installed in regional areas - is therefore matched by a reasonable assumption that most of the installations were recent, as a pure corollary of the high rate of recent growth.

As we are now considering the geographic distribution of recent systems (and thus, the probable geographic footprint of installations in coming years) we draw attention to the education level of NSW postcodes in which photovoltaics penetration is highest. We found that among these postcodes an average of 41% of residents completed year 12 in comparison with 87% of residents in postcode 2000, that is, the inner city. (See appendix X for data). This implies that the residents in suburbs with the highest photovoltaic technology penetration should have lower self-efficacy regarding internet based research.

Electricity costs may be higher in grid-connected rural areas. However the technology is cost-competitive in Sydney and this is a uniform case across Sydney. After an initial series of successes, this fact should communicate across the city greater rapidity, accelerated by increased information technology use. Why, then, is photovoltaic technology penetrating at a slower rate? The high population density of cities should make it easier for consumers to access information hubs, condensed expertise, and view demonstration technology. Photovoltaics is an emerging technology product. One would assume that information technology based research would be the dominant means of customer self-education.

One possibility is that stand-alone photovoltaic systems have operated successfully in rural areas and represented the bulk of the commercial photovoltaics market until 1998. This creates opportunity for the residents to build 'familiarity' with the systems (see background 1.8) which appears to be accelerating technology diffusion. It is possible that broader social networks outside the city promote an increase in word-of-mouth reports among consumers satisfied with the effectiveness of the technology.

Credibility of word of mouth knowledge transmission may also be stronger in smaller, closer knit communities.

Yet we also recall our own results. We found that our highly educated respondent sample, with a high self-efficacy regarding ability to research, reported a major deficiency in information on photovoltaic technology and that this information deficiency constituted barrier to purchase.

We assert that in rural areas, the mechanism by which consumers select new products is less probable to be internet based research. A lack of information available on the internet will not affect a consumer whose primary means of selecting new products is word of mouth or social advice from satisfied technology users.

On this platform we conclude that the absence of available customer information online is the primary cause of a halving of photovoltaic technology penetration in urban areas.

We may estimate the cost of this effect if we follow RAA report assumptions of an average photovoltaic system is 2.5 kilowatts and presents a sale value of $2500 (conservative estimate).

On these assumptions, if the penetration level in major cities may equate that in regional areas, 184400 sales would be made in Sydney and 452500 sales made nationally. The revenue from this would be approximately 461 million dollars in Sydney, or 1.13 billion dollars across Australia (This assumes the RAA report considered Canberra a 'major city' for calculation purposes)

In considering this statement it must be noted that the information transmission issue is solvable, and that we have provided necessary information in this report to begin the process as well as guidelines on the matter.

It would not be an impossible matter to engineer internet based information which performs a similar role to the social transmission vectors active in rural Australia.
We have indicated that young highly educated respondents lack information and this prevents technology purchase. The implication is that effective information delivery shall rapidly open a large market in a highly effective manner.

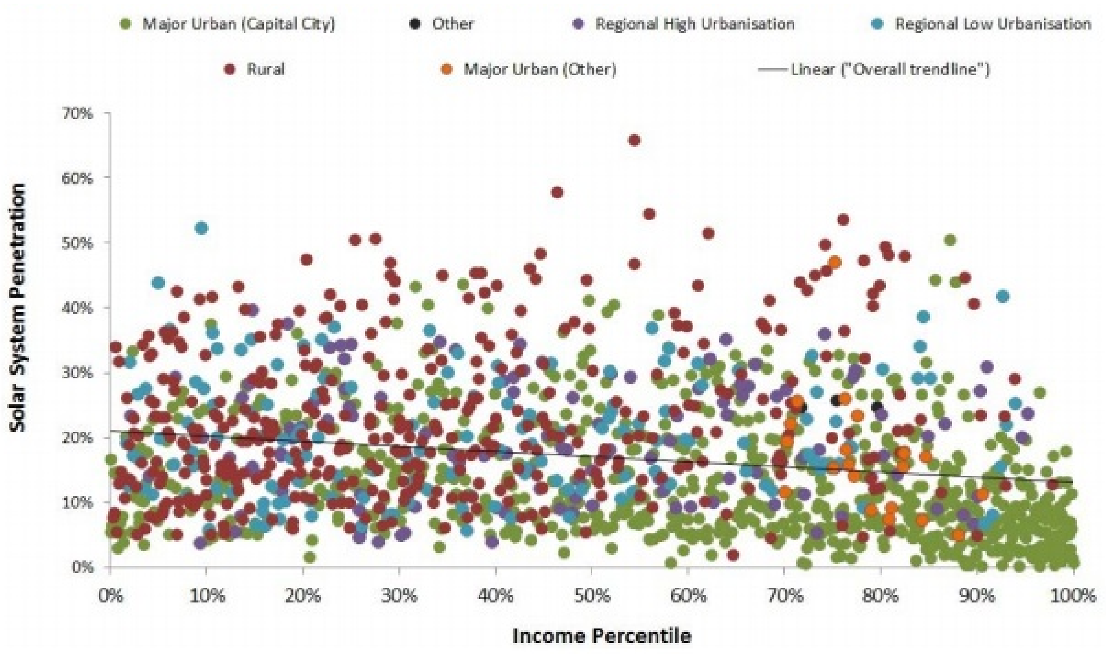


Figure 19 - RAA Research Note 3 graph - photovoltaic system penetration vs suburb average income

Finally we observe figure 19 drawn from the supporting data of the RAA report. Figure 19 indicates the relationship of inverse penetration of photovoltaic technology in a postcode with the average income in a postcode. We raise a query - to what degree is this representative of ambiguity aversion, as indicated in our literature review 1.6?

If photovoltaic technology is cost-positive yet information is severely lacking one might expect consumers with wealth may reserve their decision making.

Among low income social groups, common interest in cost-saving technology may drive communication on the issue including communication of successful technology experimentation. This may raise the impact of social transmission mechanisms, and consequently, technology uptake.

6 - Conclusions

6.1 – Our data indicates hypothesis 1 to be true

Our first hypothesis was that lack of information is contributing significantly to customer caution and this is limiting uptake of solar energy systems. Our results indicate this to be true. The result is verified by recent data from the Renewable Energy Certifiers Agents Association geographic survey.

Our results indicated that a highly educated group of respondents with a high self-efficacy regarding research possessed poor satisfaction with their awareness of information relevant to photovoltaic technology purchase. Respondents indicated that this lack of information constituted a barrier to purchase. Respondents indicated that if they were satisfied with these issues they would be more likely to purchase photovoltaic technology.

Our results also indicated an additional concern regarding lack of understanding regarding the electricity sale mechanism and lack of understanding means to compare technology suppliers. Our results indicated that lack of knowledge in these areas halts the dialogue process. Respondents with poor awareness in these areas appear to disengage from information even if this information is otherwise informative and appropriate. These observations indicate to us that information concerns are a major barrier to the penetration of photovoltaic technology.

When we reflect upon the finances of photovoltaic technology, which are positive, we infer that information barriers have probably surpassed the cost effectiveness of photovoltaic technology as the limiting factor governing levels of technology penetration.

However our survey was designed to indicate trends to direct future research, rather than construct concrete proof. Therefore the timely release of the RAA geographic report does much to verify our result.

A key finding of the RAA report was that photovoltaic technology penetration is concentrated outside urban areas. The report included data backing this finding. The data indicated 17 of the top 20 postcodes of photovoltaic system purchase are outside the city, even though Sydney represents 70% of the state population. The RAA report did not appear to explain the cause of this distribution, preferring a focus on explaining why the REC subsidy should be considered beneficial to lower economic areas. Our results appear to explain this trend.

We begin by making the inference that the RAA data reflects recent industry activity, despite the fact that the RAA report did not consider when systems were installed. We make this inference based on data regarding the growth of photovoltaic installations. The data indicated recent growth in activity has been so exponentially large that most systems which exist were recently installed.

Having determined that our geographic data was a reflection of recent activity, we considered that the areas in which more photovoltaic systems are installed match the areas in which standalone photovoltaic systems operate.

We recall that for more than a decade until 2008 standalone systems composed the bulk of the photovoltaic technology market. We propose that over this decade, the geographic populace near successful stand-alone photovoltaic systems have built familiarity with the technology and have built positive perceptions of the technology.

We then drew upon national census data which indicate education levels are relatively low in areas where photovoltaics penetration is high. Intuition would suggest that in 2012 internet based research would be the most prevalent means of customer self-education. We would also infer that higher familiarity with these research processes would cause city residents to interface with new technology faster.

Yet it appears that all of the drivers which would be expected to promote penetration of new technology more rapidly in an urban environment have been out-competed by the impact of familiarity and social interaction factors in regional areas. This is in spite of additional factors. For example, higher income levels in cities are higher. Infrastructure is more developed. Transportation costs and travel times are lower, reducing cost of maintenance. Higher population density increases the number of observers near a successful installation. Display systems and concentrations of expertise are easier to access.

Upon this background we impose the results of our own survey - in which a group of highly educated respondents indicated dissatisfaction with availability of information, and that without access to this information they would not purchase photovoltaic technology.

Our conclusion is that the lack of information regarding photovoltaics has become so severe that it has effectively broken down the technology communication process used by consumers with high levels of technology education. A failure to deliver on consumers information expectations implies that sales proceed most rapidly in places where this process may be circumvented. Geographic areas where word-of-mouth support, familiarity with existing systems and social transmission of confidence based on observed technology success appear to replace independent information technology based research as the primary driver of photovoltaic technology diffusion.

6.2 – Our data indicates hypothesis 2 to be true

We draw attention to our second hypothesis, that solutions based customer information is penetrating slowly because priority has not been placed on addressing pre-existing motives of consumers.

We recall results 4.2-5 and 4.2-6, which indicate clear levels of information among the sample. It appears that the issues of supplier comparison and the electricity purchase mechanism present engagement barriers. It appears that respondents who felt they had no awareness on those two issues paid little regard to other concerns regarding photovoltaic technology.

We therefore predict respondents who are not given information on these topics may ignore other relevant information presented to them regarding photovoltaic technology.

From this we conclude that a failure to identify the motives and concerns of customers may give rise to a 'barrier' process in which consumers only recognise information matching their core concerns. If this is not studied and resolved, this effect may become a significant retarding factor on the transmission of information relevant to photovoltaic technology.

6.3 – Our data indicates hypothesis 3 to be true

Our third hypothesis was that the information situation may be resolved if photovoltaic technology products are described in terms within a non-technical end users frame of reference, and thus their comfort zone.

This hypothesis was based on the observation that each consumer will have a series of concepts known to and familiar to themselves. They shall also have a series of motivating concerns which relate to their life at present. If photovoltaic technology products can be connected to these concepts in a consumer, then the technology is more likely to experience high uptake ratios.

We recall our 6 indicator fields. The 6 indicator fields represented plain-language generalisation of photovoltaic technology specific issues in terms of general issues common to other consumer product decision making processes. These indicators were expressed in plain language.

We recall result 4.2-4 which indicated that if high satisfaction was achieved on these 6 indicators, respondents would be more likely to purchase photovoltaic technology. We also recall result 4.2-2 which indicated that our 6 indicators were a reasonably thorough representation of respondents information requirements. Result 4.2-1 indicated respondents felt the indicators were relevant reflections of their concerns.

These three results together indicate that the information issue is solvable. Respondents reacted positively to the indicators which were designed not only to test respondents satisfaction with information but also to be a platform on which to build consumer confidence with the technology. A key factor in the design of these indicators was reflection on the FAQ queries made to a technology manufacturer and also common trends in the needs of consumers regarding other consumer purchase decisions.

We take this opportunity to highlight that if electronic information is presented to a respondent in the same order of priority as the respondents information requirement, this should be effective in giving a reader a sense of familiarity with technology. As we have observed the power of familiarity as a driving force in technology penetration, this warrants priority.

The more accurately the photovoltaics industry defines customers perceived needs and information requirements, the more effectively information may be categorised to fulfil the above criteria.

6.4 - Analysis of FAQ data is a valid means to explore this issue.

The various results and conclusions of this paper indicate that our general methodology – of using technology manufacturer FAQ data as a platform to study and observe end user information requirements – is an effective means to engage the topic. This may be valuable to researchers observing agents of change theory or diffusion of innovation theory from general viewpoints outside the photovoltaics industry.

6.5 - Consumers require a sense of control.

In our methodology we defined the requirement of consumers in the purchase process. We determined that the consumer must take the following actions:

- Determine that the benefit of the purchase shall outweigh its cost
- Determine that the benefit of the purchase shall outweigh competing investment options
- Allocate finance for the purchase

This necessitates consumers must possess personalised technical information in their own hands and an awareness of the mechanic of the sales process.

A rational technology sales agent may successfully determine all of the information which a consumer shall require, and then take action to ensure a consumer possesses all of this information.

However a sales agent may not be rational. The sales agent may not possess the information, or the industry awareness to know the important role of this information. Some consumers may purchase without knowing all financial details of the technology purchase, and these may constitute a market.

As some of the information relates to processes not directly related to photovoltaic technology - such as a consumers personal electricity use profile - a consumer may not trust a photovoltaic technology retailer as an objective information source on ever necessary matter. This barrier may be overcome if categorised relevant information is presented via the internet by an impartial source such as the government, university or a key industry association body.

6.6 - Further investigation is required regarding motivates of customers

Diffusion of innovation theory indicates that knowledge and information is only an opening step in promoting the uptake of a new technology. Priority must be placed upon identifying the motivating factors driving consumers to consider purchasing photovoltaic technology. Those motivating factors, as identifies in background 1.8, are not purely financial concerns and include emotional and social factors.

To facilitate effective develoment of consumer understanding it is recommended that research by either academic institutions or a peak industry body is conducted and that the findings of this research are made available to all key players within the industry. The commonality of the issue must be brought into consideration.

Greater understanding by the industry of real and perceived needs of potential consumers will facilitate market expansion.

Furthermore the ‘Gatekeepers’, as discussed in Background 7.4, must be identified. These gatekeepers include prominent social figures and also organisations. Gatekeeper organizations which support environmental causes exist and may be key in promoting clear communication of information on photovoltaic technology.

6.7 – Consumer information requirements must be identified and shared freely among industry participants to promote unification of a common response

A set of the information requirements of consumers are provided below as solutions strategies.

7 - Solutions strategies

Research in the photovoltaics industry has traditionally focused on technological barriers and goals. It is only recently that photovoltaic technology emerges to compete with grid electricity with minimal or no subsidy.

As the technology is finally proving cost effective a complex new process begins. It will be a large scale task to transition a technology which is little understood to a large nontechnical client base. It has been recognised that most of the potential client base for photovoltaic technology do not currently understand their own electricity usage. The impact of this on transmission of the technology appears to have received less attention, despite the fact that the issue appears to drastically disrupt the existing information transmission model.

It is inappropriate that photovoltaic technology retailers must explain electricity issues essential to technology sales yet unknown by much of the client base, without an objective third party information resource to resolve end user concerns about the impartiality of this information.

If this information is not presented to the public, then educated members of the public will recognize an information vacuum. This vector will cause educated members of the public will avoid the technology instead of moving to uptake the technology.

An additional concern is a lack of common information shared between manufacturers on how to resolve this common issue opposing the market expansion of photovoltaic technology.

It shall therefore be very timely and important that industry now focus on what consumer wants or perceive they need [at a large scale, with results openly available] because the industry as a whole needs to improve this understanding for market / sales to expand. Every player in the photovoltaic industry must benefit from this information. As stakeholders outside the photovoltaic industry have expectations upon the performance of the industry as a whole, it is inappropriate to expect each manufacturer to undertake research on this subject independently in a manner in which no results are shared.

Finally we note that this research can only be done by or with someone who understands the product and the industry. The task and information requirements are very specific and do not generalise effectively to principles of other technology. It is likely that research of this nature has occurred infrequently because of the multidisciplinary requirement of customer research combined with the intense product and industry knowledge required of the researcher.

We propose that a consumers information requirement is broken down into three parts - why a consumer should purchase, whether they are able to purchase, and how they may go about the purchase process. We shall present each information set separately as each task differs.

7.1: Solutions strategy 1 -'Why should I purchase' - Information requirements relevant to photovoltaic systems deferred-demand value model

As technology manufacturing costs fall, markets shall emerge internationally in which photovoltaics present a cost-beneficial investment in the absence of a subsidized feed in tariff.

In a market where feed-in tariffs are not significant, the cost-justification model for photovoltaic technology depends heavily on deferred demand. That is, the assumption that electricity produced by a photovoltaic system shall be used by the residence replacing the need to purchase some electricity from the grid.

To communicate this with an end user, the end user must be aware of:

- Basic concepts of voltage and electrical power.
- The household electricity usage pattern, in the form of a load profile.
- Which organisations are involved in electricity trade (e.g. electricity produced must be sold to that electricity retailer from who the household purchases electricity)

- That ownership of a photovoltaic system means ownership of electricity produced by the system
- Costing units used in electricity trade (and prices)
- Feed in tariffs are dictated commercially at present, not by government regulation, and thus unstable
- Household electricity import prices are stable and set to consistently rise (thus deferring this is a good investment)
- How to superimpose photovoltaic system generation curves over household load profiles
- How to weigh different retailers electricity import prices against the total potential profit from feed in tariff (choosing a retailer with a FIT may not be justified)

The above information therefore needs to be assessed and considered academically, and tested to see whether this description of the information requirement is comprehensive.

We propose that the potential to access clear logical information on the above matter shall promote a sense of control and security among readers. This shall promote the transmission of photovoltaic technology.

The information then needs to be presented by an institution which is not a photovoltaic technology manufacturer, to allow manufacturers to direct consumers to this objective third party education to promote their understanding.
We stress that the above information represents a comprehensive list of the information required for a customer to understand the deferred demand value model as a concept. A separate set of information is required for consumers to navigate the purchase of a specific photovoltaic technology product.

7.2: Solutions strategy 2 - 'Can I purchase?' Information requirements relative to consumers recognizing the value of photovoltaic systems but disempowered to purchase

As we indicated in result 4.2-10, apartment dwellers present a potential technology market. The ability of each residence type to purchase photovoltaic technology is supported by cases of successful third-party ownership regimes governing photovoltaic systems attached to apartment buildings.

If a technology purchase model is clearly presented for renters and apartment dwellers, and the profitability of the technology is highlighted, then consumers energy and attention may be directed to other barrier concerns improving the rate at which these are resolved and improving information transmission.

7.3: Solutions strategy 3 - 'How should I purchase' - Information requirements relative to a consumer selecting their preferred photovoltaic technology product

We propose a mechanism by which the public may self - educate on effective means to navigate the photovoltaic technology purchase process.

We propose that we have identified the six core issues governing the technology purchase process regarding photovoltaic technology. It is hoped that further studies on this subject shall confirm these factors are indeed the six key concerns of photovoltaic technology purchasers.

- "I want to access transparent and trustworthy information I need for a cost-benefit decision."
- "I want to know what key criteria I should use to compare suppliers."
- "I want to know how likely it is my system might not deliver promised output."
- "I want to understand the risks and/or benefits a solar system will have on my house"
- "I want to understand my legal protections as a consumer"
- "I want to have all the technical information I require."

We suggest that the best mechanism shall not be the promotion of answers but the promotion of questions. A consumer who feels confident they know what questions to ask in a marketplace may find their answers in many places. This knowledge by its nature promotes a consumer having control over the purchase process and therefore confidence in the purchase process. A consumer who does not possess effective questions will be hard pressed to locate or recognize relevant information.

The six indicators are therefore presented in question form. These questions, and sample answers to the six questions may be provided on an impartial site on the internet. Each supplier should also have a link to this information site, and end users should be encouraged to only purchase from suppliers who include a link to this centralized information resource on their own website.

"Has your supplier offered you complete and transparent information to guide your cost-benefit decision? Compare the cost-benefit process suggested by your supplier with the cost-benefit process found at www.----------.com."

"Test your supplier by asking how they think you should compare suppliers. Having reviewed the supplier comparison criteria at www.----------.com, - did your supplier tell you all of these things? If they didn't, make sure they explain why."

"Your supplier is aware of all the risks of how a system might not work properly. Has your supplier been informed and forthright with this information? Have they told you how they will fix any problems, should any arise?"

"Your supplier is aware of all the risks and/or benefits a solar system will have on your house. Is your supplier being clear and forthright with this information?"

"A list of your legal protections as a consumer is available at www.----------.com. Your supplier has summaries of this information. Has your supplier made you confident in your awareness of your protections under Australian law?"

While it will be impossible to have a single query to orient customers around technical information, the following statement [or one to similar effect] should also be added:

"Check with your supplier what means you have to access any technical information you might require now or in future. Ask them how their reference library compares to the logged queries at www.----------.com"

7.4: Solutions strategy 4 - Information must be centralized on the electricity price

In tandem with informing consumers, the industry must secure certainty that information on the voluntary feed in tariffs of electricity retailers shall continue to be published in one central location.

The NSW government presents a website myenergymatters.com which outlines the potential electricity tariff offered by every electricity utility. This information may change as often as the price policies of energy retailers change, and updated information on this is essential in a marketplace where the government does not a subsidized feed-in tariff.

This information is essential for consumers seeking to purchase. It must be presented, along with current electricity prices and electricity market operator price projections, on the same internet site as the information of the preceding 3 solutions strategies. This site must also contain the projected generation curves (in fair and average weather) of a photovoltaic system so a member of the public can estimate how much electricity a photovoltaic system of a given size may create and compare this with their own predicted usage data.

This will begin to give consumers who use the internet to research a central platform to approach photovoltaic technology.

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9 - APPENDICES

9.1: Appendix 1 - Barriers within the photovoltaics industry opposing information flow

The following four barriers present concerns which may prevent organizations within the photovoltaic industry from effectively delivering information solutions to the public. These barriers are proposed in the hope that a comprehensive list of the barrier concerns may be identified to assist implementation of solutions strategies.

Barrier 1 - Is the company with the most industry information always the company with the most competitive product?

If one company informs the public on performance indicators to compare technology suppliers, all purchasers shall be directed toward competing firms who outperform on these performance indicators. From an individual company perspective this not efficient advertisement investment.

Barrier 2 - No organisation exists with the PV industry that is independent of 6.5-1

Therefore no organisation would immediately profit by generating information that would most efficiently fulfill public requirements.

Barrier 3: The investment involved in acquiring comprehensive customer-oriented information is significant

it is a necessary yet insufficient criteria for customer information packages to be objective and informative. The information which is necessary must also

- Not disorient readers
- Create an affinity between readers and the technology

To avoid disorienting readers, the information must explain the technology using language and concepts that connect to existing concepts within the familiarity comfort zone of readers.
To achieve this process, the relevant existing concepts within the familiarity comfort zone of readers must be identified and categorised according to the action stage of readers.

To create an affinity between readers and the technology, it is essential to efficiently express to a reader that the technology meets the readers needs, and how.
To achieve this process it is essential to categorise and identify the 'trigger' needs which successfully attracted historic purchasers of the technology to complete technology purchases.

The pre-written information packages must therefore be created which suit end user requirements <u>before a given end user knows what their own requirements are</u>. This process requires precise identification of a user's needs.
These tasks are significant in scale and imply cross-disciplinary communication. Theory from psychology, sociology and anthropology shall be involved in the process. It is assumed that this process therefore implies significant resource expenditure.

Barrier 4 - The investment involved in acquiring comprehensive customer-oriented information is ambiguous

Because the investment cost involved in obtaining this information is uncertain, and the return on investment is ambiguous, it is more difficult for companies within the PV industry to justify investment on this information.

9.2: Appendix 2 - The Survey

Survey ID ☐☐☐

DEMOGRAPHICS
AGE

☐ 18-24 ☐ 25-34 ☐ 35-44 ☐ 45-54

☐ 55-64 ☐ ≥ 65

EDUCATION

☐ SCHOOL CERTIFICATE ☐ HIGHER SCHOOL CERTIFICATE

☐ TRADE QUALIFICATION ☐ BACHELOR DEGREE

☐ POST-GRADUATE DEGREE

SEX

☐ MALE ☐ FEMALE

HOUSEHOLD INCOME

☐ ≤ $25,000 ☐ $25,001 - $45,000 ☐ $45,001 - $65,000

☐ $65,001 – $85,000 ☐ $85,001 – $105,000 ☐ ≥ $$105,001

RESIDENCE

☐ Rent ☐ Mortgage ☐ Own ☐ Living with family/friends

DWELLING

☐ Free standing house ☐ Semi-detached house

☐ Villa/duplex ☐ Apartment

COUNTRY-- POSTCODE ---------------------------------------

Q1: Do you have a solar energy system? Yes / No

If yes, please answer questions 2-5.
If no, please turn over to answer questions 6-12

Q2: When did you buy your solar system?

Q3: From 1-8, which factors MOST influenced your decision to buy?

__ Current electricity prices

__ Expectation of future electricity prices

__ To improve the sale value of the house

__ To reduce personal carbon footprint

__ To protect the environment

__ To support renewable energy development

__ To encourage other customers to support renewable energy

__ To be involved with new technology and progress

__ Other (please describe) ______________________________________

Q4: Was the experience of finding information to assist your decision to purchase

Extremely Difficult Extremely Easy

1 2 3 4 5

Q5: What information would have made your purchase easier?

____

____

____

____

Thank you for the time you have given to assist with this research

If you do not have a solar system, please turn over to answer questions 6-12

If you do not have a solar system:

Q6: From 1-9, what concerns you most about purchasing a solar energy system?

☐ High start up cost

☐ Government rebate offers

☐ Environment

☐ Information about solar energy is too hard to find

☐ There is a risk that a system won't work as promised

☐ Impact on other risks, e.g. house fires.

☐ Legal & Warranty processes uncertain

☐ Appearance of solar panels on roof

☐ Other (please specify)_______________________________________

Q7: If information was not available regarding the concerns raised above, from 1-5 how motivated would you be to seek answers?

Not at all motivated   Extremely motivated

1   2   3   4   5

Q8: Assuming you were motivated to seek this information, from 1-5 how confident are you that you could find the answers?

Not confidant   Extremely confidant

1   2   3   4   5

Q9: If this information were not available, from 1-5 how probable is it you would buy solar?

Extremely unlikely   Extremely likely

1   2   3   4   5

Q10: Please tick any of the concerns you consider a barrier to purchasing a solar energy system:

Financial:

- ☐ Low energy user (would not need a system)
- ☐ Don't understand how the rebate / power purchase system works
- ☐ Don't understand how solar systems make money
- ☐ Solar electricity is not cheaper than grid
- ☐ Solar electricity will not become cheaper than grid
- ☐ The cost of electricity is an unknown determinate
- ☐ Other____

Q11: Information:

- ☐ There is no independent/unbiased information
- ☐ Information from companies too sparse
- ☐ Information from companies is biased
- ☐ Information from companies is too technical
- ☐ Information from different companies is not easy to compare
- ☐ Don't know criteria to compare suppliers and deals
- ☐ The finances of solar power are unclear
- ☐ I do not trust information I have found so far
- ☐ Other____

Q12: If considering the purchase of a solar power system:

A) "I can access transparent and trustworthy information I need for a cost-benefit decision."

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

B) "I know what key criteria I should use to compare suppliers."

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

C) "I know how likely it is my system might not deliver on promised output."

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

D) "I understand the risks and/or benefits a solar system will have on my house"

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

E) "I understand my legal protections as a consumer"

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

F) "I have all the technical information I require."

To what degree is the statement true:	1	2	3	4	5
To what degree is the statement relevant:	1	2	3	4	5
If this statement were 100% true how would this affect your decision to purchase solar energy	1	2	3	4	5

Q12: How thoroughly do the above statements reflect your potential concerns?

Poorly Thoroughly

1 2 3 4 5

If you have additional concerns not reflected in these statements please describe:

____

____

____

Thank you for the time you have given to assist with this research

9.3 Appendix 3 - Generic list of FAQ's - amended from specific list directed to a photovoltaic module manufacturer

1. Orientation concepts:

Customers may desire orientation as to the fundamental processes by which PV systems operate and the properties of PV modules as nonlinear electricity generation devices

A. Fundamental operating principles of PV
B. I-V curve & its impact on electrical performance
C. Product history of materials (industry evolution)

2. "I want to access transparent and trustworthy information I need for a cost-benefit decision."

Customers may not understand the value of PV output electricity, or feel uncertain about the security of electricity purchase prices.

A. Insurance
B. Economic forces in PV markets
C. Utility power purchase arrangements
D. Electricity price security

3. "I want to know what key criteria I should use to compare suppliers."

Clients may desire certainty that the system they are purchasing is of high standard and cost competitive.

A. 1. What information is important in comparing suppliers
B. 2. Where can supplier comparison information be found
C. 3. Technical spec sheets explained

4. "I want to understand my legal protections as a consumer"

A. Warranty terms, procedure & guidance
B. Photovoltaics - Australian Standards
C. Impact of Overseas Standards
D. Australian Consumer Protection Law - Manufactured Products

5. "I want to know how likely it is my system might not deliver on promised output."

Clients may wish to be assured their PV system will not suffer reduced output which would adversely affect the systems financial payback period.

1. 1. Module failure overview
2. 2. System failure overview
3. 3. System test procedures
4. 4 Module Long term durability testing
5. 5. Dirt & Cleaning
6. 6. Tilt angle & Orientation

7. 7. Shading
8. 8. Low light performance
9. 9. Corrosion of frame
10. 10. EVA
11. 11. Silicone sealant
12. 12. Backsheet damage
13. 13. Light induced degradation
14. 14. Diode failure
15. 15. Cell discolouration
16. 16. Potential induced degradation
17. 17. Hot-spots
18. 18. Mechanical loading & wind
19. 19. Frame tolerances
20. 20. Thermal expansion after installation

6. "I want to understand the risks and/or benefits a solar system will have on my house"

Clients may wish to be certain that installing a PV system will not increase risk to their existing assets or family.

A. House fire risks
B. DC electricity safety
C. Assessment of added house value
D. Installation - Grounding
E. Installation, handling & transport
F. Roof leaks under PV systems
G. Wiring, junction box & connection best practice
H. Commissioning procedure

7. "I want to have all the technical information I require."

Some clients may desire in depth knowledge regarding their photovoltaic system to promote a sense of ownership.

A. Monocrystalline pv vs polycrystalline pv
B. Silicon vs other semiconductors
C. Choice of superstrate glass
D. AR coating
E. Reflectivity
F. Absorption & light trapping
G. Raw material suppliers
H. Disposal of modules
I. IR imaging (hot-spots)
J. Electroluminescence (microcracks)
K. Output degradation measurement practices
L. Manufacturing QC checkpoints
M. BIPV specific faults
N. Sampling test procedures (large installations)

- MSDS

9.4 Appendix 4 - Solution paper for indicator 1 - Financial rationale for the purchase of a solar generator (Photovoltaic system) - NSW

The Australian Energy market Commission has forecast that the price for electricity paid by a household to the electricity grid shall rise above 30 cents within one year. The technology of Solar Generators - formally known as photovoltaic systems - has advanced to the point where household may use this technology to generate electricity at a lower price than the grid.

The following financial description reflects an optimal system.

System size	Electricity produced p/a	Price which would be paid for this electricity at current prices	Price which would be paid for this electricity at AEMO predicted 2013 price
1 kW			
1.5 kW (~ $2000)	~1710 kWh	$ 393	$ 530
2 kW			
3 kW			
5 kW			

Table 16 - Generic system data (To be drawn from simulation data)

It must be noted that the most expensive component of these systems (the photovoltaic modules) carry warranties of 25 years, and the rest of the electronics required will have a 10 year warranty if purchased from any major retailer.

Seen over a six year period, a best-case theoretical investment of $2000 should earn $3180, continuing to operate until the end of its 25 year life[4]. The purpose of this document is to discuss from a customer's perspective what steps must be taken to ensure an investment in photovoltaics is as close as possible to the theoretically optimal

[4] Readers note - the annual electricity production estimate should be drawn from simulation models which include all relevant de-rating factors, allowing these to be removed from analysis.

rate of return.

Some of the following points may appear to be truisms. However the overall strategy may be used as a best-practice method on which to base supplier comparison.

Part 1 - Basic orientation

- All households use electricity
- 'The grid' describes all the infrastructure involved in delivering electricity to the power points in businesses and residences.
- Electricity is purchased ('Imported') from the national electricity grid ('the grid')
- Households decide when they demand electricity and how much
- A household which purchases a Solar Generator owns the electricity produced by the Solar Generator
- The value of the Solar Generator is therefore equal to the monetary value of the electricity it produces
- Increasing the price associated with this output electricity allows the initial set-up cost to repay itself faster.

Part 2 - Units of electricity

- A kilowatt is a thousand watts. Both of these measure energy used per second.
- All electrical appliances have an electricity requirement measured in kilowatts. For example, the label of a bar heater may indicate it uses 1.2 kilowatts when it operates
- Kilowatts are a measure of how much electricity the appliance consumes <u>per second</u>
- Households buy electricity from 'the grid' in kilowatt-hours.
- A kilowatt-hour is the energy used by a one-kilowatt appliance operating for one hour
- This removes time from the electricity measurement, simplifying your electricity bill.

Part 3 - Electricity in the marketplace

- The market value of one kilowatt hour is not constant.
- Electricity retailers sell kilowatt hours to households at 23 cents per kilowatt hour (a price which shall soon increase)
- If a household produces electricity from a photovoltaic system, it must sell electricity to the same retailer from which it purchases electricity
- Some electricity retailers in NSW offer to buy electricity from households for 6 or 7 cents per kilowatt hour. Some offer nothing at all.

It is possible to control which price applies to the electricity produced by a Solar Generator. To control which electricity price applies, a critical first step is to be aware of the average electricity use of the household by time of day.

Part 4 - Identifying the electricity usage patterns of your household

There are four ways to gain this information:

- Research 'Residential load profiles' - that is the term used to describe household electricity use in the industry. You should be able to find some average load profiles which look like this. Note that the load profile of the same house will change seasonally, and look at several to get an idea of how they can change. This load profile was extracted from "An analysis of photovoltaic output, residential load and PV's ability to reduce peak demand" (M. Watt, 2006)

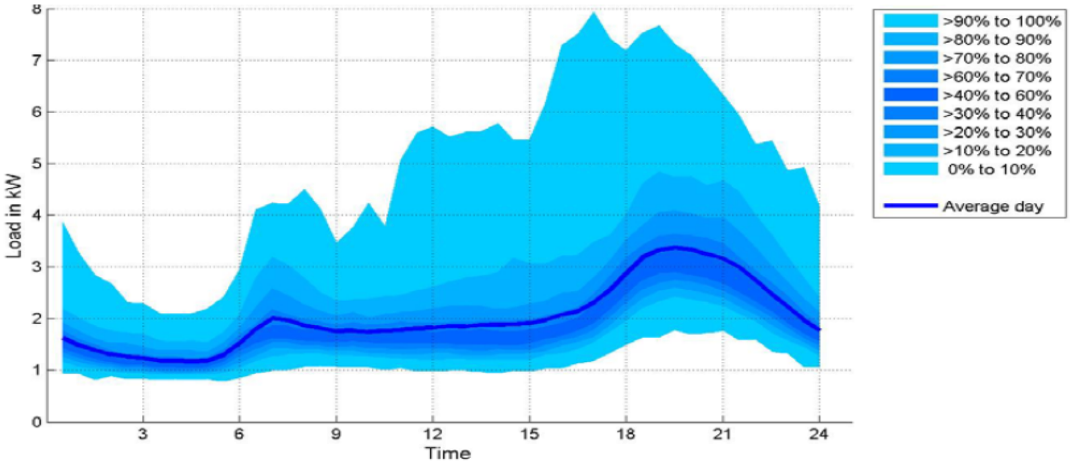

Figure 20 - Newington village load profile

- Alternately, you may use an electricity calculator or energy calculator, such as the tool offered by Origin energy: http://www.originenergy.com.au/calculator

- If you are prepared to have your electricity price vary by time of day, consider installing a smart meter. These meters measure your electricity use every half hour and you will see graphed results with each of your power bills. Make sure the meter is compatible with a photovoltaic system installation and placed close to the switchboard of your house.

- A good option is to contact a licensed electrician and ask for a quote to have a time-of-use ammeter placed on the switchboard of your house for a week. Make sure the device records your electricity use at least every 30 minutes. This is the best information with which to gauge your electricity needs.

Part 5 - Look at your electricity use at noon, when the sun is highest.

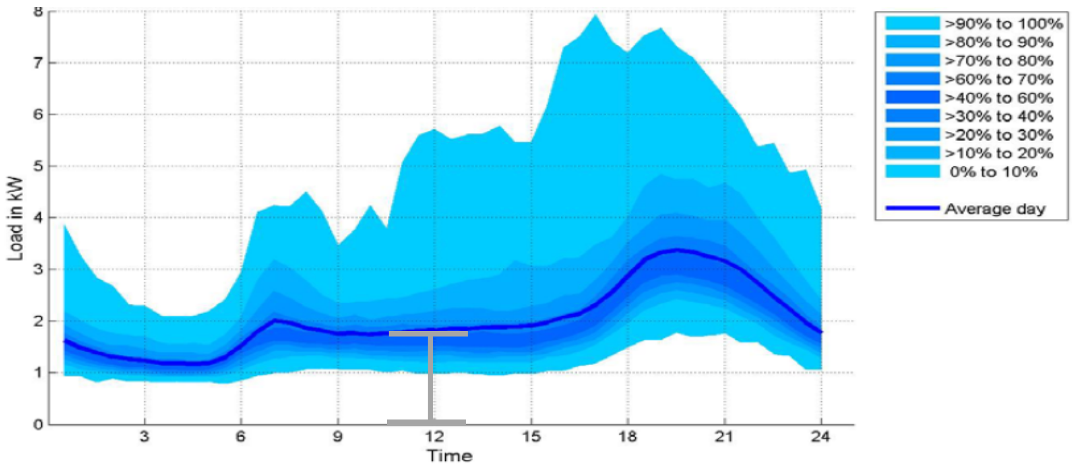

Figure 21 - Load profile indicating use at solar noon

In the example above, the electricity use of a group households was measured. The average use profile is indicated by the dark blue line. The average use at noon was about 2 kilowatts.

Now it is possible to choose a Solar Generator which has maximum production equal to the average use of your household. The first key point in this stage is to understand that Solar Generators are classified by their input, not their output. So a 1 kW Solar Generator will [after all electrical losses] produce a maximum output of around 0.7 kW if correctly installed. This is done to keep industry measurements consistent.

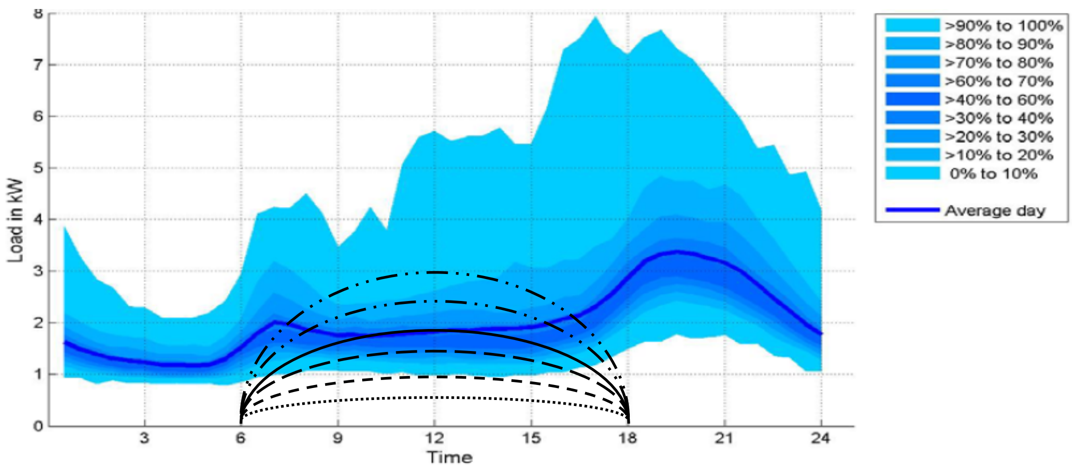

Figure 22 - Load profile with superimposed generation curve of PV

Ask your manufacturer for data about the daily output of their Solar generators in fair weather. They should be able to give you simulation estimates of the electricity in fair weather for different size solar generator systems - 1kW, 1.5 kW, 2 kW, 3 kW, 4 kW and 5 kW. You can compare this to the graph of your load profile to see what size solar generator - at noon - produces as much electricity as you use on an average day.

While it is possible that the household will use less electricity on some days, it is also possible that poor weather will reduce the power generated by the 3 kW Solar Generator. Therefore this system is sized to reap the highest economic benefit per dollar invested, assuming all relevant installation guidelines are followed (tilt, orientation and solar access)

The information which you have read in this paper is sufficient for you to calculate the cost-benefit decision to purchase a Solar Generator.

To summarise:
- Identify the electricity use of your household at noon
- Identify what category of Solar Generator will have a final output at noon equal to your household average electricity use
- Remember that Solar Generators produce more electricity in summer and less in winter, so think about how your electricity use changes seasonally!
- Using this strategy you can assume that all the electricity your Solar Generator produces is worth the same electricity price that you usually pay (since you will use all the electricity you produce)
- Find out how much electricity your Solar Generator will produce in a year, and multiply that by the price you usually pay your retailer for electricity. That is how much money you can expect to save.

You may therefore weigh the annual savings against whatever upfront investment cost is quoted to you to install a Solar Generator. Use the knowledge you gained in this paper to check that the salesman sells you a system that is right for your needs!

As a final word - be sure to only look at established brands. Look for companies that have operated for ten years or more as a rule of thumb. This is a good rule when purchasing any manufactured product, and very true for Solar Generators.

9.5 Appendix 5 - HREA application

Application Number For office use only	

The University of New South Wales

Human Research Ethics Advisory (HREA) Application Form

Instructions for applicants:

Answer all questions.

Attach any relevant documents.

Contact your school administrator for UNSW letterhead (Q7) and for the location of your School/Unit/Research Centre's central repository for the storage of collected data (Q10).

For submission requirements ie number of hardcopy and/or electronic copies please see:

Contact your HREA Panel.

Additional Instructions for student applicants:

It is required that applications from students are prepared in time for Supervisor/s to read over, suggest comments and changes, and sign before submission, otherwise the approval process will be delayed.

1. Investigator/s

School/Unit/Research Centre

School of Photovolatic and Renewable Energy

Investigator/s	**Title**	**Family Name**	**First Name**	**Work Telephone/ Mobile**	**Email**
First		Kiel	Roland	0450 175 121	azaraneth@gmail.co

Investigator					m
Co-Investigator/s					
Supervisor/s (Student applicants only)	Dr Dr	Bremner Parlin	Stephen Scott	(02) 9385 7890 (02) 9695 8147	Stephen.bremner@unsw.edu.au scott.partlin@suntech-power.com

2. Status of Investigator/s

☐ Academic ☒ Student

Candidate level (Student applicants only)

☐ PhD ☐ Masters ☐ PG Dip ☒ Honours ☐ Other ____________________

3. Project Title

An Investigation of Customer Caution in Photovoltaic Markets

4. Project Description

Attach a description of the project including aims, hypotheses, research questions and methods on a separate page (approx 500 words).
Attach a copy of sample interview questions/questionnaires/surveys and interview schedules if applicable.

Attached

5. Potential for Harm to Participants and/or Investigator/s:

Refer to the National Statement: 1.Values and Principles

Is there any potential for harm: physical, psychological, social, cultural or financial to participants and/or the investigator/s?	☐ Yes ✕ No
Are there any potential risks to participants and/or the investigator/s?	☐ Yes ✕ No
If you answered 'Yes' to either of these questions, please describe the potential harm/ risks, estimate their probability, and explain how you will seek to minimise and/or avoid these.	

6. Selection and Recruitment of Participants

Refer to the National Statement: 4.2Children/Young people; 4.5.Mental impairment; 4.4.Dependent on medical care; 4.3Unequal relationships; 1.10 and 4.7.Collectivities; 4.7.Indigenous

Please note the term recruitment is used here to mean: select, contact and request to participate. It does not necessarily denote payment or employment.

Will participants be recruited to take part in this research?	✕ Yes ☐ No
Is there any possibility that participants will feel coerced to take part in this research?	☐ Yes ✕ No
Are participants in a dependent relationship with the investigator (eg. teacher and student, friends, family)?	✕ Yes ☐ No
Will participants be offered an inducement to encourage their involvement?	☐ Yes ✕ No

The survey will be transmitted by three vehicles. These shall be 1. electronically via a google form with participants opting in via facebook 2. Face to face interaction with unknown public at five geographic locations across Sydney and 3. Presentation of the survey to a number of social groups, including my workplace, the workplaces of family members and social groups. Regarding the issues of coercion and dependent relationships: - Family will not participate in the survey. They may contact their friends or work colleagues and offer involvement in the survey. - Required survey recruitment numbers are significantly less than half of the number of people who shall be contacted. This will be included in the consent form. This creates fair leeway for each person contacted to elect against participation. Responses from known persons shall be separated from other responses. No inducements will be offered. No teachers shall be involved. I have no dependents other than those mentioned.

7. Informed Consent

Refer to the National Statement: 1.10 Respect, 2.2,2.3: Consent ; 4.4.Dependent on medical care; 3.2 Databanks ; 3.4.Tissue samples; 3.5.Genetic research

Will the investigator/s request written informed consent from participants?	☒ Yes ☐ No
If you answered ‘No’ please justify why not. If you answered ‘Yes’ please complete and attach a Participant Information Statement and Consent (PISC) form. Please note PISC forms that are not on the appropriate UNSW letterhead will not be approved by the panel.	

8. Privacy

Will the investigator/s need to identify, collect, use or disclose information of a personal nature (either identifiable or potentially identifiable) about individuals without their consent (eg from Commonwealth departments or agencies, State departments or agencies, or non-government organisations)?	☐ Yes ✕ No
If you answered ‘Yes’ to any of these questions, please complete and attach the HREA Panel Privacy Data Form	

9. Observations and Records

Refer to the National Statement: 2.3.Qualifying waiving conditions of consent

Is it necessary for the investigator/s to make recorded observations of participants (eg. audiotapes, videotapes, photographs or written notes) during this research?	☐ Yes ✕ No
Is it necessary for the investigator/s to use records or database information during this research?	☐ Yes ✕ No
If you answered ‘Yes’ to either of these questions, please briefly explain why and how this will be done. Please note that any form of recorded observation must be outlined on the PISC form.	

10. Confidentiality, Privacy and Anonymity

Is there any possibility of participants being inappropriately identified or confidential data being divulged during or after the research has taken place?	☐ Yes ✕ No
If you answered ‘Yes’ please describe the measures you will take to ensure privacy, confidentiality and anonymity are preserved.	

Please confirm that all collected research data will be stored for a minimum of 7 years in the investigator/s school/unit/research centre's central repository.	✕ Yes ☐ No
School of Photovoltaics and Renewable Energy, Tyree building.	

11. Deception and Debriefings

Refer to the National Statement: 2.3 Qualifying and waving conditions for consent

Is it necessary during the research to deceive participants?	☐ Yes ✕ No
If you answered 'Yes' please explain why and outline how this will be done. Please attach a description of your debriefing procedure for participants.	

12. Conflict of interest, including financial involvement

Refer to the National Statement: 5.4 Conflicts of Interest

Is the research being funded by an agency outside UNSW?	☐ Yes ✕ No
Is any conflict of interest (including financial gain) likely to result from this project?	☐ Yes ✕ No
If you answered 'Yes' to either of these questions, please provide details and attach official documentation.	

13. Organisations other than the University of New South Wales

Are organisations other than UNSW involved in this research?	✕ Yes ☐ No

If you answered ‘Yes’ please provide details and attach a letter of support from the organisations.

14. Declaration of Investigator/s

I/we apply for approval to conduct research. If approval is granted, the research will be undertaken in accordance with the information provided in this application, the protocols described in this application, and any other relevant guidelines, regulations and laws.

Investigator/s	**Name**	**Signature**	**Date**
First Investigator	Roland Kiel		
Co-Investigator/s			

15. Declaration of Supervisor/s (if applicant is a student)

I/we have read over this application in its entirety and will endeavour to ensure my/our student undertakes his/her research according to all UNSW ethics protocols.

Supervisor/s	**Name**	**Signature**	**Date**
Supervisor			
Co-Supervisor			

Checklist (to be filled in by the applicant)

Required

Checked HREA website for number of hardcopies and/or electronic copies required for submission	☐ Yes ☐ No

Question	Document	

4	Project Description	☐ Yes ☐ No
14 & 15	Signature/s of all Investigator/s and Supervisor/s	☐ Yes ☐ No

Additional Attachments

Question	Document	
4	Sample interview/questionnaire/survey questions	☐ Yes ☐ No
4	Interview schedule	☐ Yes ☐ No
6	Recruiting advertisement/poster	☐ Yes ☐ No
7	Participant Information Statement and Consent (PISC) form	☐ Yes ☐ No
8	HREA Panel Privacy Data form	☐ Yes ☐ No
11	Debriefing procedure	☐ Yes ☐ No
12	Funding details	☐ Yes ☐ No
13	Letter of support from external organisation/s	☐ Yes ☐ No
	Other:	☐ Yes ☐ No

29th May 2012

To whom it may concern,

For the duration of the 2012 academic year, Roland Kiel will be undertaking his 4th year undergraduate thesis with Suntech R&D Australia (SRDA).

He has discussed with SRDA his plans for his thesis "**An investigation of customer caution in photovoltaic markets**", including his intention to survey the general public.

SRDA understands the issues arising from this thesis, and supports Roland's work in this regard.

Sincerely,

Scott Partlin
Senior Engineer, Thesis Supervisor

82-86 Bay Street Botany NSW 2019 Sydney Australia. Telephone +61 2 9316 6811 Facsimile +61 2 9666 4079 Web www.suntech-power.com
Suntech R&D Australia Pty Ltd ACN 109 221 258 is a wholly owned subsidiary of Suntech Power Co., Ltd.

UNSW

School of Photovoltaic and
Renewable Energy

22 May 2012

Dear Sir / Madam

The following survey is part of an investigation into customer caution in photovoltaic (solar energy) markets. The survey seeks to determine what information the public desire to know about solar energy.

The survey also seeks to determine whether public access to such information is sufficient and if this information is understood by potential consumers. If it is not, the survey explores the effectiveness of a proposed method to improve the communication of information, and what effect this may have on purchase decisions.

It is hoped that the results of this study will improve communication regarding solar energy to the general public.

Participation is entirely optional and all information is de-identified.

If you would like more information about this study you may contact me on
0450 175 121.

Kind Regards
Roland Kiel

I have read the above and consent to participation in this survey

No / Yes

(Printed Name)___________________________

(Signature) ______________________________

THE UNIVERSITY OF NEW SOUTH WALES
UNSW SYDNEY NSW 2052 AUSTRALIA

Telephone: +61(2) 9385 2840
Facsimile: +61(2) 9385 2163

ABN 57 195 873 179
CRICOS Provider No. 00098G

Project Description

Project title: An Investigation of Customer Caution in Photovolta

Background:

Electricity produced from solar systems has varying monetary worth a
to constant change from government policy. The product is technical
members of the public therefore have little or no pre-existing awareness of the solar industry.

The information transmission vehicle for consumer awareness of solar energy is solar system retailers. Retailers tend to offer such information as aids the sales of that retailer, due to vested interests.

Without objective information, customers are unable to act as rational purchasers in the marketplace.

Aim:

To improve information transmission in the PV marketplace by creating a unified framework that guides consumers to what information they should seek.

Hypotheses:

- Lack of information is contributing significantly to customer caution and this is limiting uptake of solar energy systems.
- Current solutions-based customer information is penetrating slowly because priority has not been placed on addressing pre-existing motives of consumers.
- An effective solution to this problem would be to provide customers with a list of queries that they ought to expect any solar retailer to provide answers to.

Research questions:

- Does customer caution exist
- To what degree is this finance related
- To what degree is this information related
- Are other factors present

Method:

A survey will be designed to examine the research questions.

This survey will be distributed to an extended network of workplace environments and through social media including internet contacts and facebook. The general public will be approached and invited to participate at three urban environments in the city of Sydney: Circular Quay, Kirribilli Markets and Parramatta Mall.

Descriptive statistics will be calculated for numbers data (quantitative) collected from participants and additional data will be analysed by summarising key themes made by respondents.

Following analysis of the data, solutions papers to address the concerns will be written which will be made available to industry for distribution to customers.

Outcomes:
For this project it is necessary to

- Identify & define the information transmission issue
- Validate the existence of an information gap via a demonstrative survey
- Use the survey results to compose appropriate solutions

The goal of this survey is to determine whether the issue warrants broader investigation. Conclusive proof of the trend, evaluation of the solutions papers and whether they influence consumer behavior is to be left to future work.

Because the purpose of this survey is only to demonstrate the existence of an issue it shall be possible to present survey forms to more people than are required for its sample size (by a wide margin). This addresses concerns that potential respondents might feel pressured to be involved. Large response sizes are not essential for the project to succeed in its core outcomes.