ANALYSING SOCIAL ACCEPTANCE OF RENEWABLE ENERGY POLICY IN AUSTRALIA:

COMMUNITY, INDUSTRY AND GOVERNMENT PERCEPTIONS OF RESIDENTIAL SOLAR ENERGY

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This thesis is presented for the degree of Doctor of Philosophy of The University of Western Australia
School of Earth and Environment
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THESIS DECLARATION

I, Genevieve Simpson, certify that:

This thesis has been substantially accomplished during enrolment in the degree.

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The research involving human data reported in this thesis was assessed and approved by The University of Western Australia Human Research Ethics Committee (Approval #RA/4/1/6197).

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This thesis contains published work and work prepared for publication, some of which has been co-authored.

Signature:

Date: 8 March 2017
ABSTRACT

Australian governments, at federal, state and local levels, have promoted the increased penetration of renewable energy generation in an effort to reduce greenhouse gas emissions. While some policies have supported the development of large-scale projects, financial incentives have been made available to stimulate the adoption of residential solar (photovoltaic) systems. Incentives are provided on the assumption that they will increase the likelihood of solar systems being adopted; however, social acceptance of the technology is also required. Wüstenhagen et al. (2007) developed a ‘triangle of social acceptance of renewable energy innovations’ to describe the various dimensions of this social acceptance. Social acceptance includes community acceptance and issues of justice, such as whether the costs and benefits of a technology to the wider community are deemed acceptable. Community acceptance also translates into trust in both a technology and the procedures and practices around its adoption. Market acceptance is another dimension, where investors/consumers are willing to participate in transactions supporting the technology. Finally, socio-political acceptance is required in the form of policies and stakeholders willing to provide official support for the technology and any changes to institutions required for its adoption. This model was used as a framework for considering the social acceptance of renewable energy and associated policies in Australia, with a particular focus on the acceptance of residential solar energy in Western Australia. The research considered perceptions of justice around the cross-subsidisation associated with incentivising solar, the influence of incentives on the market acceptance of solar, perceptions of the policies and government processes associated with supporting solar and trust in industry.

The study used a mixed-methods analytical approach, including quantitative survey data, qualitative interview data and content analysis of publicly available secondary sources. Four metropolitan and two regional communities in Western Australia participated in two mail-out surveys in 2013 (295 and 362 responses), with follow-up semi-structured interviews with 35 householders in 2013-15. An additional 33 interviews with members of industry and government were performed during 2015. Triangulation of findings from the researcher-generated data was undertaken through the use of government review submissions, publicly available installation data, analysis of policy announcements and legislation, and responses from the media. The findings are provided via seven published
and submitted research papers, each reflecting the perceptions of a different group of stakeholders in relation to a different aspect of renewable energy support.

These papers present a picture of the Australian residential solar energy market and its consumers. The results of the research indicate that incentives promote the adoption of residential solar energy by a group of consumers who would otherwise have chosen not to adopt. Additionally, incentives may be promoting adoption by a more disadvantaged group of consumers, with associated financial equity benefits. Residential householders, both those who have installed solar and those who have not, support the availability of financial incentives to stimulate solar adoption and most accept contributing to financial incentives, including through their electricity tariffs. However, residential householders lack the knowledge to make sound decisions around renewable energy, and are uncertain of who to trust. Both residential householders and representatives from industry view governments and government processes related to solar technology incentives unfavourably. Government policies are seen as unreliable and not sufficiently comprehensive in their support for renewable energy. Industry has suffered under frequent review processes, a lack of stability in policy and a lack of transparency around government decision-making. Network operators are perceived to be ‘pushing back’ on increasing penetrations of distributed generation, including residential solar. Additionally, householders believe that the solar industry is untrustworthy and not appropriately regulated. The findings of the research were used to develop policy recommendations for increasing the social acceptance of residential energy, which are transferable to other jurisdictions or innovations.

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CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

'The effectiveness of incentive policies can be improved by conducting empirical studies to evaluate the effects of incentives on the rate of adoption, continuation and consequences of innovations.'

(Rogers 2003, p239)

The advancing threat of anthropogenic climate change has led industry, governments and communities to consider alternative forms of resource production and consumption. With electricity generation accounting for 33% of Australia's greenhouse gas emissions, the largest contribution from any sector (Australian Government, 2015), the development of renewable energy technologies represents a valuable opportunity to transition towards a decarbonised economy. At present a number of government policies support both the technological advancement of renewable energy and the increasing penetration of renewable energy in the electricity sector.

A number of frameworks have been used to interrogate the transition of the energy sector towards a higher penetration of renewable technologies, including the 'multi-level' socio-technical transitions model (Rip and Kemp, 1998). This model suggests that a transition process occurs across three tiered levels. The initial 'niche' level is the point at which a technology favoured by special interest stakeholders will take advantage of a 'window' to integrate with the incumbent 'regime'. The 'regime' level is where the existing system is situated, not only in terms of technological infrastructure but in terms of key stakeholder interactions and institutions that act as the 'rules of the game' for how the 'regime' functions. Above the 'regime' level is the 'landscape'; the level at which over-arching social, economic and environmental objectives can influence the 'regime', for instance an economy-wide strategy for emissions reduction.

In order for the transition to a low emissions energy system to emerge, social acceptance of new technologies is required at the 'niche', 'regime' and 'landscape' scale. Wüstenhagen et al. (2007) theorised the 'triangle of social acceptance of renewable energy innovation' as a
model to describe the different forms that social acceptance must take to be integrated into the electricity regime (Figure 1.1). In this model each of the three ‘corners’ of the triangle reflect a dimension of social acceptance. Community acceptance recognises that society-wide support for renewable energy will not necessarily translate into localised support for renewable energy developments, and instead acceptance is influenced by perceptions of justice in the implementation of projects. Market acceptance recognises that, in order for renewable energy to be widely adopted, renewable energy consumers and investors must be willing to financially endorse this new technology. Furthermore, market acceptance must also include industry participants from the incumbent energy ‘regime’ if there is to be successful integration of renewable energy with the existing energy infrastructure. Finally, socio-political acceptance, in the form of public, political and policy support is required to ensure that a reliable and consistent institutional environment exists to support renewable energy investments. While Wüstenhagen et al. (2007) did not indicate that any ‘corner’ of the triangle was more important than any other, Wolsink (2013) considered the socio-political acceptance dimension to be the most important for social acceptance of renewable energy. This is because community and market acceptance are both reliant on institutional and government support, not only of renewable technology but the institutional changes required to ‘link’ it to the incumbent system. Furthermore, socio-political acceptance is required to overcome the ‘lock in’ of the existing energy regime, which inherently favours existing modes of production and incumbent players.

A number of government policies are developed to help drive social acceptance of renewable energy technologies. In particular, financial incentives have been popularised as a form of support for promoting the installation of small-scale, distributed solar photovoltaic energy, particularly residential solar systems. Financial incentives reduce the capital cost of systems for potential solar consumers, driving market demand, promoting industry growth, increasing technology acceptance and therefore increasing the total penetration of renewable energy on the electricity network (Sun and Nie, 2015). And yet, financial incentives used to promote acceptance of a technology type might also result in issues for the institutions and communities that are required to sustain a transition towards a distribution-level renewable energy transition. For example, incentives can also influence adoption decision-making, result in cross-subsidies between consumers, promote unsustainable growth in industry and may not be relied upon across electoral cycles. Therefore, in order to develop best-practice financial incentives and other support policies,
the process and perceptions of financial incentive practices should be considered. Furthermore, the impact and interactions of these incentives with incumbent institutions, and the extent these institutions are set-up to accept increasing penetrations of distributed renewable energy like solar energy, should be considered.

Figure 1.1: The ‘triangle of social acceptance of renewable energy’ as developed by Wüstenhagen et al. (2007). Each dimension of social acceptance at each corner of the triangle is of equal importance.

The availability of financial incentives for the installation of residential solar energy has led to Australia having the highest penetration of small-scale solar installations in the world (Bruce and MacGill, 2016), with associated greenhouse gas emissions reductions and also increased electricity costs to pay for subsidies. This research examines the social acceptance of renewable energy, specifically residential solar energy, in Western Australia. The research focuses on the provision of financial incentives as a way to promote social
acceptance of residential solar energy technology, and the implications of this for members of the community, industry and government. The research considers stakeholders’ perceptions of the financial incentives themselves, as well as residential solar energy technology. The research findings inform the development of policy advice for improved social acceptance of residential solar energy, even in the absence of financial incentives. Therefore, the research considers the extent to which policies could be used to improve the institutions required to support an increase in the penetration of renewable energy. Furthermore, the thesis provides context for the findings in the broader discussion of attitudes towards renewable energy, government policy for its support and social equity outcomes. The thesis begins with an introduction to the status of Australia’s renewable energy policies and issues of relevance to the adoption of residential solar energy, separated according to the dimensions of social acceptance identified by Wüstenhagen et al. (2007).

1.2 Community Acceptance Dimension

Wüstenhagen et al. (2007) prioritised elements of justice in their description of the community dimension in the ‘triangle of social acceptance of renewable energy innovations’. The academic literature examining justice issues in relation to renewable energy projects has focused on procedural justice, distributional justice, and to a lesser extent outcome justice. A further important contributing factor in the community acceptance of renewable energy is the ability for social networks to promote engagement with renewable technologies. As such, community acceptance relates more to the institutions and modes of organisation that are developed to support, or continue to resist, renewable energy than the technology itself.

Procedural justice concentrates on the extent to which community members believe they have been included in the ‘procedure’ surrounding the development of a renewable energy project. In particular, given the perceived negative implications of large-scale wind project siting both in Australia (Gross, 2007) and overseas (Devine-Wright, 2005), such as negative visual amenity and (perceived) health impacts, the decision-making process regarding project planning and implementation is particularly contentious. Where localised opposition to renewable energy projects has been referred to as a case of ‘NIMBY-ism’ (Not In My Back Yard), where general public support for an innovation exists but there is site-based opposition, research has found that community responses are more nuanced and are
a reflection of the inclusiveness of decision-making and the ability to address local concerns (Wolsink, 2000). Literature broadly indicates that communities are more supportive of wind farms where the community is involved with the wind farm planning and development, where the community might be included in the management of the wind farm (by being shareholders, for instance) or where there are financial benefits to the community (Breukers and Wolsink, 2007).

The academic literature regarding energy policy and procedural justice generally focuses on site-oriented planning issues, for instance planning of wind farm locations (Gross, 2007) and re-opening of nuclear facilities (Visschers and Siegrist, 2012). The potential costs and benefits associated with facility siting are generally well-understood by community members and therefore the importance of planning agents focussing on fairness in decision-making processes is recognised. Given the distributed and personal nature of residential photovoltaic systems, and the lack of transparency regarding costs and benefits to all consumers, as well as individual experiences with institutions associated with adoption, there is understandably scant information regarding perceptions of procedural fairness in the development of policies incentivising adoption of residential photovoltaic technology. There is therefore an opportunity to investigate perceptions of procedural justice by community members regarding these policies. Procedural justice in relation to residential solar energy adoption in Australia might include consideration of the extent to which governments show commitment to renewable energy policies, including on-going support for existing schemes, efforts to use alternative methods to promote solar adoption, and regulation of the industry to promote market confidence. It also might consider the sense of ‘ownership’ over policy development processes by members of the public, including in terms of changes to Australia’s longest running vehicle for the support of renewable energy, the Renewable Energy Target.

Earle and Siegrist (2008) report on the ‘socio-ecological dilemma’: that in the majority of cases pro-environmental behaviours have benefits accruing to society as a whole, whereas the burdens and costs of pro-environmental behaviour are individualised and distributed throughout society, generating distributional justice outcomes (Wolsink, 2013, Gross, 2007, Törnblom and Vermunt, 1999). In relation to large-scale renewable energy projects the ‘goods’, including financial reimbursement for wind-farm siting, are internalised by landowners, while the ‘bads’ are shared by all those in the vicinity of the wind farm (Cowell...
Distributional justice issues also apply to support for the installation of residential solar systems, with financial benefits from the availability of incentives and reduced electricity bills and costs associated with paying for financial incentives and network support, unevenly spread across socio-economic classes.

Nelson et al. (2011) found that Australian policies developed to stimulate investment in residential photovoltaic installations, in particular premium feed-in tariffs in various jurisdictions, resulted in private benefits internalised by the participating household. Macintosh and Wilkinson (2011) found that these financial benefits likely fell disproportionately to higher income earners, with 66% of all households receiving a rebate over the life of the Australian Government’s Photovoltaic Rebate Program in areas with medium-high or high ratings on a regional socio-economic ratings scale. In contrast to those receiving financial benefits of residential solar systems, Nelson et al. (2011) found that those households within the lowest socio-economic bracket paid the highest proportionate rate of small-scale renewable energy taxation. The consideration of perceptions of distributional justice issues surrounding support for residential solar energy systems in Australia has not been previously researched. Additionally, it is worth noting that conflicting advice exists, with information available in the media suggesting that uptake of solar systems in regional communities and mid-lower socioeconomic areas is higher than in metropolitan and higher socioeconomic regions (Neales and Taylor, 2012), suggesting that further investigation of this issue is required.

It could be suggested that Australia’s policies regarding residential photovoltaic installations are resulting in social inequality, with households receiving subsidies and benefits that were sourced from tariffs that are not means tested and are therefore paid equally by all consumers, even those in hardship or on a low income. Householders who have chosen not to install, who do not have the funds available to install or who are incapable of installing solar systems for other reasons (for example tenancy status or structural limitations) are subsidising householders with installations. In spite of this, public support for renewable energy investment is high, with Australia’s Climate Institute finding that 71% of Australians (n=1145) support Australia’s Renewable Energy Target policy (Stefanova et al., 2014), which includes the delivery of financial subsidies for residential solar adoption. The high level of support for this policy appears to be a reflection of ‘outcome justice’, where support for a policy, including its costs, is based on perceived
benefits of its ‘outcome’, in this case reduced reliance on fossil fuel generation. Visschers and Siegrist (2012) have previously identified that the acceptance of a policy decision can be more heavily informed by the acceptability of the outcome of the policy and the energy source it promotes (renewable versus nuclear, for instance) than the acceptability of the decision-making procedure or distribution of costs and benefits. There is a question, then, as to how householders, both those who have installed systems and those who have not, perceive distributional injustice associated with the support of residential solar energy - whether they perceive this difference in the distribution of costs and benefits as unjust or an acceptable outcome in order to secure the environmental benefits associated with installation of renewable energy resources.

Finally, community acceptance of renewable energy innovations is demonstrated through community-initiated mechanisms promoting its adoption. The academic literature highlights the influence of peer-to-peer interactions, individuals acting as ‘champions’ within a community, and the development of ‘community renewable energy’ projects on community acceptance of renewable energy technologies. While definitions can vary (Hoffman and High-Pippert, 2010), community renewable energy projects are typically commercial-scale projects owned as a consortium by community members to deliver community benefits, such as reduced pollution (Krupa et al., 2015), economic benefits (Dóci and Vasileiadou, 2015), or improvements in energy supply and resources (Hoffman and High-Pippert, 2010). In its most ideal form, community renewable energy projects should be 'open and participatory', with community members involved in the planning, implementation and running of a renewable energy project, and also 'local and collective' with the benefits (financial and otherwise) accruing to the local community (Walker and Devine-Wright, 2008). In this way, community members develop a sense of ‘ownership’ over the community renewable energy project.

Not all communities have the capacity, resources, or accessibility to establish commercial-scale systems. In this case, community solar organisations can be established to promote the installation of residential solar energy systems (Noll et al., 2014). Local ‘solar champions’ often lead these community groups, using their existing links with community members to ‘spread the word’ and influence decisions regarding technologies, and their available time and resources to invest in its promotion (Ruggiero et al., 2014). These solar organisations take advantage of existing ‘peer-to-peer’ networks to promote adoption, and
increase trust in renewable energy technologies by acting as an independent source of information. Rai and Robinson (2015) refer to the benefits of ‘peer-to-peer’ networks as ‘non-price’ interactions for driving the adoption of residential solar energy. Furthermore, active forms of ‘peer-to-peer’ interactions are not necessarily required to promote community acceptance of renewable energy innovations, with passive peer-to-peer interactions, including the presence of solar systems on other people’s rooftops, acting as tacit confirmation of the technology (Palm, 2016). While research exists around the development of commercial-scale community renewable energy projects in Australia (Hicks and Ison, 2011), prior to this thesis there was no research examining solar community organisations and associated peer-to-peer interactions promoting solar systems in Australia.

1.3 MARKET ACCEPTANCE DIMENSION

The ‘triangle of social acceptance of renewable energy innovation’ highlights market acceptance as a key dimension in the social acceptance of renewable energy. Wüstenhagen et al. (2007) highlight three key elements of market acceptance: consumer acceptance, investor acceptance and intra-firm acceptance. In the case of residential solar energy adoption consumers and investors are generally one-and-the-same and are treated as such here.

The most prominent model describing market acceptance of an innovation is Rogers’ (2003, 1962) Diffusion of Innovations Theory. While there are many elements to this theory, the most widely applied is the categorisation of adopters during the adoption process. The diffusion process begins with ‘innovators’ and ‘early adopters’, representing approximately the first 15% of the population who choose to adopt an innovation, before acceptance by the ‘early majority’. The innovators/early adopters and early majority adopters have markedly different characteristics in terms of demographics, interest in the innovation and information sources. The academic literature regarding community perceptions of residential solar systems has also used Rogers’ (2003) framework to describe the adoption process, indicating that those who choose to install photovoltaic systems are typical of the ‘early adopters’ in the diffusion process (Faiers and Neame, 2006). Namely, early adopters are educated (Sigrin et al., 2015, Stedmon et al., 2013, Keirstead, 2007, Vasseur and Kemp, 2015), concerned about the technical or environmental aspects of the technology (Chen,
2014, Schelly, 2014, Haas et al., 1999), and have disposable income allowing them to invest in an innovative technology (Faiers and Neame, 2006, Sigrin et al., 2015, Stedmon et al., 2013, Keirstead, 2007, Vasseur and Kemp, 2015, Islam, 2014). Studies on those intending to purchase systems in the future reflect similar motivations; consumers considered installing systems on environmental grounds, noting that cost barriers prevented them from purchasing systems at present (Leenheer et al., 2011).

Alternatively, ‘early majority’ adopters have demographic characteristics consistent with the general population and are less interested in the ‘innovativeness’ of a technology than on the utility of the technology to serve a function. In the case of residential solar energy systems, this could be interpreted as those who are less inclined to purchase a solar system on environmental or technological grounds compared with financial grounds. Additionally, ‘innovators’ and ‘early adopters’ are generally well-informed about a technology (Rogers, 2003). ‘Innovators’ are likely to be involved in the innovations industry and ‘early adopters’ are likely to be engaging with innovators. Therefore, these consumers are likely to have a good level of understanding on the strengths and potential weaknesses of an innovation (which is linked to their acceptance of potential failure of the technology). Conversely, the ‘early majority’ are more likely to receive information from friends or family, or have a general expectation of the effectiveness of an innovation not informed by expert advice. Therefore, positive experiences from previous ‘early adopters’ and ‘early majority’ adopters is likely to influence later adopters and the overall process of diffusion. There is, as yet, a lack of research around the characteristics and experiences of ‘early majority’ adopters of residential solar energy systems.

The academic literature also emphasises the importance of government policies and incentives, aimed at promoting the installation of solar systems, in increasing solar system installation rates. Rebates and subsidies reduce up-front costs to households (Macintosh and Wilkinson, 2011) and other mechanisms, such as feed-in tariffs, reduce the payback periods for systems (Couture and Gagnon, 2010). Couture and Gagnon (2010) review a range of feed-in tariffs from various jurisdictions, noting that feed-in tariffs consistently deliver an increasing supply of renewable energy more effectively and at a lower cost than other policy mechanisms. Similarly, Macintosh and Wilkinson (2011) found that an Australian solar rebate scheme was the central driver in a six-fold increase in the number of residential solar systems installed on conclusion of the scheme. The availability of rebates
themselves and perceptions of ‘free money’, as well as the ease of transactions associated with the purchase and installation of a system and securing of a rebate, and the extent to which information is readily available to those householders that seek it, will all impact on the success of government schemes. For instance, Adachi and Rowlands (2009) note that the ‘on-the-ground’ manner in which consumers interact with incentive programs, as opposed to the value of the incentives themselves, ultimately determines their effectiveness.

The academic literature indicating that financial incentives are effective in promoting consumer adoption of residential solar energy is unsurprising given Rogers’ (2003) theory on the effects of incentives on the adoption of innovations. These conclusions suggest that generous financial incentives promote adoption, promote adoption by a group of adopters different from those who would otherwise adopt, and those who choose to adopt may be heavily influenced by the availability of subsidies as opposed to an understanding of potential benefits of the innovation. In the short term, therefore, it appears that generous financial incentives may be able to overcome the ‘chasm’ in the process of adoption that occurs between ‘early adopters’ and ‘early majority’ adopters (Moore, 2014). However, given that early majority adopters may not fully appreciate the potential costs and benefits of an innovation, satisfaction with the innovation may be impacted by the availability of financial incentives, with likely influence on communication between later adopters around the innovation. Therefore, while generous financial incentives may promote early market acceptance of a technology this acceptance may not continue in the absence of financial incentives. Rogers’ (2003) conclusions on the effects of incentives on the adoption process have not yet been applied to the financial incentivisation of residential solar energy adoption.

Wüstenhagen et al. (2007) suggest that, in addition to consumer and investor acceptance of renewable energy innovations, intra-firm acceptance is required for complete market acceptance. In some ways the consideration of intra-firm acceptance is more important than general consumer and investor acceptance given it is at the point of intra-firm acceptance that the path dependent process of infrastructure decision-making, where all decisions are based on previous experiences with existing technologies (Foxon, 2007), is likely to be overcome. While Wüstenhagen et al. (2007) describe intra-firm acceptance in terms of those large-scale generation organisations that have historically invested in fossil fuel-based generation sources moving towards acceptance of renewable energy adoption.
technologies, other key stakeholders in the electricity sector regime and government agencies may also require intra-firm acceptance of renewable energy. In particular, the interaction between residential solar electricity systems and network operators is important given it is at this point in the electricity regime that solar will ‘link up’ with the incumbent energy system (Elzen et al., 2004). Network operators have historically been required to transport power from large-scale, centralised sites of generation, through transmission and distribution systems, to end-users. In the case of small-scale renewable energy systems, including residential solar systems, renewable energy technologies will be distributed throughout the energy system, closer to sites of consumption, with implications for network operators (Wolsink, 2012). In particular, installation of small-scale solar systems on networks results in the two-way flow of power in distribution networks, with voltage fluctuation outcomes (Sayeef et al., 2012). Furthermore, the installation of residential solar energy systems is resulting in a loss of revenue for network operators, given reductions in demand for grid-supplied electricity (Simshauser, 2016). This reduction in revenue for network operators in Western Australia, alongside inefficient tariff structures, is resulting in cross-subsidies between electricity consumers. The Chairman of Western Australia’s electricity retailer indicated that cross-subsidies to solar consumers are currently in the order of AU$280 million per year (Diss, 2015).

Cross-subsidies have always been a feature of electricity tariff structures in Australia. The majority of network costs can be attributed to ‘peak demand’ days in summer, when the use of air conditioners drives high residential electricity demand. Given air conditioner use is associated with high electricity consumption, and the ability for analogue meters to accurately measure electricity consumption, networks used the consumption part of the tariff to charge for network upgrades, with approximately 50% of the consumption tariff allocated to network costs (Synergy, 2014). However, this has historically resulted in households without air conditioning paying higher network charges than is equitable. Residential households with both air conditioning and solar are now thought to receive the largest cross-subsidies in network charges, with solar reducing the peak demand of the households only minimally but these households paying a fraction of their former total consumption rate (Simshauser, 2016). Potential cost recovery mechanisms implemented by networks include increasing the network charge on consumption-based tariffs, which would see higher electricity tariffs and further financial incentive for consumers with available capital to purchase solar systems to avoid consumption-based charges. In turn, network
operators might increase charges prompting further grid disconnection or solar installation in an ongoing cycle referred to as the ‘electricity death spiral’ (Simshauser, 2014). The existence of these cross-subsidies therefore has negative outcomes for both the network, in terms of cost recovery, and electricity consumers, in terms of increasing electricity charges. The process of acceptance of increasing penetrations of distributed renewable energy by network operators has not yet been considered in the academic literature.

1.4 SOCIO-POLITICAL ACCEPTANCE DIMENSION

The ‘triangle of social acceptance of renewable energy innovations’ devised by Wüstenhagen et al. (2007) also suggests that social acceptance of renewable energy innovations is reliant on socio-political acceptance. In particular, they suggested that it is not enough to have community support for renewable energy technologies as the acceptance of key stakeholders and commitment by policy actors to develop and implement effective policies and amend or create institutions to support renewable energy is a requirement of social acceptance. In other words, while there might be societal support for the ‘niche’ level technology, there must be a sufficient ‘window’ in the regime-level energy sector to accept renewable energy, which is likely to require support via landscape-level policies and guiding visions.

Internationally, most policies promoting renewable energy adoption are based on either Renewable Portfolio Standards or feed-in tariff schemes (Sun and Nie, 2015). These policies act as market incentives to promote renewable energy adoption. The first places a requirement on industry players, generally electricity retailers, to commit to supporting renewable energy investment, either in terms of supporting increased capacity of installed generation, or ‘certificates’/’credits’ equivalent to renewable energy generation. In this way, demand is created for renewable energy technologies. Feed-in tariffs require industry players, again generally retailers, to provide guaranteed income for renewable electricity generated and accepted on to an electricity network. In this case, demand for renewable energy is not created, however these policies provide financial benefits to renewable energy project proponents to increase cost-competitiveness with incumbent fossil fuel generating technologies. Additional forms of support for renewable energy technologies include publicity and education, tax exemptions, government rebates or subsidies directly for renewable energy installations, or regulations mandating proportions of renewable energy
(Everett et al., 2012), which are particularly relevant to small-scale technologies that can be included in building codes.

The penetration of residential-scale renewable energy technologies in Australia has increased as a result of a combination of some of these policies. The Australian Government’s Renewable Energy Target was developed to promote renewable energy adoption, with a target of 20% renewable energy as a proportion of total electricity generation by 2020 (Climate Change Authority, 2012). This policy includes support for large-scale generation via the Large-scale Renewable Energy Target and for small-scale generation (less than 100kW) through the Small-scale Renewable Energy Scheme. Technologies supported under the latter scheme include small-scale wind, hydro and solar photovoltaic systems and renewable energy displacement technologies, including solar water heaters and ground-source heat pumps (so-called because they ‘displace’ fossil-fuel electricity consumption). The Renewable Energy Target is effectively a Renewable Portfolio Standard policy, requiring electricity retailers and large energy users to purchase a proportion of large-scale and small-scale certificates each year. The value of these certificates is set in an open market, with small-scale technologies able to access a ‘deemed’ or assumed number of certificates over the theoretical life-span of a system (15 years for photovoltaic systems and 10 for displacement technologies). Solar retailers are therefore able to provide an upfront discount on solar systems to solar installers, based on the capacity of the solar system, the market value of certificates and the location of the house, with houses in areas of higher solar radiation allocated more certificates.

Residential-scale renewable energy system adoption in Western Australia has also been influenced by state-based policies. In relation to solar photovoltaic systems, the state government provided a cash rebate for systems installed during 2008-2009, with funds varying depending on financial benefits received through other government rebates (Collier, 2009a). All households that had installed a system prior to August 2010 also received access to the state’s premium net feed-in tariff (Collier, 2011). The premium net feed-in tariff, combined with the state’s compulsory ‘Renewable Energy Buyback Scheme’ which provides guaranteed cost-of-wholesale electricity payment for electricity, is well in excess of the state’s regulated retail tariff for householders. This has generated significant financial benefits for householders installing larger-capacity solar systems.
Historically, policies for increasing renewable energy generation have received bipartisan political support. An earlier incarnation of the Renewable Energy Target, the Mandatory Renewable Energy Target, was initiated by Australia’s right-wing conservative Liberal Party, while this policy was expanded into the Renewable Energy Target by the left-wing Labor Party (Jones, 2010). Similarly, in Western Australia, both the state Liberal and Labor parties took residential solar feed-in tariff policies to the 2009 election (Collier, 2009a). Since this time, however, support for renewable energy has become increasingly contested. The reasons for this are varied, but include rapidly increasing electricity costs presumed to have been influenced by increasing renewable energy penetration (Simshauser and Nelson, 2014), a reduction in electricity demand across Australia resulting in the Renewable Energy Target policy settings requiring more than 20% renewable energy (Climate Change Authority, 2012), and an increasingly fractured right-wing party approach to climate policies, including not only attitudes towards the Renewable Energy Target but carbon pricing policies as well (Pearse, 2016). At a state level, the over-subscription to the premium net feed-in tariff policy led to escalating costs associated with the scheme (Parker, 2011). These escalating costs, alongside a downgrade in state revenues associated with a reduction in mining-based revenues, led the state government to attempt to wind back access to the scheme (Buswell, 2013). The fractured political approach to policies to support the adoption of renewable energy technologies is indicative of issues with the institutions required to provide socio-political support for renewable energy.

Social support for renewable energy technologies in Australia has been in part through opposition to Liberal-government policies to reduce support for renewable energy and the renewable energy industry. This included a rapid opposition to Western Australian Government attempts to wind back the premium net feed-in tariff (Solar Citizens, 2013), as well as opposition to the Australian Government’s attempts to reduce the Renewable Energy Target (Solar Energy Industries Association Inc, 2014). The use of consultative review processes to develop renewable energy policy, particularly in the case of the Renewable Energy Target, has also contributed to the politicisation of renewable energy and industry uncertainty.

Consultation processes as a form of policy review and development have been favoured by both state and federal government departments in a number of strategic portfolio areas, including defence (Cheeseman and Smith, 2001), water-management (Crase et al., 2005).
and state development (Manwaring, 2010). These consultation processes can be undertaken at any point in the policy cycle, including policy development, progress review and final policy appraisal. Similarly, these processes can be undertaken by any number of agencies, from government departments under the purview of the government of the day; parliamentary review processes overseen by government, opposition and cross-benchers; government supported, legislated independent advisory bodies; and even politically-affiliated 'think tank' policy research institutes. All have the potential to influence government policy, are influenced by different stakeholder groups, and can potentially run concurrent ‘reviews’ on the same policy. There is therefore growing criticism of the use of these consultation processes to inform policy, as they create uncertainty in the industries under review. Additionally, it has been noted that governments often favour the ‘status quo’ in policy development, including in environmental areas, with governments supporting the existing policy regime in spite of the outcomes of consultation processes (Effendi and Courvisanos, 2012). This led to Cheeseman and Smith (2001) coining the phrase ‘choreographed consultation’ to describe consultative review processes that are unlikely to inform government policy. Together, the use of consultative review processes and only minor amendments to policy coming out of these processes has been referred to as ‘disjointed incrementalism’ (Lindblom, 1979), emphasising an inherently conservative approach to policy-making.

Australia’s Renewable Energy Target is subject to this consultative style of policy development, with ten reviews specifically examining elements of the Renewable Energy Target in five years, none of which resulted in significant changes to policy (Australian Government, 2013). Periodic reviews of the Targets were included as a requirement in the Renewable Energy Target legislation. The first of these reviews, the Tambling Review in 2003, invited submissions on the functioning of the former Mandatory Renewable Energy Target (MRET). Kent and Mercer (2006) presented an overview of the range of opinions on the MRET, the recommendations of the Committee overseeing the review and the response from the Australian Government. Consistent with the incremental policy development process, the then Liberal Australian Government’s response to the Tambling Review’s findings emphasised a ‘business-as-usual’ policy framework, with fossil fuel continuing to dominate the energy sector in future (Jones, 2010). In finalising the 20% Renewable Energy Target legislation the Labor Australian Government also pandered to the fossil-fuel industry by establishing exemptions from Renewable Energy Target liability for ‘emissions intensive
trade-exposed activities’ (Jones, 2010). The implication of the reviewing process is a lack of certainty for the renewable energy industry and is evidence of a lack of political acceptance to change institutions and political norms to assist the transition to a renewable energy-based electricity regime. There has been a lack of consideration of the Renewable Energy Target review processes in the academic literature since Kent and Mercer (2006) and Jones (2010) and therefore a re-examination of the scheme is necessary to identify whether issues around choreographed consultation and disjointed incrementalism continue.

The potential continuation of the status quo in development of renewable energy policies at the federal government level, particularly if fossil fuel industry continues to benefit from particular policy settings, is indicative of the lack of a landscape-wide government policy ‘vision’ for a new electricity regime. In the absence of federal government visions and associated policies for a transition towards a new energy future, local governments can play a role in promoting ‘bottom-up’ change. Higher tiers of government have increasingly come to recognise that the relationship between local government and their residents enables the former to establish services and policies that can overcome social, cultural and economic barriers to innovation acceptance (Dollery et al., 2006). An inherent perception of increased ‘trust’ and sharing of ‘knowledge’ between these two bodies means there is a greater level of engagement between service providers and service recipients, leading to increased efficiencies, greater levels of understanding of need and even an increased prevalence for volunteer or community-led initiatives with benefits to all within a civil society (Peters et al., 2010). In accordance with this theory local governments and associated community groups are better placed to introduce environmental-focussed projects and policies to individual households than higher tiered governments undertaking more ‘top-down’ measures (Thomas, 2010). While Johnson (2010) researched the interaction between local governments and renewable energy projects, focussing on the planning approval processes for larger-scale systems, there does not appear to be any consideration of the potential of local governments to interact with the community organisation and promote adoption of small-scale renewable energy technologies in the academic literature.

Regardless of the level of government support for renewable energy technologies, the involvement of other key stakeholders acting at the ‘regime’ level of the electricity industry is required. In the case of residential solar systems, key stakeholders include solar system suppliers and installers, alongside network operators connecting renewable energy systems
and retailers implementing financial incentive schemes. In Australia, solar system installations are regulated under Australian Standards, with basic electrical safety inspections undertaken by state-based electrical safety regulators and comprehensive inspections undertaken by the federal Clean Energy Regulator (Clean Energy Regulator, 2016). The solar systems themselves are approved by the Clean Energy Council, an industry advocacy body, according to Australian Standards and then submitted for registration to the Clean Energy Regulator. Western Australia still has a state-owned electricity network operator, so decisions around retail and network support for solar are effectively made by the state government, with regulatory oversight and reporting undertaken by the state's Economic Regulation Authority. Therefore, while governments (state and federal) have significant opportunities to inform the level of support key stakeholders will provide for increasing renewable energy generation, key stakeholders at the regime level still function relatively independently of one another.

### 1.5 Intersections and Trust

While the ‘triangle of social acceptance of renewable energy innovation’ separates research examining social acceptance into three discrete ‘corners’ or dimensions, many studies have considered several dimensions of the model simultaneously. For instance, studies on procedural justice in the case of renewable energy siting decisions have involved criticism of the socio-political policies or planning strategies underpinning renewable energy decision-making (Zoellner et al., 2008, D’Souza and Yiridoe, 2014). Financial incentives developed as a part of a socio-political tool for acceptance with the intention of influencing market acceptance, have also been found to have equity outcomes for the community resulting from cross-subsidisation (Nelson et al., 2011). Finally, a local government initiative to support the development of community-scale projects will ideally reflect high levels of community acceptance through peer-to-peer interactions, but has also in the past contributed to market acceptance of a technology (Dóci and Vasileiadou, 2015).

One specific element identified by Wüstenhagen et al. (2007) that crosses dimensions is that of trust. While Wüstenhagen et al. (2007) placed trust within the Community dimension, it could be allocated within each of the other dimensions. For example, trust is considered to be part of the ‘package of conditions’ that is required for the success of community renewable energy projects, with this trust not necessarily present in existing communities.
or resulting from particular policy settings (Walker et al., 2010). Trust in what Wüstenhagen et al. (2007) referred to as ‘intermediaries’, in particular renewable energy installers and suppliers, is required to maintain market acceptance. For instance, Baskaran et al. (2013) identified that an inability to find a trustworthy solar water heater supplier was preventing consumers from purchasing a system. Trust is also required in the reliability and continuation of political decisions. That is, continued support in the socio-political dimension, has been identified as important to increasing renewable energy development. In its most extreme case, a lack of trust and certainty in the continuity of political decisions in renewable energy policy has been identified as a source of ‘sovereign risk’ in Australia (Heath, 2014), with a lack of trust in government policy in this one policy area extending to a lack of trust in all decisions by that government.

One particular area of social acceptance requiring levels of trust is in the provision of information on renewable energy technology. Again, relevant to every ‘corner’ of the social acceptance triangle, information is required and generated by community members, informs market decisions and is guided by socio-political context. Access to reliable and trustworthy information has been identified as an ongoing issue for residential-scale renewable energy adoption in the academic literature (Caird and Roy, 2010, Balcombe et al., 2014). Part of the issue associated with the accessing of reliable information is the lack of energy literacy in the general public, with potential market consumers unlikely to be able to assess the veracity of information provided to them (Baskaran et al., 2013, Sovacool and Blyth, 2015). Winther and Ericson (2013) found that information on renewable energy provided to research participants was deemed so incomprehensible it ‘produced ignorance’ in respondents. That is, people’s trust in the technology decreased because they felt they understood it less. Research has found that information provided by industry is deemed untrustworthy (Winther and Ericson, 2013), but there is also a lack of trust in government messages, with some believing governments ‘sensationalise’ environmental problems to increase support for costly policies with environmental outcomes (West et al., 2010). However, community organisations developed to promote solar energy have been found to increase trust through ‘trust networks’ (Noll et al., 2014), which must be underpinned by a factual understanding of renewable energy technologies and the policies and institutions required to assist with their adoption. With this lack of knowledge in the consumer base, associated with stakeholders having vested interests to provide inaccurate information, the
question remains as to who is responsible for providing quality information, and whether they will be trusted by stakeholders.

These examples also highlight that trust in both renewable energy technologies and institutions (including incentive policies) for their support is important across all layers of the socio-technical transition framework. Trust is required in the technology at the ‘niche’ level for market acceptance, trust is required in the ‘intermediaries’ acting in the regime level and trust is required in the political decisions influencing the regime from the ‘landscape’ level. A point at which all these levels intersect is in the role of regulators and regulations. Influenced by government policy, regulations can help ensure trust in both the technology and intermediaries, can encourage or enforce installation, or act as barriers to adoption, and so are considered important for the continued acceptance of renewable energy (Claudy and O’Driscoll, 2008). Furthermore, regulations and regulators are key institutional components of the ‘regime’ into which renewable energy is to be inserted into. Socio-political acceptance of renewable energy technologies by these institutions is critical for the increasing penetration of renewable energy.

1.6 RESIDENTIAL-SCALE SOLAR TECHNOLOGIES AND INCENTIVES IN WESTERN AUSTRALIA

Western Australia has a long and chequered past with the adoption of residential solar systems. Western Australia was the location for the development of one of the earliest solar industries in Australia, the production of household solar water heaters in 1953 (Mercer and O'Shea, 2015). While financial incentives initially drove the highest solar water heater adoption rates in the Northern Territory, Western Australia experienced the second highest adoption rates, at approximately 25% in the early-1980s (Foster, 1993, Newman, 1982). This relatively high adoption rate was experienced even though the economics of system installation were not sound, with a payback period of ten years for a solar water heater compared to less than two for a conventional water heater (Newman, 1982). The academic literature has previously identified that this was as a result of concern around fossil fuel stock security in Western Australia (Newman, 1982) and presence of the local solar water heater industry (Foster, 1993). By 2001 the installed rate of solar water heaters had dropped to 20%, leading to the state government to develop a subsidy scheme to support
the installation of solar water heaters (Barnett and Court, 2001). While the availability of the scheme increased the installation of solar water heaters in Western Australian compared with other states, with a 60% installation rate in new homes compared with 30% in other Australian jurisdictions, the Solar Water Heater Subsidy Scheme did not reach its proposed subscription rates (Ripper, 2004). The 2001 Scheme announcement projected an expenditure of up to AU$3 million per year with subsidies of between $250 and $400 (Barnett and Court, 2001). Alternatively, three years later less than AU$2.5 million had been spent across the scheme, resulting in the decision to increase the value of incentives (Ripper, 2004).

The Solar Water Heater Subsidy Scheme was extended for a budget cycle period (four years) in 2009, and was discontinued in 2013 (Collier, 2009b). The Scheme was never over-subscribed. A possible reason for this was the lack of information on the benefits of solar water heater adoption provided to the community, and peer-to-peer interactions communicating a lack of financial benefits of solar water heater adoption (Foster, 1993). Research undertaken in Queensland confirmed that previous experience with a solar water heater was the highest predictor of solar water heater adoption, while gaining information from peers on the costs and benefits of solar water heating was the largest predictor of non-adoption (Foster, 1993). While the subsidisation of solar water heaters by the Western Australian Government has been discontinued, incentives are still being paid out to those who have installed a solar photovoltaic system.

Incentivisation of residential solar photovoltaic systems by the Western Australian government was first proposed in the lead-up to the 2009 Western Australian state election (Energy Matters, 2009), with the Liberal party proposing a AU$13.5 million budget for a gross feed-in tariff. On gaining office, financial modelling predicted the AU$13.5 million was insufficient to cover the costs of a gross feed-in tariff, so funds were instead distributed as a reimbursement to all residential householders installing small-scale solar systems between the state election and the media release announcing that the gross feed-in tariff would not proceed (Collier, 2009a). In its place a premium net feed-in tariff was made available to all householders signed up to the retailer’s Renewable Energy Buyback Scheme, the feed-in tariff designed to compensate solar customers for the ‘fair’ value of the electricity generated by their solar system that was fed into the grid. The Renewable Energy Buyback Scheme is a true feed-in tariff in that it is not an incentive or subsidy, but instead provides a guaranteed
rate of return for the value of electricity fed into the grid and is paid by all electricity consumers (Government of Western Australia, 2016a). Alternatively, the premium net feed-in tariff was designed to incentivise adoption of residential solar energy systems. The ‘contract’ signed by solar consumers guaranteed a AU40 cents per kWh feed-in rate, well in excess of the regulated retail tariff at AU27 cents per kWh, in addition to the ‘fair’ value of electricity paid by the Renewable Energy Buyback Scheme (AU7 cents per kWh). Funds used to pay for the premium feed-in tariff are sourced from consolidated state revenue (Collier, 2010). According to the government agency implementing the scheme (Government of Western Australia, 2016b), the objectives of the premium net feed-in tariff scheme were to:

- “Encourage the uptake of household renewable energy systems;
- Increase the affordability of investment in residential renewable energy systems;
- Help residents to take positive action to reduce greenhouse gas emissions associated with household electricity use;
- Help householders manage electricity price increases;
- Support the renewable energy industries that supply systems to the residential sector; and
- Contribute to meeting national renewable energy and carbon reduction targets.”

While at the initiation of this research the premium feed-in tariffs available in Australia were considered ‘generous’ by media outlets (Dee, 2011, Lloyd, 2010), there was also evidence suggesting such incentives would generate perverse outcomes. Evidence of negative outcomes of feed-in tariff rates similar to retail tariffs was available prior to the initiation of the Western Australian premium feed-in tariff, with Germany and Denmark already abandoning feed-in tariffs of between 75% and 90% of the retail tariff due to the high cost of these tariffs for electricity consumers (Lesser and Su, 2008). Net feed-in tariffs in excess of the prevailing retail tariff rate are also considered to have perverse outcomes in that they encourage load shifting of residential electricity consumption to outside solar generation hours when it could place additional strain on the electricity network and potentially increase peak demand (Zahedi, 2010). Furthermore, the objectives outlined above do not identify any particular technical or market-based challenges within the electricity regime that an effectively designed feed-in tariff policy could address, such as helping to meet peak demand where electricity market prices are volatile (Couture and Gagnon, 2010).
Concurrently, the federal government was also making financial incentives available to residential householders installing solar systems. At the time the research was initiated, the incentive was delivered through the Small-scale Renewable Energy Scheme, a subcomponent of Australia’s Renewable Energy Target (Climate Change Authority, 2012). The objectives of the Renewable Energy Target, based on the previous Mandatory Renewable Energy Target from 2001 (Commonwealth House of Representatives, 2000), are to:

- “Accelerate the uptake of grid based renewable electricity to reduce greenhouse gas emissions;
- Provide an ongoing base for the development of commercially competitive renewable energy as part of the broader package to stimulate the use of renewables; and
- Contribute to the development of domestic industries which could compete effectively in overseas markets.”

The value of certificates available to consumers installing a solar system through the Small-scale Renewable Energy Scheme is determined by a market, where electricity retailers purchase certificates to meet renewable energy purchase obligations, with the cost of these certificates passed through to all electricity consumers. Therefore, this scheme provides householders with the opportunity to receive ‘fair value’ for the renewable electricity generated by their system, given the value of renewable energy in the wider Australian electricity marketplace. However, as with the Western Australian Government’s feed-in tariff scheme, there was another incentive mechanism that distorted the value of small-scale solar systems in the certificate marketplace. This mechanism was called the ‘Solar Credits Multiplier’ and effectively multiplied the number of certificates a residential-scale solar system could generate, starting with a multiplier of five in June of 2009 (Climate Change Authority, 2012). This resulted in the generation of certificates that did not equate to actual renewable energy generation, contrary to the Renewable Energy Target’s objectives. Furthermore, the Solar Credits Multiplier was found to have the perverse outcome of ‘crowding out’ other renewable energy types (Valentine, 2010). This scheme was also effectively over-subscribed (Climate Change Authority, 2012), like the Solar Homes and Communities Grants it was intended to replace (Macintosh and Wilkinson, 2011), leading to significant additional financial costs to electricity retailers and consumers.
Together, the state and federal government incentives for residential-scale solar energy adoption resulted in substantial financial benefits to householders adopting residential solar systems, at a time of declining system costs, with perverse outcomes for electricity costs, competing forms of renewable energy and state budgets (Nelson et al., 2011). Therefore, while they encouraged community-level support for residential-scale solar technologies, they were also examples of policy mechanisms with outcomes likely to negatively impact on institutional support for residential solar energy, with implications for its continued adoption.

1.7 This Research

The research takes a multi-faceted approach to consider perceptions of, and experiences with, residential solar energy technology and government support for its installation in Australia, in particular the financial subsidisation of residential solar energy, using the ‘triangle of social acceptance’ by Wüstenhagen et al. (2007) as a framework for analysis. The objectives of this research are to:

1. Examine community acceptance of residential solar energy and related policies, including community perceptions of justice and peer-to-peer interactions
2. Examine market acceptance of residential solar energy and the effectiveness of related policies to promote its adoption through consideration of Rogers’ Diffusion of Innovations Theory and intra-firm acceptance
3. Examine socio-political acceptance of renewable energy technologies, in particular residential solar energy, and associated policies, including those regulating industry and supporting the financial incentivisation of residential solar energy
4. Develop advice to government to support the increased adoption of renewable energy

The Results and Discussion part of the thesis, starting in Chapter Three, is broken down into seven research papers, each one focusing on a particular dimension of social acceptance of residential solar energy, and frequently with additional insights into other dimensions of the triangle. A significant finding in each paper is used as a starting point for the research in the subsequent paper.
After an overview of the research methodology provided in Chapter Two, Chapter Three considers perceptions of financial incentives for the promotion of residential solar energy, examining distributional, procedural and outcome justice. Chapter Four looks at the perceptions of the solar adoption experience from householders with a solar system, in particular highlighting potential issues with government support and industry delivery. Chapter Five investigates whether Rogers' (2003) conclusions on the effects of incentives on the adoption process can accurately be applied to those receiving financial incentives for solar system installations in Australia. Chapter Six studies the experiences of solar adoption in two regional Western Australian communities, considering the role of peer-to-peer interaction, solar champions and community organisations in the adoption process. Chapter Seven considers intra-firm acceptance of distributed renewable energy generation by network operators in Western Australia. Chapter Eight analyses the Australian Government's Renewable Energy Target policy, in particular in relation to its 2012 Review process. Chapter Nine provides a short commentary paper considering the use of consultative review processes in developing renewable energy policy, and the extent to which this influences 'ownership' over renewable energy projects. Chapter Ten summarises key findings according to the dimensions of social acceptance of renewable energy generation and draws together all policy suggestions.

1.8 REFERENCES


MERCER, D. & O’SHEA, B. 2015. Solahart to cut 100 workers in shake up [Online]. The West Australian. 29 October 2015. Available:


CHAPTER TWO: RESEARCH METHODOLOGY

2.1 INTRODUCTION

This Chapter provides an overview of the justification for the use of methods in each of the Results and Discussion Chapters, and a summary of the methods and their limitations. As each method was used in several of the Chapters the description provided here is a brief synopsis, with additional detail provided in the methods section of each Chapter. Furthermore, given the nature of this being a thesis by publication, there will be some level of repetition between information provided here and that which is included in subsequent Chapters. This Chapter concludes with consideration of the ethical implications of the research process.

This thesis uses a ‘lived experience’ approach, inspired by the social practices model, to assess the social acceptance of renewable energy, and in particular residential solar photovoltaic systems, in Western Australia (Spaargaren, 2003). The researcher approached this study from an interpretive social science perspective, which holds that social beings create meaning and constantly make sense of their worlds (Rabinow, 1987). There are therefore no prescriptive ‘rules’ that necessarily define how individuals will respond to stimuli such as financial incentives for the promotion of residential solar energy. Rather, all interactions are informed by previous experiences, context and, importantly, place and human interactions, a key tenet of the social practices model (Spaargaren, 2003). This research aims to understand and describe meaningful social action in such a way that lessons can be learned as to how to guide optimal outcomes (Newman, 1991), through best-practice policy. In this way, research undertaken contributes to a wider body of knowledge that can be used to develop theories on the way humans behave and interact in relation to their social acceptance of renewable energy. Unlike a positivist scientific approach, however, it is assumed that these theories can never be proven, but only refuted by demonstrating instances where findings are inconsistent with expectations (Ransome, 2013). The generation of quantitative data can be useful in testing hypotheses around these theories, including Rogers’ Diffusion of Innovations Theory, supported by an understanding of the context that the target research community is exposed to, including policies in place and peer-to-peer interactions. However, this research also understands that the outcomes of human behaviours, and the policies developed to promote particular human behaviours,
cannot be assumed and that it is only by undertaking qualitative research that the full suite of interactions and influences can be understood (Schelly, 2014), and even then the findings will be limited to the information the researcher is capable of ‘mining’ from the research subjects (Denzin and Lincoln, 2008). Additionally, hidden biases, conflicting interests and personal interactions can all work to undermine the potential for uncovering the ‘truth’ of behaviours and attitudes, as much as a lack of robustness in research preparation and delivery. For this reason, triangulation of researcher-generated data against already existing information is useful in testing the robustness of research findings, approaching a consistent explanation of processes rather than assuming accuracy in research participants’ statements (Yin, 2009).

This research therefore views research as a constructivist exercise, where knowledge developed during research is constructed by social scientists (Latour and Woolgar, 2013). This is compared with a positivist approach to research, where it is assumed that there are finite truths in nature that can be ‘known’ and measured by scientists. Taking a constructivist approach to research acknowledges that multiple methods of inquiry are appropriate, conflicting results from different research areas are not necessarily indicative of ‘incorrect’ findings and the questions the researcher asks, and how they go about asking them, will necessarily influence research outcomes (Viney, 1992). This research, therefore, acknowledges that any conclusions drawn in Results and Discussion chapters may be specific to the Western Australian context, or even the specific communities assessed.

In spite of this understanding of the potential subjectivity in the results, each Results and Discussion chapter uses trends in quantitative survey results and qualitative themes to attempt to arrive at conclusions that are at least generalisable for the research sample population. Because of this, when viewed independently, these papers may appear positivist in their approach to drawing conclusions. This is particularly the case for Chapters 3, 4 and 5, which use the results of quantitative survey data analysis to draw conclusions. The decision to represent the research methods and data analysis in more positivist framings is influenced by the existing literature of relevance to each topic of interest and the choice of journal for Chapter submission. Journals for potential publication were selected based on their representativeness in the relevant literature, with many of these journals having a mixed discipline audience including engineers, economists and public practitioners (for example Energy Policy and Renewable Energy journals). Given the
writers and readers of these journals often lend themselves to higher levels of objectivity when preparing research methodology and stating conclusions, this objectivity is somewhat echoed in the construction of the Results and Discussion Chapters. Furthermore, while this research is focused on analysing the perceptions of community, industry and government representatives with regards to residential solar energy, associated subsidies and renewable energy in general, the emphasis on perception is also somewhat diminished in the Results and Discussion chapters. This is, again, in order to be able to generate more objective conclusions for the relevant journals.

The analysis of data and their interpretation were developed by combining a number of different data sources and analysis techniques. Specifically, Chapter Three applies pre-existing ideas on perceptions of justice in renewable energy project development to the increasing penetration of residential solar systems through generous incentives. The findings of this research are based solely on a mail-out survey, with both descriptive statistical analysis of the quantitative results and thematic analysis of the qualitative comments used to draw conclusions on the perceptions of justice in relation to financial incentives for solar systems. Chapter Four uses questions from within the second survey, on the motivations for adoption and satisfaction with solar systems, to determine some measures of satisfaction and trust in solar systems by those who have solar systems installed on their premises. In this case the qualitative comments from the survey are used not to measure preferences, as they are in Chapter Three, but to interpret the experiences of those who have engaged with solar system ownership. In this case, comments made by householders regarding the trustworthiness of industry, negative experiences with solar systems and negative perceptions of governments can be tested against publicly available information and data. For this reason, triangulation against externally available data and documents was undertaken to test the veracity of residential householders’ comments, alongside quantitative analysis of publicly available data. In Chapter Five the research returns to consider a pre-existing theory in trying to determine whether Rogers’ (2003) conclusions on the effects of incentives on the adoption process apply in the case of residential solar system adoption in Western Australia. In this chapter the characteristics of those householders who have chosen to adopt solar systems is used, relying on quantitative data analysis of the second survey results. The descriptive statistics are supported by statements made in interviews with householders, where the researcher had the opportunity to direct comments about householders’ perceptions of financial incentives,
solar systems, government support and members of industry. Since this chapter considered measures of equity and demographic trends in adoption, the research findings were supported with the analysis of publicly available quantitative data, including socioeconomic index information. Chapter Six examines the process of solar adoption in two regional communities, with findings based exclusively on interview responses. This paper focused on a social acceptance of renewable energy framework approach to considering the progress of adoption of residential solar energy in two disparate communities. The research aimed to observe and describe the process of adoption and identify potential opportunities for government intervention to promote the installation of residential solar systems within communities. Chapter Seven used an entirely grounded theory approach (Strauss and Corbin, 1994, Corbin and Strauss, 1990), in that the analysis of intra-firm reactions to the increasing penetration of distributed renewable energy generation was based entirely on interview respondents’ comments, not on any pre-existing theory. In this case the survey respondents were asked just two, broad questions about whether they believed network operators supported the increasing penetration of residential solar energy, and then if they supported the increasing penetration of large-scale renewable energy. In order to test the validity of respondents’ comments triangulation was used, seeking reliable sources of data that supported assertions made by interview participants. Chapter Eight presents a re-examination of the Australian Government’s Renewable Energy Target Review process, based on the methods used by previous researchers. In this case the thematic analysis was based on pre-determined themes identified in the document guiding the Review process, the Issues Paper, and on previous literature considering Review processes. This research used the full suite of Review responses as the main source of data, with underlying claims made by respondents verified through examination of publicly available documents and analysis of quantitative data. Lastly, Chapter Nine is a short commentary chapter based on the findings in Chapter Eight. A summary of the sources of data, methods of analysis and analytical tools, and the research Chapters they contribute to is available at Figure 2.1.
2.2 RESEARCH AREA SELECTION

This research acknowledges that the academic literature identifies that place-based interactions influence behaviour around residential solar energy adoption. In particular, research has found that solar community organisations can influence adoption in target communities (Noll et al., 2014, Mallett, 2007), and the ‘clustering’ of solar system adoption is increasingly evident (Graziano and Gillingham, 2015, Palm, 2016). Based on this knowledge this research analysed residential householder experiences in six different geographic locations, hoping to elicit place-based influences on the adoption process, as opposed to disseminating a survey to a random portion of the population within the state of Western Australia where place-based influences might be lost. The research aimed to canvass a variety of experiences, so four metropolitan and two regional communities were selected (Figure 2.2).
Figure 2.2: Map detailing the locations of the two regional and four metropolitan postcodes surveyed in this research. The two regional communities also served as the basis for regional qualitative case study investigations.

The four metropolitan communities were selected to include two high installation and two low installation postcode areas, and two high and two low socioeconomic ranking postcodes. The criteria for postcode selection was that postcodes were required to have a minimum of 200 systems installed, minimum of 1000 free-standing dwellings (appropriate for solar installation) and maximum of 25% rental rate in the 2011 census (Australian Bureau of Statistics, 2013a). Using the Australian Bureau of Statistics index of socioeconomic welfare, SEIFA, (Australian Bureau of Statistics, 2013c), all metropolitan postcodes meeting the census criteria and appearing amongst the highest (in the top 3 decile places) and lowest (in the bottom 3 decile places) socioeconomic status communities.
in Western Australia were collected, creating a total pool of 24 potential postcode regions. The postcode areas with the highest and lowest residential solar penetration rate as of January 2013 were chosen from each of the decile groups (Clean Energy Regulator, 2013). These postcode areas included City Beach; Kingsley and Woodvale; Maddington and Orange Grove; and Alexander Heights, Girrawheen, Koondoola and Marangaroo.

City Beach had the highest SEIFA ranking and lowest penetration of solar systems of all metropolitan postcodes, with 11% solar penetration. It had a rental rate of 13% and a median household weekly wage of AU$2,576. Kingsley and Woodvale, alternatively, also ranked in the top 10% of postcodes according to socioeconomic advantage, but had one of the highest solar penetration rates in the state at 25%. As an average, these two suburbs had a median household income of AU$1,820 and a rental rate of 12%. The postcode regions of Maddington/Orange Grove and Alexander Heights/Girrawheen/Koondoola/Marangaroo were both in the lowest 20% of postcodes in terms of socioeconomic advantage. Maddington/Orange Grove had the highest solar penetration rate for postcodes meeting this criterion at 23%, and with 23% rental rates and median household income at $1,073. Interestingly, and a potential precursor to findings in Chapter Five, Alexander Heights/Girrawheen/Koondoola/Marangaroo, the disadvantaged postcode area with the lowest penetration of solar that meets the criteria identified above still had a penetration rate of 18%, significantly higher than City Beach's 11%. This postcode had a median household income of $1,173 and rental rate of 23%.

In relation to the two regional communities, the first, Carnarvon, was purposively chosen given its reputation as a self-started ‘solar town’. Carnarvon had one of the first privately-owned solar farms in Western Australia (Carpenter, 2005), and has seen a further large-scale installation (Energy Made Clean, 2016) and a large number of small-scale systems connected to the grid (Mercer, 2011). In spite of the enthusiasm for solar photovoltaic systems in Carnarvon, in 2013 the town had only a 13% penetration rate. This is the result of a moratorium on new solar systems connecting to the network, the product of the local network operator’s concerns for an increasing risk of grid instability associated with high solar penetration on a small, regional grid (Telford, 2012). The town of Narrogin was selected as an alternative community, based on its similar population size, number of free-standing dwellings, median household wage and proportion of rental accommodation (Australian Bureau of Statistics, 2013b). Narrogin was also considered a useful alternative...
community given it had its own renewable champion, with biofuels as opposed to solar photovoltaic systems promoted. As at January 2013 Narrogin had a solar penetration rate of 10%.

2.3 DATA COLLECTION

There were two sources of researcher-generated data in this research, surveys and semi-structured interviews. This section briefly considers the process undertaken in collecting these data and provides reasons behind choosing these data sources.

2.3.1 SURVEYS

While research investigating adoption of residential solar energy frequently makes use of regression analysis from large datasets (often either geographically based or obtained from electricity retailers) to determine demographic characteristics linked with solar adoption (Graziano and Gillingham, 2015, Richter, 2013, Balta-Ozkan et al., 2015, Bollinger and Gillingham, 2012, Davidson et al., 2014, Guidolin and Mortarino, 2010, Schaffer and Brun, 2015, Zahran et al., 2008), the use of survey data is commonly used to consider individual motivations and experiences involved in the adoption process (Vasseur and Kemp, 2015, Baskaran et al., 2013, Rai et al., 2016, Sardianou and Genoudi, 2013, Haas et al., 1999, Leenheer et al., 2011, Faiers and Neame, 2006). Given this research is seeking to consider individual perceptions of residential solar energy and associated policies, including personal perceptions of financial incentives, direct surveying of members of the population was required. Quantitative analysis, in the form of surveys comprised of series of Likert-type statements, provided statistics on householders’ attitudes regarding residential solar energy and policies designed to increase its penetration. Questions requesting demographic information and an open text section were included.

While there was the potential for ‘snowball sampling’ by finding members of the community who have been allocated a role around promoting renewable energy or equity issues, it was determined this would have led to sampling bias. In particular in relation to Chapter Three, Nancarrow and Syme (2001) stress the importance of including all community members in a discussion regarding social justice, as opposed to stakeholder advisory groups. Any wide-reaching pro-social views felt by stakeholder advisory representatives are minimised in discussion in order to stress the representatives’ primary interests, as dictated to them by
their position in the stakeholder body. For this reason a large sample of householders with varying socio-economic backgrounds and experiences with photovoltaic installation was surveyed to capture as wide a cross-section of the Western Australian community as possible. For the survey used in Chapter Three (Appendix 1) the ‘address finder’ function in publicly-available Landgate data was used to randomly generate addresses for individual households in each postcode area (Landgate, 2013). In the case of the survey used in Chapters Four and Five (Appendix 2), which focused on the perceptions of those who had a solar system installed, individual households in each postcode area were randomly selected for the mail-out survey using publicly-available aerial photography (Landgate, 2013), with the most recent solar systems installed in January 2013.

The mail-out surveys were implemented in three stages in order to maximise response rates (Dillman et al., 2009). The initial survey was sent with a cover letter and reply paid letter. This was followed by a reminder postcard and then another copy of the survey, cover note and reply paid envelope. The value of follow-up surveys for increasing response rates was identified in a related study (Baskaran et al., 2013). A raffle incentive prize, in the form of an iPad Mini, was provided to further increase the response rate. Surveys were sent out between August and December 2013.

The demographic statistics of the surveyed sample were compared with the demographic characteristics of postcodes to attempt to determine whether those individuals sampled are likely to be representative of the ‘general’ postcode inhabitant considered in the socio-economic rankings. Response rates for the two surveys were modest but sufficient to develop theories. The survey used in Chapter Three had a response rate of 22% (295 surveys returned completed), with the sex ratio and income levels of survey respondents consistent with the postcode areas they are situated in. Survey respondents were, however, more likely to be tertiary educated than the underlying population. The survey used in Chapters Four and Five had a response rate of 38% (362 surveys returned completed). Survey respondents for Chapters Four and Five were more likely to be male and over the age of 60, however the income level of respondents was generally consistent with the underlying population. Lower socioeconomic metropolitan communities had lower response rates than other communities in each survey. Given these modest response rates the findings throughout this thesis are exploratory only, and should not be considered predictive.
2.3.2 INTERVIEWS
In order to identify perceptions from members of the public, industry and government the research aimed to interview a number of respondents from each of these stakeholder groups. In order to restrict the scope for potential interview subjects the two regional communities were taken as the focal point for the interview participants. In doing so, a manageable number of potential interview candidates, both those involved in the renewable energy industry and those who were not, could be contacted. Additionally, where it was deemed that state-level stakeholders would interact with or influence the activities of regional-level stakeholders these were also interviewed.

Interview respondents were identified in a number of different ways, with the initial starting point being an internet search. The local government websites were searched to identify members of local government to approach (the CEO and Mayor – or equivalent), any agency involved in the delivery of regional-level solar incentives, and any renewable energy projects in the region. This led to the identification of state-level solar retailers involved in solar projects in the regional communities. A search on ABC news online, the news source with the highest level of regional news content in Australia, was used to find regional community members with an interest in renewable energy. It was from these news searches that the renewable energy ‘champions’ for each community were identified. During the interview process a further community member in Narrogin was identified as having an interest in solar energy, however this was not reflected in the media or in the context of a particular community group. The local Parliamentarian for each area was also approached for comment. An internet search of local electrical contractors was undertaken, with each contacted to determine whether they were involved in the installation of solar systems. Two further regional solar installers were identified as important during the interview processes.

In terms of state-level stakeholders, the two most recent CEOs of a renewable energy advocacy group were contacted for an interview. In addition, six representatives from the state-based agency responsible for renewable energy policy development were contacted based on the researcher’s previous interactions with the agency. This led to the identification of an individual in Consumer Protection involved with residential solar issues. Two other Members of Parliament were contacted based on their known interest in renewable energy issues, as identified from Hansard (Parliamentary transcripts). The
current and former Ministers for Energy were also approached for an interview, but did not respond during the research period. A letter outlining the purpose of the research was sent to the Managing Director of each of the state-based network operator utilities, Horizon Power and Western Power, seeking contact with an individual involved in policy and decision-making around renewable energy issues. The regional network operator offices in Carnarvon and Narrogin were also phoned for potential interview subjects.

Residential householders interviewed for this research were selected after completing one of the two mail-out surveys. The first portion of the survey asked survey respondents to self-identify if they would be happy to participate in a future interview process. A random 50% of self-selected survey respondents from the metropolitan communities were approached for interviews, with all respondents self-selecting from the regional communities contacted. A break-down of the respondents by location and whether they had a solar system installed is available at Table 2.1.

Table 2.1: Semi-structured interview
Metropolitan interviews were undertaken by telephone during December 2013. Regional interviews were conducted in-person during May and June 2015. Interviews with industry and government stakeholders were performed, mostly in person, between May and October 2015. In all, 35 interviews with residential householders were undertaken and 33 interviews with other stakeholders. Details regarding respondent types and questions provided to residential householders are available in the methods sections provided in each relevant Chapter.

2.4 DATA ANALYSIS

As identified in Figure 2.1, this research included five different data analysis techniques. It should be noted that some of these data techniques are applied to different data sets presented in different Chapters and so have been generalised here to be of relevance to all chapters where they were used.

2.4.1 DESCRIPTIVE STATISTICAL ANALYSIS OF SURVEY DATA

Quantitative analysis of survey findings in this research was undertaken using SPSS Version 22.0 (IBM Corporation, 2013), and was based on non-parametric descriptive analysis, given the data was not normally distributed and was ordinal in nature (Field, 2013). Chapters Three and Five, which sought to test pre-determined ideas around perceptions of equity in the provision of financial incentives, and the effects of incentives on the adoption process, were analysed using Likert-type subscales. Subscales were chosen given the use of subscales increases reliability compared with single statements, particularly when measuring intentions and attitudes (Leenheer et al., 2011). In each case the subscale was predefined, and the results tested for internal consistency using Cronbach's coefficient alpha and tested for unidimensionality using item-total correlation (De Vaus, 2002). In an effort to keep the surveys short but allow a number of dimensions to be considered, only a small number of statements were included in each subscale, for this reason a low Cronbach's coefficient alpha of 0.60 and minimum item-total correlation of 0.30 were set (Cortina, 1993). Where an individual statement did not meet minimum internal consistency or unidimensionality tests, or where Cronbach's alpha was higher when removed, the statement was analysed independently. Modest pre-tests of both surveys were undertaken and did not highlight particular issues with the subscale dimensions. Further details of the
survey questions and specific objectives are available in the methods section in each paper and in Appendices 1 and 2.

There were two limitations identified in the survey data. Firstly, it should be noted that the response rate for both surveys was modest and that Cronbach's coefficient alpha was in some cases low, therefore the survey findings should be considered exploratory as opposed to predictive. Secondly, it appears that the contents of the survey have the potential to 'prime' survey respondents towards particular survey responses. For instance, in the case of the two surveys included in this research there was only one question that was included in both surveys and both surveys produced different results. In response to the question 'I would only purchase a solar electricity system if it was subsidised by the government' 59% of respondents to the justice-related survey (included in Chapter Three) who had a solar system installed indicated they would not require a solar subsidy. Alternatively, in response to the same question, only 26% of respondents to the solar adoption survey (included in Chapters Four and Five) who had a solar system installed on their premises indicated that they would not require a solar subsidy. In this case, the focus of the questions on the cost of incentivising solar systems to the community in the justice-related survey may have prompted respondents to be more mindful of the circumstances in which they would choose to install a system without disadvantaging lower income earners (as identified in the survey).

2.4.2 THEMATIC ANALYSIS OF SHORT COMMENTS
Qualitative feedback, in the form of written comments at the end of the surveys, was used as a source of data in Chapters Three and Four. The research in this thesis benefitted from an engaged respondent group, with many respondents providing comprehensive qualitative comments that provided an opportunity to consider a rich data set covering a larger range of respondents than could have been covered in interviews alone. 72 out of the 295 respondents to the survey in relation to equity aspects and financial incentives for solar provided qualitative comments, and 121 out of 362 respondents provided qualitative comments in relation to their experiences with solar systems, policy and industry. In order to ensure a robust analysis of this data, inter-rater reliability tests were undertaken between the researcher and the co-ordinating supervisor (Landis and Koch, 1977), with subsequent collaboration to clarify theme description and ensure agreement on thematic
groupings. Thematic analysis was undertaken using NVivo Version 11 (QSR International Pty Ltd, 2015).

2.4.3 Thematic analysis of long-form texts from interviews
The transcripts of the semi-structured interviews were first analysed via a 'close reading' of the transcript text and notes generated during the interviews (Ruggiero et al., 2014). The significance of statements in the context of the researcher's questions was analysed, focusing on the explicit meaning of the response, exploring repetitive concepts to develop consistent and coherent themes (Allen et al., 2012). In the case of interview responses for Chapter Five, where a pre-established theory was being tested, and Chapter Six, where themes had been established, interview responses were coded according to previously identified themes from the literature. In the case of Chapter Seven, a grounded theory research approach was undertaken, given pre-defined theories relating to network operators had not been established (Strauss and Corbin, 1994). In this case a large number of highly specific themes were initially generated before similar themes were consolidated into the final over-arching themes presented in the Results section (Nygren et al., 2015), with interview transcripts coded using NVivo Version 11 (QSR International Pty Ltd, 2015).

2.4.4 Thematic analysis of long-form texts from the Renewable Energy Target review submissions
Kent and Mercer (2006) suggested that submissions made available to a review of Australia's Mandatory Renewable Energy Target undertaken in 2003 potentially represented the most comprehensive overview of the status of Australia's renewable energy sector available. Based on this assertion the decision was made to undertake a similar examination of the 2012 Renewable Energy Target Review submissions. This Review process was undertaken by the Climate Change Authority as the first review process under the expanded Renewable Energy Target, legislated in 2009. The Climate Change Authority undertook a number of face-to-face interviews and other stakeholder engagement opportunities, but the body of the Final Report was based on submissions from stakeholders responding to an Issues Paper (Climate Change Authority, 2012). These 162 submissions (excluding repeated pro-forma campaign submissions) were used for the majority of the analysis undertaken in Chapter Eight, which informed the development of Chapter Nine. Submissions were assessed according to the questions outlined in the Issues Paper and according to criteria identified by Kent and Mercer (2006), with NVivo Version 11 (QSR
International Pty Ltd, 2015) used to establish coherent codes based on these previously defined over-arching themes. In the case of this research, within-sample triangulation can be performed, where the level of agreement between stakeholders regarding elements of the scheme, particularly where stakeholders might be ‘experts’ in a particular area and where stakeholders are expected to have disparate views, counts as increased evidence of the validity of a claim (Patton, 2002). Both Kent and Mercer (2006) and Jones (2010) also identified systematic issues in the way the Australian Government responds to Review advice and opportunities to change renewable energy policy. Based on this the Australian Government’s response to the review process was also analysed.

This research was undertaken first and provided a basis for understanding both the dynamics of the Australian Government’s primary policy tool for promoting increased penetrations of renewable energy, the Renewable Energy Target, and also for understanding key issues with industry, as identified by stakeholders. However, this research appears last in the thesis as the thesis has been structured to focus first on generalizable householder perceptions of residential solar policy, before moving to the experiences of industry, government and community in the selected geographical locations, before expanding to consideration of the perceptions of the ‘Australia wide’ renewable energy policy.

2.4.5 TRIANGULATION WITH EXTERNAL DOCUMENTS
Triangulation, where externally available data is used to support empirical research findings from the raw data, is used in three of the Chapters. Triangulation was performed in order to increase the robustness of findings (Heras-Saizarbitoria et al., 2011), with assertions made by survey and interview respondents, as well as stakeholder submissions to the Renewable Energy Target Review, supported by information and data made available through government and industry reports, media articles and submissions to government processes.

It should be noted that the number of reports, news articles and parliamentary debates relating to the promotion of renewable energy in Western Australia, and Australia more broadly, is vast and it would be impossible to comprehensively examine them all. In particular, regulatory bodies in the National Electricity Market, such as the Australian Energy Market Commission, the Australian Energy Market Operator and the Australian Energy Regulator, frequently release lengthy reports. This is in addition to the Australian Government Clean Energy Regulator, the industry-supported Clean Energy Council, the
legislated body the Climate Change Authority and the independent Climate Institute, who all publish reports relating to renewable energy. Because of this, it is understood that there is some limitation in the extent to which it was possible to identify all issues or developments of relevance to this research. Instead, two approaches were taken to collecting data, the first based on a systematic review of newly available information; and the second based on ‘searching’ for information in response to qualitative comments from interview participants.

A frequent review of local news sources (including energy news sources) was undertaken to identify news articles of relevance to the research. News sources are often partisan, therefore where possible news sources were used as a starting point to identify source material that could be used to assess the credibility of statements. The Western Australian online parliamentary Hansard records were searched for new parliamentary debates relating specifically to small-scale renewable energy and proved a valuable source of supplementary information. In particular, Hansard transcripts of Senate hearing committees between parliamentarians and government-owned energy utilities provided details on government perceptions of the performance of utilities not available elsewhere. Together, news articles and Hansard extracts informed much of the background understanding of the political developments in support for renewable energy policy in Western Australia. In addition, external reports were sought after qualitative data had identified potential issues. For example, comments from respondents around the lack of trust in the renewable energy industry led to searching for evidence of a lack of reliable interactions with the renewable energy industry on consumer protection websites and by considering state and federal-based audit programs. It is recognised that a limitation in this research is therefore around the potential important issues that were not identified in the process of interviewing, and therefore are not considered in the research.

There was no specific analytical method used when collecting and collating content from external documents, however it should be noted that statements made by politicians/agencies were recorded with the surrounding context retained in order to prevent claims being made out of context. An example of the most important sources of externally available data is provided in Table 2.2.
## Table 2.2: Sample of key documents for content analysis

<table>
<thead>
<tr>
<th>Type</th>
<th>Key Sources</th>
<th>Issuing Office</th>
</tr>
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<tbody>
<tr>
<td>Government Report</td>
<td><strong>Renewable Energy Target Review Final Report 2012</strong></td>
<td>Climate Change Authority</td>
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<td></td>
<td><strong>Renewable Energy Target Review Final Report 2014</strong></td>
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<td></td>
<td><strong>Renewable Energy Target Administrative Report</strong></td>
<td>Clean Energy Regulator</td>
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<td></td>
<td><strong>Renewable Energy Target Scheme - Report of the Expert Panel</strong></td>
<td>Government of Australia</td>
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<tr>
<td></td>
<td><strong>Solar City Annual Report</strong></td>
<td>Western Power</td>
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<tr>
<td>Policy descriptions</td>
<td><strong>Hansard (Parliamentary) extracts</strong></td>
<td>Government of Western Australia</td>
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<tr>
<td>and changes</td>
<td><strong>Budget papers</strong></td>
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<td></td>
<td><strong>Acts and Amendments (Various)</strong></td>
<td>Parliament of Western Australia</td>
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<td></td>
<td><strong>Acts and Amendments (Various)</strong></td>
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<td></td>
<td><strong>Renewable Energy Policy descriptions (various)</strong></td>
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<td></td>
<td><strong>Renewable Energy Policy descriptions (various)</strong></td>
<td>Western Australian Department of Finance</td>
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<td><strong>Media releases (various)</strong></td>
<td>Government of Western Australia</td>
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<td></td>
<td><strong>Greater Narrogin Region - Growing our Community</strong></td>
<td>Landcorp</td>
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<td><strong>Gascoyne Regional Blueprint</strong></td>
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<td><strong>Reports on ACCC findings on solar industry inquiries</strong></td>
<td>Australian Competition and Consumer Commission</td>
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<td><strong>Reports of Consumer Protection findings on solar industry inquiries</strong></td>
<td>Western Australian Department of Commerce</td>
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<td><strong>Hottest Complaint Lists</strong></td>
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<tr>
<td>Audit or inquiry</td>
<td><strong>Carnarvon: A Case Study of Increasing Levels of PV Penetration in an Isolated Electricity Supply System</strong></td>
<td>Australian PV Association</td>
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<tr>
<td>results / responses</td>
<td><strong>Australia’s Electricity Sector: Ageing, inefficient and unprepared</strong></td>
<td>Climate Council</td>
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<td></td>
<td><strong>Climate of the Nation 2014</strong></td>
<td>Climate Institute</td>
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<td><strong>Solar intermittency: Australia’s clean energy challenge</strong></td>
<td>CSIRO</td>
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<td><strong>Meeting the Renewable Energy Target - Innovative approaches to financing renewable energy</strong></td>
<td>Ernst &amp; Young</td>
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<td><strong>Sundown, sunrise: How Australia can finally get solar power right</strong></td>
<td>Grattan Institute</td>
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<td><strong>The Australian Government’s solar PV rebate program</strong></td>
<td>The Australia Institute</td>
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<td>Industry information</td>
<td><strong>Solar standards</strong></td>
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<td><strong>Accredited Installers list</strong></td>
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<td><strong>Renewable Energy Target Review Submissions</strong></td>
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<td>Energy News Sources</td>
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<td><strong>PV Magazine</strong></td>
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2.4.6 Descriptive Analysis of Externally Available Data

Externally available quantitative data sources were used to support research findings, where relevant (Table 2.3). The central quantitative data source was the Clean Energy Regulator postcode-level data on small-scale renewable energy installations. These data are updated monthly, and provide details on the number of small-scale (less than 100kW) solar photovoltaic, efficient water heater and small-scale wind systems installed (Clean Energy Regulator, 2016). It is noted that these data are based on ‘small-scale’ installations, as opposed to ‘residential’ installations, however it is used in Australia as a proxy for residential solar adoption (Green Energy Trading, 2014). The data are used in the research to highlight changes to installation levels and installed capacity in Western Australia. Other externally available data included in the research involves the prices paid for solar systems in Western Australia. There is no consistent database available, so results have been agglomerated across three sources (Solar Choice, 2016, Australian PV Institute (APVI), 2015, Clean Energy Regulator, 2014). Outside of these sources there is no comprehensive data source relating specifically to small-scale renewable energy, although certain documents prepared by government agencies and consultants/think tanks are referred to in the research.

Australian Bureau of Statistics data, in the form of Socio-Economic regional area ranking statistics (Australian Bureau of Statistics, 2013c) and census data (Australian Bureau of Statistics, 2013a), have also been used, particularly in Chapter Five when considering equity outcomes of financial incentives for supporting residential solar energy adoption. Australian Bureau of Statistics data, particularly the Socio-economic Indexes for Areas ranking system, are frequently used in Australian research analysing place-based socio-economic phenomena. However, it should be recognised that some reports have found that the ‘averaging’ of statistics across postcodes has the potential to misrepresent individual experiences (Lim and Gemici, 2011).
Table 2.3: Data sources and quantitative variables

<table>
<thead>
<tr>
<th>Source</th>
<th>Variable</th>
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<tr>
<td>Clean Energy Regulator</td>
<td>Postcode data for small-scale installations - number of solar PV installations installed by month</td>
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<td>Postcode data for small-scale installations - capacity of solar PV installations installed by month</td>
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<td></td>
<td>Postcode data for STC zone calculation</td>
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<td></td>
<td>Renewable Power Percentage (Large-scale)</td>
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<td>Renewable Power Percentage (Small-scale)</td>
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<td>State-based solar installation rate and price (Out-of-pocket expenses)</td>
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<td>SolarChoice</td>
<td>Residential solar PV price index</td>
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<tr>
<td>Australian PV Institute</td>
<td>State-based solar installation rate and price</td>
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<td>Green Energy Trading</td>
<td>Renewable Energy Certificate prices</td>
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<td></td>
<td>Postcode and Income Distribution of solar</td>
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<tr>
<td>Socio-Economic Indexes for Areas (Australian Bureau of Statistics)</td>
<td>Postcode rank - Socioeconomic Advantage and Disadvantage</td>
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<tr>
<td>Census of Population and Housing (Australian Bureau of Statistics)</td>
<td>Population</td>
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<td>Sex</td>
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<td>Education</td>
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<td>Levels of home ownership</td>
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2.5 Ethics in Social Research

This research complied with and received ethics approval through The University of Western Australia’s Human Ethics Research Office. Respondents were notified that all information gathered would be recorded, transcribed and analysed in such a way that maintained their anonymity (Appendix 3). In addition to adhering to the conditions included in the ethics application, it is the view of the researcher that consideration of ethics is an ongoing, reflective process. Two ethical issues arose during the implementation of this research.
Firstly, while the ethics approval stipulated that all research was to be anonymous, both in terms of publication and in terms of participants’ knowledge of each other’s involvement, undertaking research in a small community with a local elite led to high visibility of the researcher and research subjects. There were instances where research subjects were choosing to identify each other, although the researcher never identified participants. In turn, some participants requested that research subjects highlight particular opinions or points of view in their interviews. Attempts were made to keep interview subjects to the semi-structured interview transcripts to ensure a consistent approach to interview implementation between subjects. In addition to this, engagement with the local ‘solar champion’ in Carnarvon resulted in a professional working relationship wherein the researcher co-authored a chapter in a book with the ‘solar champion’ based on her own research (Simpson and Fullarton, 2016). In this case the impartiality of the researcher has been compromised by an increasing understanding of the relationship between the ‘solar champion’, community members and the energy industry. This did, in part, inform the direction of Chapter Seven, a paper which makes use of grounded theory research (Strauss and Corbin, 1994, Corbin and Strauss, 1990). However, all attempts were made to remain objective when developing the content for Chapter Six, the paper examining the two regional communities as a case study. Indeed, this Chapter includes some content which is critical of the ‘solar champion’, and has led to the researcher experiencing feelings of guilt and a sense of betraying the subject, a condition referred to as an ‘ethical hangover’ (Lofland and Lofland, 2006).

The second ethical issue encountered was in the case of the attribution of comments from public servants. The public servants received approval from management to be involved in this research, and were informed of how the research interviews were going to be used, that is, that it sought to determine peer-to-peer ‘channels of influence’ in renewable energy decision-making and policy development, and sought to develop an understanding of the perceptions of residential solar energy and associated policies and subsidies, including in terms of the kinds of language used by interview subjects. Knowing the sensitive position that these public servants are in, the researcher informed them that if any long-form quotes were to be used the subjects would have the opportunity to ask that they be repealed. On contacting the public servants to ask for permission to publish long-form quotes the public servants raised the issue with management and requested that all direct attribution to them be removed. Although the results had been completely anonymised, it was stated that the
agency could be identified based on the comments and that negative comments could damage relationships between stakeholders. In response to this advice, all identification of public servants has been removed from the body of the Results and Discussion section in Chapter Seven. This does somewhat reduce the robustness of the findings and specificity of the statements. The researcher is also mindful of the extent to which confidentiality can be used as ‘a cloak behind which power elites operate’ p120 (Horowitz and Katz, 1975), suggesting that a respect for anonymity can in some cases act as a barrier to the publication of information that could serve multiple interests. In the case of this research, however, it is thought that the findings were not substantially diminished in maintaining confidentiality, and that they would be significantly more so if the public servants chose to withdraw from the research altogether.

There are two other points regarding the ethics of research that should be raised. Firstly, the researcher acknowledges what Homan (1991) refers to as ‘the persistence of research habits’. While the research has been undertaken within a university setting, according to ethics requirements and with a mind to adhering to good research practices, the research findings are necessarily informed by experiences outside of the research setting, in particular considering the researcher’s history in the energy industry, and maintenance of contacts therein. Social interactions therefore give opportunity for research reflection with others in the energy industry, which informs the development of ideas, which are used to enrich themes. This is accepted as a natural by-product of the research process and one which should not be avoided. Again it does call in to question the objectiveness of the researcher and its commitment to remaining within the confines of the research collected during ‘official’ data collection processes; however it could be argued this provides a complementary viewpoint to the research. Where the semi-structured interviews were approaching the formation of ideas from an etic account of perspectives, the ‘lived experiences’ of the researcher contributed to an emic account of the development and application of energy policies in Western Australia.

The second point relates to the need to frame the research findings in a manner useful to external parties. Each of the Results and Discussion Chapters includes consideration of the policy implications of the research findings. This is in response to an understanding of the need for social scientists to frame their research findings in such a way as to positively
influence policy outcomes and in order for the results not to be misconstrued. This is noted in the context of the British Sociological Association, which has stated that:

‘[Sociologists] have a responsibility both to safeguard the proper interests of those involved in or affected by their work, and to report their findings accurately and truthfully. They need to consider the effects of their involvements and the consequences of their work or its misuse for those they study and other interested parties.’


Additionally, this has been included because the research chooses to use as its focal point a form of policy, the incentivisation of residential solar energy adoption, and therefore findings of this research have a valuable potential contribution to make in the growing discourse around the effectiveness of financial incentives for promoting the adoption of small-scale renewable energy generation.

2.6 NOTES ON TERMINOLOGY

It should be noted that this research includes a number of terms which are similar, but not all are analogous. Additionally, in some cases different Chapters use different terms that are analogous. The choice for these terms has been guided by the use of terminology in previous articles in the target journal, and depending on the context of the research. Each is defined at the outset of each chapter, however for the sake of clarity, these terms are provided here.

Analogous terms:

- Distributed generation and decentralised generation. These terms do not necessarily equate to solar photovoltaic systems, however in the vast majority of cases in Australia this is the case. For example, while there are over 210,000 solar distributed generation systems installed in Western Australia there are only 38 small-scale wind systems and one small-scale hydropower system.

- ‘Small-scale solar system’. Whilst this does not necessarily indicate a residential system, it is consistent with the terminology used in relation to the Australian Government Renewable Energy Target, that is, a system of less than 100kW.
• Solar microgeneration system, solar PV system, solar photovoltaic system, and solar system. Although the latter can also include solar water heaters, the context generally makes it clear that this refers to a solar photovoltaic system.

• Residential solar energy and domestic solar energy. Neither are necessarily solar photovoltaic, although for the sake of brevity these are generally the terms used in this research to imply a photovoltaic system.

2.7 REFERENCES


QSR INTERNATIONAL PTY LTD 2015. NVivo qualitative data analysis Software. 11 ed.


CHAPTER THREE: PROLOGUE

The Research and Discussion portion of the thesis begins with Chapter Three, a paper investigating Western Australian residential householders' perceptions of distributional, procedural and outcome justice in relation to the delivery of financial incentives for the promotion of residential solar energy. The research starts by considering the extent to which residential householders are supportive of the availability of financial incentives for the promotion of solar systems, and the extent to which they are willing to pay for these financial incentives, including in their electricity tariffs. The research then tries to determine whether survey respondents would prioritise distributional justice, via reduced financial imposts for subsidising solar, or outcome justice in the form of increased renewable energy penetration. The survey did not seek to address procedural justice issues; however, the vast majority of qualitative responses indicated that procedural justice issues appear to be of greater concern to respondents than distributional justice issues. The research is based on qualitative and quantitative survey data collected in a mail-out survey in the six postcode areas selected for the thesis research, undertaken between August and December 2013.

This portion of the research considers residential householders' perceptions of the provision of financial incentives. The research primarily focuses on consideration of the community dimension of Wustenhagen et al’s (2007) 'triangle of social acceptance of renewable energy innovation' in that it examines distributional and procedural justice issues, however, the research also considers the efficacy of policy development and therefore crosses to the socio-political dimension. Both trust in continuation of government policies, and trust in intermediaries (solar suppliers and installers) are considered in the Results and Discussion sections of this Chapter.

This Chapter has been published in Renewable and Sustainable Energy Reviews, as:

Simpson G., Clifton, J., (2016), Subsidies for residential solar photovoltaic energy systems in Western Australia: Distributional, procedural and outcome justice, Renewable and Sustainable Energy Reviews, 65, 262-273
SUBSIDIES FOR RESIDENTIAL SOLAR PHOTOVOLTAIC ENERGY SYSTEMS IN WESTERN AUSTRALIA: DISTRIBUTIONAL, PROCEDURAL AND OUTCOME JUSTICE

ABSTRACT

Governments seek to increase renewable energy capacity by providing subsidies to householders opting to install residential solar energy (photovoltaic) systems. The funds used to pay for these subsidies are sourced from tax revenue or electricity tariffs paid by all community members, including those on a low income. This sees a redistribution of funds from all community members to installers of residential solar energy systems. This research compared community attitudes towards distributional justice, or the fairness of this redistribution of funds, with outcome justice associated with the environmental benefits of renewable energy. A randomised survey distributed in four metropolitan and two regional communities in Western Australian resulted in 295 responses, a response rate of 22%. 33% of community members prioritised distributional justice, 30% prioritised outcome justice and 37% indicated that they were ‘unsure’ about their preference. However, support for renewable energy was found with 80% of respondents supportive of renewable energy subsidies and 68% supportive of renewable energy taxation, including in electricity tariffs. Qualitative comments indicate that in spite of the preoccupation with distributional justice in the residential solar energy literature, community members are concerned with procedural justice issues. In this case procedural justice can be interpreted as government commitment to existing policy, the expanded scope of renewable energy policy and enhanced regulations.

3.1 INTRODUCTION

Government policies to reduce greenhouse gas emissions increasingly rely on the use of renewable energy to replace fossil-fuel electricity generating systems. All tiers of government, from nation-states to local councils, have come to recognise the important contribution that embedded residential solar energy systems can make towards renewable
energy targets. Governments have therefore instituted a range of financial incentives to promote the adoption of residential solar energy. By increasing the penetration of renewable energy, such subsidies and rebates (when efficiently delivered) can be considered to have environmental benefits associated with reduced carbon emissions from fossil-fuel based generation.

Benefits and costs associated with subsidies and rebates are, however, unevenly spread across socio-economic classes. Nelson, Simshauser and Kelley (Nelson et al., 2011) found that those households within Australia’s lowest socio-economic bracket paid the highest proportionate rate of small-scale renewable energy taxation (funds captured in the retail electricity tariff and designated to support solar installations). To this end policies regarding residential solar energy installations are resulting in social inequality, with households receiving subsidies sourced from tariffs that are not means tested and are therefore paid by all consumers, even those in hardship or on a low income.

3.1.1 Policies to promote the adoption of residential solar energy systems

Sauter and Watson (2007) describe three deployment models for the adoption of residential solar energy: individualised purchasing of a system by a householder (‘plug and play’), industrialised third-party assisted installation (‘company control’) and community-based adoption profiles (‘community grid’). All models have the potential to benefit from government intervention, however most governments seek to promote individualised adoption.

The academic literature emphasises the role that government policies and incentives play in increasing individualised solar system installation rates. Rebates and subsidies reduce up-front costs to households (Macintosh and Wilkinson, 2011) whilst other mechanisms, such as feed-in tariffs, reduce the time it takes to pay off the capital cost of systems (Couture and Gagnon, 2010). Financial incentives have been the favoured form of residential solar energy support in many economies at different tiers of government, including the UK (Cherrington et al., 2013), Germany (Andor et al., 2015), Italy (Palmer et al., 2015), China (Yang and Zhao, 2015), Japan (Chowdhury et al., 2014), New Zealand (Baskaran et al., 2013) and Australia (Macintosh and Wilkinson, 2011). The adoption of residential solar energy can also be enforced by mandating the installation of residential solar energy systems. However,
experience with such a scheme in Bangladesh found that regulation did not sufficiently prevent the ‘renting’ of solar systems to cover obligations during the compliance period (Rasel, 2014).

Third-party installation assistance can be made available through governments, utility companies and solar energy retailers. The most common form of third-party arrangement involves the leasing of solar systems to reduce upfront costs to consumers (Rai and Sigrin, 2013). While this has been a successful form of support the interest associated with leasing agreements results in the total system cost being much higher than up-front system costs, meaning consumers require a higher level of confidence in the expected benefits of the system before they are likely to invest. Another form of third-party installation is where the system remains the property of the solar provider and the household enters a power purchase agreement for the solar electricity generated (Drury et al., 2012). This has the benefit of an absence of capital costs but in some jurisdictions has been limited by regulatory barriers (Huijben and Verbong, 2013). Indirect government intervention in the promotion of residential solar energy can therefore include the reduction of regulatory barriers to third-party access and by providing quality information on the benefits of solar.

The expansion of renewable energy can also be assisted by the formation of community groups with an interest in renewable energy. Community groups can reduce barriers to adoption by providing trusted information to community members on the benefits of solar energy, assisting community members with deciding on a solar system model, and even by purchasing systems direct from wholesalers to reduce capital costs (Noll et al., 2014). Developing community or special-interest group business models for the increased penetration of solar is outside the remit of the government, although policies could be enacted to facilitate development of these projects (Nolden, 2013).

Even in the absence of direct financial investment in residential solar energy governments and utilities may allow the indirect subsidisation of householders installing residential solar energy systems through a redistribution of network costs via changes in household demand profiles (Simshauser, 2016). Many tariff structures allow this redistribution and rectifying the disparity requires considerable administrative action.
3.1.2 Energy-related Justice Literature

Given the continuing trend towards increasing renewable energy capacity, several scholars have researched the social and environmental justice aspects of renewable energy applications and policies. ‘Equity’ and ‘justice’ have been defined in terms of traditional distributive justice, that is, the equitable distribution of ‘goods and bads’ in human society (Cowell et al., 2011). The majority of studies assess the distribution of benefits and costs in relation to wind turbine siting, with financial ‘goods’ often internalised by those landowners hosting wind turbines, while negative impacts associated with changed landscape, reduced public amenity value and (perceived or potential) health impacts accrue to all residents in the vicinity of the wind turbines (Baxter et al., 2013, Jones and Richard Eiser, 2010, Wolsink, 2007, Devine-Wright, 2005, D’Souza and Yiridoe, 2014). While the distribution of these elements across the local community is considered important, the potential role citizen interaction can play in decision-making processes is given priority consideration in both planning processes (Clean Energy Council, 2013), and academic literature (Hindmarsh and Matthews, 2008, Gross, 2007, Ottinger et al., 2014). The capacity for landholders to feel that they ‘have a voice’ and are capable of influencing decision-making results in increased support for some energy projects, even where distribution of costs and benefits remains uneven between landholders (Cowell et al., 2011). The inclusion of citizens in decision-making, and their capacity to influence outcomes, is termed procedural justice.

The interaction between distributional and procedural justice in landowner engagements is complex. Procedural justice issues may be prioritised above distributional justice issues by members of the public who are not likely to be comprehensively affected (morally or otherwise) by a decision, whereas members of the public who perceive themselves as being significantly disadvantaged may identify a process as unjust because of an underlying distributional justice issue, even where procedures are fair and transparent (Earle and Siegrist, 2008). In such cases, large benefits accruing to some landowners but not others may generate conflict between residents (Baxter et al., 2013). Additionally, the breadth of the community included in consultation around renewable energy infrastructure siting, and allocation of costs and benefits, will impact on perceptions of justice. For instance, some consultation processes prioritise a ‘those affected’ approach to engagement, identifying parties to be included in consultation based on the likelihood of a project impacting on their livelihood or lifestyle. However, it is difficult to define such a ‘community’, with Simcock
finding that community members deemed to be ‘not affected’ by project proponents were angered by a perceived lack of inclusivity in consultation.

The literature specifically highlights justice issues in relation to large-scale renewable energy infrastructure but less frequently considers the case of small-scale, distributed renewable energy systems. The latter could be perceived as being characterised by the same issues as large-scale projects, with some citizens feeling that they are ‘visual pollution’, with householders internalising financial benefits of systems, and with an uneven distribution of the economic costs associated with subsidisation of such systems and their connection to the grid.

Consideration of equity issues for small-scale systems has thus far concentrated on this final issue, with examination of the potential for subsidisation to occur between households. Nelson, Simshauser and Kelley (Nelson et al., 2011) found that policies developed to stimulate investment in residential solar energy installations resulted in private benefits internalised by the participating household. Thus, householders who have chosen not to install, who do not have the funds available to install or who are incapable of installing small-scale renewable energy systems for other reasons (for example tenancy status or structural limitations) are subsidising householders with installations. Furthermore, funds appropriated for the payment of subsidies and rebates are often sourced through regressive forms of taxation, in particular as a tariff surcharge in energy utility bills (Nelson et al., 2011). Such policies have a dual negative outcome for those in lower income brackets, with lower income households having a higher proportion of their income contributing to renewable energy subsidies compared with those on a higher income. There is also the potential for lower income householders to pay a larger proportion of network charges than wealthier households that have installed small-scale renewable energy systems and therefore avoid paying network components of consumption tariffs (Severance, 2011). Inequity also exists in the extent to which individual characteristics of households may influence their energy consumption and therefore overall subsidisation of small-scale renewable energy, with geographic location and associated variations in climate/temperature, condition of housing stock (older houses might require more energy for heating/cooling) and lifestyles of occupants (pensioners at home during the day) influencing consumption patterns (Adams et al., 2012).
In defence of the inclusion of charges for subsidies in electricity tariffs, it has been found that there is higher acceptance for a mandatory ‘tax’ for promoting environmentally friendly practices, when compared with voluntary donations (Wiser, 2007). The higher likelihood of ‘free-riding’ on environmental benefits in the case of voluntary donations reduces the likelihood of individuals choosing to donate, and results in an associated reduction in total environmental benefits. Furthermore, the inclusion of costs for renewable energy in all electricity tariffs, regardless of customer type, and the consistent availability of some rebates for all householders wishing to install residential solar energy systems, mean small-scale renewable energy policies demonstrate ‘universal fairness’ [18].

Given the existence of costs and benefits of small-scale renewable energy system subsidisation and installation practices, procedural justice principles could be used to maximise positive perceptions of such policies. However, the fundamental process of procedural justice relates to ‘who should have a seat at the table’ for discussion (Lind and Tyler, 1988). Given residential solar energy policy is generally applied at a state or national level and therefore does not interact with a particular community it is difficult to determine who, when and why a member of any community should be given a ‘voice’ to speak. This is particularly the case given the preference for procedural justice to use a ‘those affected’ principle to identify procedure participants. In the case of small-scale renewable energy systems this could be any member of the community – anyone paying an electricity bill or considering installing solar. Determining who is ‘most’ affected is particularly difficult, as this could be based on those most likely to be impacted by electricity tariff increases (low income or those with lifestyles that expose them to higher electricity usage), or based on those who do not have the capacity to take advantage of the most obvious benefits of subsidies, installation of renewable energy systems (those who are not home-owners or those who own dwellings not suitable for solar installations).

A final area of discussion in relation to procedural justice involves the acceptability of policy outcomes, termed ‘outcome justice’. Visschers and Siegrist (2012) found that public acceptance of new energy policy decisions may be largely contingent upon the perception of fairness in what the policy is trying to deliver and general perception of the energy-type itself (renewable versus nuclear, for instance), as opposed to the fairness of the decision-making procedure or the distribution of costs and benefits. In the case of small-scale renewable energy subsidisation, regressive taxation may not be considered unjust by
community members if the environmental benefits (or internalised financial benefits) associated are thought to be ‘worth it’.

3.1.3 Western Australian Context

This research focuses on the subsidisation of residential solar photovoltaic energy systems given the higher installation rates of solar systems and higher levels of rebates provided to these types of systems in Australia. In the five years since 2010 over one million solar photovoltaic systems have been installed in Australia, compared with 77 wind systems, 6 micro-hydro systems and under 340,000 efficient water heater systems (Clean Energy Regulator, 2016a). Furthermore, a former federal government scheme, the Solar Credits Multiplier (Simpson and Clifton, 2014), and before that the Photovoltaic Rebate Program (Macintosh and Wilkinson, 2011) provided greater financial benefits to solar photovoltaic systems compared with other household renewable energy systems.

Western Australian householders interact with small-scale renewable energy policy in two ways, firstly by benefitting from subsidies when installing their own systems and secondly by contributing financially to subsidies for the installation of others’ systems. Western Australian householders can access two forms of subsidies for installation of their own solar unit. The first is via upfront one-off subsidies to installers, with funds for these subsidies collected through the mandatory purchase of Small-scale Renewable Energy Certificates by electricity retailers (Climate Change Authority, 2012). The second is a state-based premium net feed-in tariff, which provides credit for each unit of electricity fed into the state grid (Collier, 2010).

Households subsidise one another’s solar energy systems through several mechanisms. These include contributions to state revenue and electricity tariffs used to fund the premium net feed-in tariff (Government of Western Australia, 2012), payment of electricity tariffs that underwrite Small-scale Renewable Energy Certificates purchased by electricity retailers (Synergy, 2012), and through subsidising network investments and infrastructure that are required by (and in some instances made more expensive because of) households with residential solar energy installations (Mercer).

The proportion of residential regulated retail tariffs that goes towards subsidising residential solar energy systems is not clear. However, the state-owned energy retailer
('Synergy') states that approximately 4% of ‘your electricity bill at home’ is made up of regulations and fees ‘involved with meeting State and Federal Government obligations and policies’ [1], which would include payments for Small-scale Renewable Energy Certificates. The subsidy received by each household installing a solar system will vary depending on the location of the house, the value of certificates in the market and the size of the system they have installed, however most systems would receive a subsidy of at least AU$1,500 (based on a 1.5 kW system) (Clean Energy Regulator, 2016b). The cost of Western Australia’s premium net feed-in tariff is paid in part through consolidated revenue and in part through Synergy absorbing costs into its operating expenses. The 2014-15 Western Australian budget indicates a AU$121 million contribution (excluding additional payments absorbed by Synergy) over four years [6]. There are approximately 75,000 recipients of the premium feed-in tariff captured under Synergy’s billing framework, each receiving an average benefit of at least AU$400 per year. These direct subsidies are in addition to the financial benefit that residential solar installers receive in reducing their consumption of electricity from the grid and therefore paying reduced network costs, which Synergy indicates make up 42% of electricity bills [1]). Synergy is heavily subsidised by the Western Australian government, with the 2014-15 Western Australian budget indicating that the subsidy to be paid for electricity is in the region of AU$1.9 billion over four years [8].

In total, this portrays a complex interaction between the financial benefits and costs of solar to all consumers. While there is transparency around the rates applied to direct subsidies that householders receive for installing small-scale residential solar systems, including in terms of federally-funded upfront rebates and state-based feed-in tariffs schemes, the cost of these schemes to individual households, passed through electricity tariffs and consolidated revenue losses, is difficult to determine.

In the absence of transparent indicators on the financial costs and benefits to households installing or subsidising residential solar energy systems the Australian media plays a pivotal role in informing community perceptions of justice around the issue. Media attention has focussed on elements of inequality surrounding subsidisation processes, in particular referring to solar policies as 'middle class welfare' and ideas that solar system owners are causing increases in network costs that are then paid disproportionately by non-solar households (Mercer, 2012). Alternatively, the media also highlights public support for solar energy (Mercer, 2013b) and the extent to which adoption is largely focussed in
‘mortgage belt’ locations, and that the wealthy are therefore not the largest recipients of solar subsidies (Neales and Taylor, 2012, Mercer, 2013a). These mixed messages have resulted in the promotion of residential solar energy system installation becoming a highly politicised and complex policy area in Western Australia.

3.1.4 THE RESEARCH

This research investigates community members’ attitudes towards residential solar energy policies, and in particular whether community members consider the redistribution of funds from all members of society, including those on a low income, to householders installing systems as an appropriate sacrifice for increasing renewable energy. In doing so, the objective of this research is to ‘fill the gap’ in the academic literature around investigating justice interactions in the expansion of renewable energy, particularly in the presence of financial incentives for residential solar energy systems. The aims of the research are to explore:

- Whether respondents are supportive of renewable energy and in particular to the extent that they are willing to pay for renewable energy through their electricity tariffs;
- Whether respondents are supportive of the availability of subsidies and other support mechanisms for renewable energy, and in particular their accessibility to householders;
- Whether respondents prioritised maximising the capacity of renewable energy installed or social equity benefits through reduced financial burdens for low income earners;
- The extent to which demographic or experiential factors influence the above. In particular, whether self-interest, measured in terms of whether respondents accessed renewable energy subsidies in installing their own system, had an influence on attitudes towards renewable energy and renewable energy subsidies;
- Whether additional themes emerge in the unguided, qualitative responses to the survey.

Research examining aspects of justice in the expansion of renewable energy frequently employ the measurement of attitudes and perceptions. For instance, perceptions have been measured regarding technologies (Vazquez and Iglesias, 2015), risks (Baxter et al., 2013)
and siting issues (Devine-Wright, 2005) in relation to renewable energy. Given the distributed and personal nature of residential solar energy systems, and the lack of transparency regarding costs and benefits to all consumers, there is understandably scant information regarding perceptions of justice in the development of residential renewable energy policies. Perceptions of residential renewable energy and associated subsidies have the potential to be complex, with large-scale renewable energy projects prone to localised opposition as much as conventional facilities, in spite of broad-based societal support for renewable energy (Aitken, 2010, Jones and Richard Eiser, 2010, Bell et al., 2005). In spite of this, ‘perceptions themselves likely have real consequences on their own’ p942 (Baxter et al., 2013). The benefits of researching public perceptions and attitudes, and considering policy approaches to improve them, has been highlighted in the research, including with the UK government indicating that social controversy around the siting of wind farms is a potential barrier to achieving emissions reduction targets (Devine-Wright, 2005).

Discussion of the findings is separated into three sections. The first addresses the extent to which survey respondents support renewable energy, and compares the data here with other literature. The second section examines survey results from a justice perspective, in particular considering whether respondents’ attitudes appear to prioritise environmental outcome justice or financial distributive justice. The final section provides policy recommendations based on the findings, with consideration of procedural justice elements.

As is noted in 3.1.2 above, the interaction between alternative forms of justice (distributional, outcome or procedural) is complex, with attitudes unlikely to be fixed over time, between contexts and influenced by information available. For instance, prioritisation of one form of justice over another in the case of residential solar energy may be influenced by the extent to which individuals understand the benefits of renewable energy in combatting climate change, or the value of the subsidy they are paying to other householders. Furthermore, it is noted that aspects of justice cannot be treated in isolation or without a level of understanding of the costs and benefits of decisions (Törnblom and Vermunt, 1999). However, given the highly political nature of subsidy schemes (Simpson and Clifton, 2015) and the extent to which media interpretation of community and industry response to policies can influence acceptance of solar (Heras-Saizarbitoria et al., 2011), using indicative findings on prioritisation of forms of justice to inform policy could increase acceptability of the cross-subsidisation of solar, and support for solar more generally.
This research does not seek to claim that residential solar energy systems should receive subsidisation ahead of larger-scale renewable energy projects. Nor does it suggest that the findings will be replicable in other regions. Instead it paints a picture of contemporary attitudes towards technological support policies that can benefit both the environment and individual households. The findings will be useful to those considering implementation of technology-promotion programs that generate universal environmental benefits but an uneven distribution of financial costs and benefits.

3.2 MATERIAL AND METHODS

In order to represent a range of solar perspectives in Western Australia, six geographic areas were selected for this research, including four metropolitan postcode areas and two regional communities. The four metropolitan areas were required to have a minimum of 200 systems installed, minimum of 1000 free-standing dwellings (appropriate for solar installation) and maximum of 25% rental rate in the 2011 census (Australian Bureau of Statistics, 2013a). Using the Australian Bureau of Statistics index of socio-economic welfare (Australian Bureau of Statistics, 2013b), metropolitan postcodes of the highest (in the top 3 decile places) and lowest (in the bottom 3 decile places) socioeconomic status communities in Western Australia were collected, creating a total pool of 24 potential postcode regions. The postcode areas with the highest and lowest residential solar penetration rate from each of the decile groups (Clean Energy Regulator, 2014) were chosen from these 24 potential postcode regions. The two regional communities had similar population sizes, similar median household wages, and proportion of rental accommodation. The first regional community, Carnarvon, was selected given it has been identified as a case study example for the successful promotion of residential solar energy. Narrogin was selected based on it being the most similar regional community in terms of demographic attributes to Carnarvon. The ‘address finder’ function in publicly-available Landgate data was used to randomly generate addresses for individual households in each postcode area (Landgate, 2013).

Quantitative analysis, in the form of a survey comprised of a series of Likert-type statements, provided statistics on householders’ attitudes regarding residential solar energy. Questions requesting demographic information, details on whether the respondent had installed a system and an open text section were included. A modest pre-test was
conducted with the survey instrument being completed by seven purposively chosen respondents. No significant issues with the survey design were noted at this stage.

The postal survey was implemented in three stages in order to maximise response rates (Dillman et al., 2009). The initial survey was sent with a cover letter and reply paid letter. This was followed by a reminder postcard and then another copy of the survey, cover note and reply paid envelope. The value of follow-up surveys for increasing response rates was identified in a related study (Baskaran et al., 2013). A raffle incentive prize, in the form of an iPad Mini, was provided to further increase the response rate. Surveys were sent out between August and December 2013. Implementation of the survey complied with The University of Western Australia’s ethical procedures.

1339 surveys were sent out and 295 completed surveys received. The overall response rate of 22% is below that reported in similar research, which varies between 35% and 45% (Baskaran et al., 2013, Earle and Siegrist, 2008, Wiser, 2007). Response rates varied between communities, from 13% to 30% (Figure 1). Lower socioeconomic metropolitan communities had notably lower response rates compared with their higher socioeconomic counterparts. In all communities respondents to the survey had a higher educational attainment compared with the populations from which they originate. In three of the four metropolitan communities survey respondents were, on average, older than the general population. However, the sex ratio and income levels of survey respondents were statistically consistent with their communities. Overall, 78 respondents stated they had a residential solar electricity system installed, 202 stated they did not and 15 respondents provided no response. The proportion of survey respondents who had installed systems in each location was generally consistent with the regional level of installation reported elsewhere (Clean Energy Regulator, 2014).
Figure 3.1: Number of surveys sent out, surveys not received/incomplete, surveys received, gender breakdown of respondents and percentage response rates by sampled geographic area.

SPSS Version 22.0 (IBM Corporation, 2013) was used to undertake non-parametric analysis of the quantitative survey data, given the data was not normally distributed (Field, 2013). The purpose of the survey analysis was to examine community member’s attitudes regarding renewable energy subsidisation, with three major themes. The survey included questions relating to respondents’ level of support for renewable energy, including the inclusion of payment for renewable energy in electricity tariffs (objective 1), respondents’ level of support for renewable energy subsidies, and in particular subsidies directed at householders (objective 2), and whether respondents prioritised support for low income earners through reduced tariffs or support for maximising renewable energy capacity through increased availability of subsidies and support mechanisms (objective 3). Each of these three objectives was examined using six Likert-type statements. Objective 1 was examined using three statements assessing whether respondents believe renewable energy is valuable/beneficial, and three statements assessing whether bills/electricity costs should
be increased or sacrifices should be made for renewable energy. Objective 2 was examined using three statements addressing prioritisation of subsidisation of renewable energy in households before industry, and three statements assessing approval of government subsidisation and support for renewable energy. Objective 3 was examined with four statements relating to support for low income households before support for expanding renewable energy capacity, and two statements relating to whether all electricity consumers should have to contribute to renewable energy components in electricity tariffs. A final Likert-type statement asked survey respondents whether they would ‘only purchase a solar system if it was subsidised by the government’. Four additional Likert-type statements were provided to regional community members to highlight regional-specific issues.

The six Likert-type statements under each of the three objectives were tested for internal consistency using Cronbach’s coefficient alpha and tested for unidimensionality using item-total correlation (De Vaus, 2002). Given the low number of Likert-type statements under each objective a minimum alpha of 0.60 and minimum item-total correlation of 0.30 were set (Cortina, 1993). Likert-type statements with an item-total correlation of less than 0.30 or with a higher alpha when deleted represented a divergence from the objective being measured and so were not included in the scaled score for these objectives.

The scale created under Objective 1, relating to support for renewable energy including payment through electricity tariffs, was both unidimensional (minimum item-total correlation of 0.48) and highly internally consistent (Cronbach’s alpha of 0.83, n=6). The scales created under Objective 2 and 3 both required the removal of individual Likert-type statements before being internally consistent. Objective 2, measuring levels of support for renewable energy subsidies and in particular for residential households, had a minimum item-total correlation of 0.40 and Cronbach’s alpha of 0.73, after having one Likert-type statement removed (n=5). Objective 3, relating to whether respondents prioritised support for renewable energy or low-income householder, had a minimum item-total correlation of 0.36 and Cronbach’s alpha of 0.65, after having two Likert-type statement removed (n=4). Where Likert-type statements were excluded from scaled scores, individual items were analysed. The precise wording of individually analysed Likert-type statements is included in the results section.
It should be noted that the sample is not representative of the general population, the response rate is modest and Cronbach’s alpha for Objective 3 is low. Thus, the following analysis is exploratory only, and the findings should not be considered predictive.

Qualitative feedback, in the form of written comments at the end of the survey, was provided by 72 survey respondents. Given some respondents provided feedback in more than one thematic area, a total of 146 individual comments were analysed. All comments were coded into themes decided on by the authors after consideration of the full suite of responses. Inter-rater reliability between the two co-authors for coding of themes was substantial (Landis and Koch, 1977), with a Cohen’s K of 0.609 (95% CI, 0.525 to 0.693, p<0.0001). Clarification of theme descriptions was undertaken in a collaborative process to ensure agreement was reached for all thematic groupings.

### 3.3 RESULTS

The results section firstly provides an overview of the statistical analysis of quantitative survey results and secondly considers the qualitative comments provided at the end of each survey, according to emergent themes identified by the authors.

#### 3.3.1 QUANTITATIVE RESULTS

This section first considers general support for renewable energy and associated subsidies by respondents (objectives 1 and 2), and then examines the potential interactions between this support and respondents’ experience with solar installations, age, education level and geographic location. The results of objective 3, an analysis attempting to determine whether householders prioritise maximising renewable energy installations (outcome justice) or providing low income support (distributional justice), are then provided. A summary of these results can be found at Table 3.1.
Table 3.1: Percentage agreement to scaled items and individual Likert-type statements referenced in the text.

<table>
<thead>
<tr>
<th>Scaled item: Questions indicating support for renewable energy to the extent that electricity tariffs should be raised to increase its adoption</th>
<th>Disagree</th>
<th>Unsure/Don’t know</th>
<th>Agree</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaled item: Questions indicating support for the availability of subsidies for the installation of residential solar energy systems</td>
<td>5%</td>
<td>27%</td>
<td>68%</td>
<td>295</td>
</tr>
<tr>
<td>'I would only purchase a solar electricity system if it was subsidised by the government'</td>
<td>43%</td>
<td>15%</td>
<td>42%</td>
<td>291</td>
</tr>
<tr>
<td>'Funding should go to large, efficient renewable energy projects instead of household projects'</td>
<td>44%</td>
<td>26%</td>
<td>30%</td>
<td>295</td>
</tr>
<tr>
<td>Scaled item: Questions indicating support for maximising support for residential solar energy at the cost of low income support</td>
<td>33%</td>
<td>37%</td>
<td>30%</td>
<td>295</td>
</tr>
<tr>
<td>'I would be more supportive of subsidies knowing that most solar installers are not wealthy'</td>
<td>30%</td>
<td>24%</td>
<td>46%</td>
<td>291</td>
</tr>
</tbody>
</table>

Western Australians are both supportive of renewable energy, and supportive of subsidising renewable energy, with 68% of respondents supporting renewable energy to the extent that electricity tariffs should be raised to increase its adoption (n=295) and 80% of respondents supportive of renewable energy subsidies for residential householders. There was no statistically significant difference in support levels between respondents in different income classes (n=280). When respondents were asked to decide if ‘funding should go to large, efficient renewable energy projects instead of household projects’, subsidisation of small-scale residential renewable energy systems above large-scale renewables is still preferred, with 44% supporting small-scale and 30% supporting large-scale investment (n=295).

Self-interest, measured as a function of whether respondents have installed a system and therefore benefitted from solar subsidies and incentives, appears to influence perceptions of policies. Ninety-five per cent of those who have installed a system are more supportive of residential subsidies and rebates (n=78) compared with 75% of those who have not installed a system/not responded (n=217), significant at the p<0.001 level (two-tailed Mann-Whitney U=6228.5). Furthermore, a larger proportion of respondents who have already installed a system reported that they did not agree that they would ‘only purchase a solar electricity system if it was subsidised by the government’ (59%, n=76) compared with
those that have not installed a system (37%, n=215), again significant at the p<0.05 level (two-tailed Mann-Whitney U=6682.5).

Respondents from regional areas were more supportive of renewable energy subsidies for householders, with 86% of regional respondents supportive (n=81) versus 78% of metropolitan respondents (n=214), significant at the p<0.05 level (two-tailed Mann-Whitney U=7395). They were also more likely to agree that they would 'only purchase a solar electricity system if it was subsidised by the government', with 54% of regional respondents saying they would require a subsidy (n=80) compared with 38% for metropolitan customers (n=211), significant at the p<0.005 level (two-tailed Mann-Whitney U=6623). This likely reflects the increased capital costs associated with installation of residential solar energy systems in regional areas, and is further evidenced in that 54% of regional respondents believed that 'only wealthy people can afford to install solar systems in regional areas' (n=81). These data can be contrasted with that from City Beach, the suburb with the highest socioeconomic rating and lowest solar penetration of any postcode district in Western Australia. Only 60% of respondents in City Beach were supportive of solar subsidies for households (n=68) compared with 86% from all other areas (n=227), significant at the p<0.0001 level (Kruskal-Wallis X²[5, n=295] = 36.4). City Beach respondents also prioritised funding 'to large, efficient renewable energy projects instead of household projects', with 53% of City Beach respondents (n=68) supporting large-scale projects, compared to 23% for all other regions combined (n=227), significant at the p<0.0005 level (Kruskal-Wallis X²[5, n=295] = 24.12). Furthermore, they were less likely to 'only purchase a solar electricity system if it was subsidised by the government', with only 25% of respondents needing a subsidy (n=68) compared to 47% for all other regions (n=223), significant at the p<0.01 level (Kruskal-Wallis X²[5, n=291] = 15.7).

The third objective of the survey explored whether respondents had a preference for solar subsidies maximising environmental benefits through higher installed renewable energy capacity, or for prioritising low-income support. No clear preferences were identified, with 33% of respondents favouring reduced electricity tariffs and increased support for low income earners, 30% of respondents supporting an increase in renewable energy capacity above low income support and 37% not providing a clear indication of their direction of support (n=295). However, the age, educational attainment and income of respondents were shown to interact with renewable energy or low income support. Those over the age
of 60 were more likely to support low income earners (47%, n=118) compared with those under 60 (24%, n=173), significant at the p<0.0001 level (Kruskal-Wallis $X^2[5, n=291] = 24.909$). Those with only a primary or secondary school attainment were also more supportive of reducing costs for low income earners (50%, n=90) in contrast to those who had attained higher education (25%, n=199), although the higher education group was more likely to be ‘unsure’ (41% compared with 29% for lower educational attainment) significant at the p<0.01 level (Kruskal-Wallis $X^2[4, n=289] = 14.55$). Forty-four per cent of respondents earning less than AU$65,000 per year prioritised low income support over renewable energy support (n=104). This was statistically significantly greater (p<0.01; Kruskal-Wallis $X^2[4, n=280]=14.4$, using pair-wise comparison between income classes) than the 24% of respondents earning over AU$65,000 per year who held similar priorities (n=176).

In spite of this, there was no difference between income groups regarding whether ‘all electricity consumers should contribute equally to the costs of renewable electricity’ (Kruskal-Wallis $X^2[4, n=279] = 2.983$, p=0.561). There was also no statistically significant indication that those who consider installing systems to be cost prohibitive or cannot install for other reasons are more supportive of prioritising low income support above increasing renewable energy capacity compared with those who have installed their own system (two-tailed Mann-Whitney U=7764.5, n₁=202, n₂=78, p=0.844). Furthermore, less than half of all respondents (46%) indicated that they would be ‘more supportive of subsidies knowing that most solar installers are not wealthy’ (n=291).

Survey responses indicated that the capital cost of systems continues to be a barrier to adoption, and that government subsidies may continue to be relied upon for installation. Of all respondents who had stated that they had not installed a residential solar system, 29% indicated that they ‘would like to install a solar electricity system but [they] could not afford it’ (n=203). A slight majority, at 51%, were earning less than AU$65,000, however 28% of these respondents were earning more than AU$90,000 per annum (n=57). 42% of all respondents indicated they would ‘only purchase a solar electricity system if it was subsidised by the government’ (n=278), with 47% of respondents earning less than AU$120,000 per year requiring subsidisation (n=200). The subsidy requirement decreased to 28% amongst respondents earning more than AU$120,000 (n=78). Difference between income groups were significant at the p<0.05 level (Kruskal-Wallis $X^2[4, n=278] = 10.504$).
3.3.2 Qualitative Results

Of the 295 completed surveys, 72 respondents provided written statements, with 146 unique comments. Survey respondents were largely supportive of renewable energy, with 19 respondents citing general support for renewable energy, particularly in the face of climate change, and a further two respondents noting that Western Australia is an ideal location for residential solar energy installation.

Many respondents focused on the need for government to maintain or increase its involvement in renewable energy and associated subsidies, with a preference for more targeted support. Specifically, 18 comments requested additional government foresight, will or long-term commitment in developing policies to increase renewable energy; 15 comments supported increasing government-sponsored research and development around renewable energy and energy efficiency; eight comments indicated that a more effective way of supporting residential solar energy would be to mandate its installation in new homes; and eight comments called for greater regulation of the solar/electricity industry. Three comments supported general subsidisation of renewable energy installations in homes and businesses. Six comments suggested government subsidies and policies provide support for low income earners, in particular opposing ‘middle class welfare’ and ‘throwing money away to those who don’t need it’. Five comments requested governments ensure equal subsidies, access to subsidies and access to the electricity network for all householders. One respondent prioritised support for large-scale infrastructure that would benefit everyone equally. Four survey respondents indicated that solar installation decisions were made largely on a financial basis, alluding to the important role subsidies can play in promoting adoption of residential solar.

Twenty one respondents made 27 individual comments that were critical of residential solar energy. Seven respondents demonstrated concern for the reliability of residential solar technology and 14 respondents indicated that residential solar energy was too expensive to install, particularly for pensioner-age respondents. Three respondents did not think solar rebates should be available. Reasons included the now-reduced price of solar systems, a lack of support for ‘paying for someone else’s solar panels’ and a lack of faith in the technology. Two respondents rejected any renewable energy support for businesses and one respondent thought that those installing solar systems should be charged additional network costs. Eight comments prioritised other energy sources (‘clean coal’,
natural gas or nuclear fission/fusion), and a further three were notably opposed to renewable energy.

Nine comments detailed individual solar installation stories, and ten comments could not be matched to research themes.

3.4 DISCUSSION

The discussion section is separated into three parts and uses survey results and literature to make assertions on levels of support for renewable energy, its subsidisation and associated justice issues. This research should be viewed within the socio-political context of renewable energy in Western Australia, an economically developed state with a high incidence of solar irradiation. Attitudes towards solar in this research may be influenced by the high, and rapidly increasing, electricity tariffs within Western Australia, along with a high level of awareness around renewable energy, with attention paid to this technology in the media (Simpson and Clifton, 2015). Furthermore, Western Australians received generous subsidies for the installation of residential solar energy systems, but state and federal renewable energy policies have been subject to policy instability (Simpson and Clifton, 2015, Simpson and Clifton, 2014). The discussion section concludes with policy recommendations.

3.4.1 SUPPORT FOR RENEWABLE ENERGY

The majority of survey respondents (68%, n=295), supported renewable energy and a renewable energy component in electricity tariffs, underlined by survey comments such as ‘current electricity tariffs should be increased to pressure the public to support research into alternative energy (not necessarily solar)’. This appears to corroborate other findings that some consumers are willing to pay a higher price for electricity to internalize the additional costs associated with securing a 'clean' form of electricity generation (Longo et al., 2008). The level of support for renewable energy, in spite of additional costs to the consumer, noted in this research is higher than cited in earlier literature [47], in which 34% (n=667) of respondents were willing to contribute funds for electricity generated from a renewable energy source. A possible reason for the higher acceptance in this research is that Western Australians already contribute to renewable energy in their electricity bills.
Survey respondents who are aware of this and who also support providing funds to renewable energy in their electricity bills could be supportive of maintaining the status quo.

The survey results demonstrated a high level of support for renewable energy subsidies, and in particular for households, with 80% of respondents confirming support for renewable energy and its subsidisation. This finding is similar to that found in other research, with a 2014 Australian policy think tank-funded study finding that 71% of Australians supported expansion of a policy to increase the proportion of renewable electricity generation in Australia (Stefanova et al., 2014). Support for renewable energy did not vary according to the income groups of respondents, although the geographic location of respondents did have an impact on attitudes. In particular the relatively small but significantly different level of support for renewable energy and subsidies between regional communities (86%) and metropolitan communities (78%) is likely evidence of the additional energy security and financial benefits accruing to regional installers, and in particular in the Carnarvon community, which benefitted from higher feed-in rates than metropolitan communities (Horizon Power, 2015).

There was a noticeable difference in the attitudes of those who had installed a system and those who had not. In spite of media articles claiming that solar installers are ‘shirking their dues’ (Mercer, 2012), these findings suggest solar installers may in fact demonstrate a pro-social and/or pro-environmental ethic, with the majority of installers convinced of environmental and/or financial benefits of residential solar energy and therefore not requiring subsidies. This is reflected in that respondents who had installed systems were less likely to require a rebate to install a system compared with those who had not (59% versus 37%). Similarly, those respondents who had installed systems appeared to adhere to either a pro-social ethic in supporting the opportunity for others to benefit from subsidies they themselves received, or a pro-environmental ethic in supporting increased renewable energy installation, with those who had installed a system being more supportive of subsidies than people who had not (95% versus 75%).

While the underlying factors contributing to the differences in attitudes between those who have already adopted residential solar and those who have not cannot be determined in the absence of additional questioning, three possible contributing factors include the possibility of path dependency, the development of solar communities and existential guilt attributed
to the accessing of rebates. In the case of path dependency the future installation of residential solar energy systems could be influenced by the past adoption of residential solar energy systems by some householders (Foxon, 2007). In particular, households 'lock-in' the use of a solar system and adjust their behaviours accordingly, and therefore replace a solar system with a solar system, even in the absence of rebates. The decision to continue with the use of residential solar would be dependent on the solar systems meeting householders' expectations, with this level of satisfaction leading those who have already installed a system to support the expanded adoption of residential solar energy by other householders. This finding could also be explained on the basis that those who have installed solar become part of a 'solar community' and adopt positive attitudes based on their lived experiences with solar. This would then exist as a parallel to perceptions of large-scale renewable energy, with members of communities with large-scale renewable energy projects having considerably higher levels of support for renewable energy, once installed, compared to communities with no large-scale system. For example, Baxter, Morzaria and Hirsch (Baxter et al., 2013) found that a control community with no renewable energy project had only 25% support for renewable energy (n=116) compared with 69% in the community with an existing renewable energy project (n=109). A final potential influence on this attitude is around the emotional response that those who have already installed systems, and therefore benefitted from rebates and incentives, have towards those who have not. Montada and Schneider (1989) identify that evaluations of justice are influenced by existential guilt, where an individual's awareness of their own undeserved relative advantage over others can influence them to perform pro-social actions.

The survey responses also demonstrated the important role that subsidies could play in the decision to install a residential solar energy system. A large proportion of respondents (42%) would only install a residential solar energy system if it were subsidised by government, and this was particularly the case for regional respondents, renters or other non-home-owners. Of respondents who had not installed a system, 29% said they would like to install one but could not afford to do so. Fourteen survey respondents provided comments indicating that residential solar energy systems were too expensive to install, particularly for pensioner-age and regional respondents, and four survey respondents stressed that installation is made on a financial basis, so must remain attractive in economic terms. Comments included: 'my family is willing to install [a] solar electricity system when it is more affordable' and 'access to solar and other renewable resources is expensive in
regional and rural Western Australia’. The economic barriers to the installation of residential solar energy systems, and the important role that subsidies can play in reducing this barrier, is recognised in the literature (Karakaya and Sriwannawit, 2015, Faiers and Neame, 2006, Balcombe et al., 2014).

3.4.2 DISTRIBUTIONAL, OUTCOME AND PROCEDURAL JUSTICE

The main aim of this research was to explore whether householders prioritised distributional justice or outcome justice in the provision of rebates and subsidies for renewable energy. This was tested by having survey respondents prioritise social equity benefits associated with cost protection for low income earners or renewable energy capacity growth through subsidisation. Both the quantitative and qualitative results did not identify a clear preference across the sampled population. The quantitative results found 33% support for low income earners, 30% support for increased renewable energy and 37% unsure or no clear preference. This was echoed in the qualitative survey responses, with six comments supporting low income assistance and five comments supporting equality of access to rebates and networks.

The level of support for distributional or outcome justice varied between different groups of respondents. Respondents over the age of 60, those earning less than AUS$65,000 and/or with educational attainment not extending beyond high school prioritised low income support and associated reduced renewable energy installation above renewable energy support and expansion. These findings reflect theories in the literature around characteristics of community members and likely support for pro-environmental activities. The socialisation hypothesis, after Inglehart (Inglehart, 1990), proposes that socio-economic conditions and experiences during adolescence and young adulthood shape life-long environmental opinions. The older cohort in this study, born mostly in the baby-boomer era of increasing materialism and a relative lack of awareness of ecological issues (Inglehart, 1981), are more supportive of social benefits of reduced electricity tariffs than increasing the penetration of renewable energy. This is evidenced in that 47% of respondents over 60, versus 24% of respondents under 60, were supportive of low income assistance. The affluence hypothesis, based on Maslow’s hierarchy of needs (Maslow, 1943), suggests that higher income groups favour environmental concern because they can afford to pay the costs of reducing pollution (Gelissen, 2007). This hypothesis may help explain the 20% difference in support between lower income earners (44%) versus higher income earners.
(24%) for low income support in renewable energy policies. The quantitative findings therefore align with other research examining justice and decision-making issues in that different segments of the community will prioritise different forms of justice based on their own experiences, with ramifications for the acceptance of renewable energy policies within various sectors of the community.

The quantitative survey results identified that the largest group of respondents (37%) had no clear preference for distributional or outcome justice in the case of renewable energy subsidies. The survey included no attempt to provide information on increases to electricity tariffs to support renewable energy, or the financial benefit accruing to households receiving subsidies. This, combined with a lack of understanding on how much respondents contribute financially to renewable energy in Western Australia, likely impacted on survey respondents’ capacity to judge their levels of support. A choice modelling experiment around the opt-in ‘GreenPower’ program in Australia, where electricity consumers can choose to pay for additional renewable energy, found that 25% (n=477) of their sample was unsure of whether they were even subscribed to the scheme (Hobman and Frederiks, 2014). This research indicates that consumers may be relatively unaware of the financial impost placed upon them to support renewable energy, how that may grow under different renewable energy schemes, and how other householders and the environment might benefit. Consumers may not therefore be expected to develop a clearly articulated or consistent view on solar subsidisation.

Distributional justice in the case of Western Australia’s renewable energy policies could be made more equitable by having revenue sourced from electricity tariffs directed towards large-scale renewable energy investments, with greater economic efficiencies for environmental output compared to small-scale systems and reduced internalised financial benefits for some householders (Nelson et al., 2011). However, the survey responses indicated a preference for support of residential subsidisation above ‘industry’ subsidisation, with this finding remaining unchanged regardless of income level or education level. The prioritisation of community and environmental welfare above potential industry profit is noted elsewhere in the environmental justice literature, with Kals, Maes and Becker (Kals et al., 2001) finding that community members supported regulations that would harm local industry development but generate air quality benefits. It does appear, however, that the finding in this research may have been influenced by an
assumption that residential systems have similar efficiencies to large-scale systems, with the statement around funding going 'to large, efficient renewable energy projects instead of household projects' having a statistically significant difference in the range of responses than statements that did not include 'efficient'. Qualitative survey responses did not appear to prioritise one form of renewable energy generation over another, with multiple respondents requesting support for both large-scale and small-scale renewable energy investment and only one respondent clearly prioritising large-scale for the reason that benefits would be evenly distributed throughout society, rather than as a result of the increased economic efficiency of large-scale projects.

While the quantitative findings did not clearly indicate whether Western Australians have a preference for principles of distributional justice or outcome justice, analysis of the qualitative comments included in the survey indicated that respondents demonstrated prioritisation of procedural justice in the delivery of residential solar rebates and subsidies in Western Australia. Of 72 qualitative survey respondents, 32 made comments on procedural justice issues and only 10 cited distributional justice objectives – with those respondents prioritising low income support, rejecting the availability of subsidies and suggesting householders installing solar systems should be charged more for accessing the network due to associated network/storage costs. While procedural justice is usually based around issues of stakeholder inclusion in decision-making, which is difficult to accomplish effectively in the case of policies impacting states or nations, procedural justice in the case of this research appeared to be focussed on expectations for governments to demonstrate increased commitment to new and existing renewable energy policies.

The most popular themes for survey comments, after general support for renewable energy (19 comments), related to government policy and made particular reference to uncertainty surrounding renewable energy policy, even where ‘contracts’ existed (18 comments). Survey respondents had particular concern around the capacity for governments to develop and commit to long-term policy, with comments indicating that governments ‘are short sighted regarding renewables’, ‘lacked any foresight in the potential of this renewable energy technology’, ‘rules... cannot be relied upon to remain stable because of changing government’, ‘subsidies in the future are not guaranteed’ and ‘support for renewable energy strategies needs to have a political platform that is not affected by the election cycle’. Respondents also demonstrated concern around appropriate regulation of the solar
industry (8 comments), with comments such as ‘I would purchase solar panels but I feel that companies selling them are ripping us off and the government is doing nothing to stop them’ and ‘it seems you can only get advice from commercial representatives and they’re out to make a buck – I do not trust that I am receiving good advice, just a sales pitch’. Issues of policy certainty and industry regulation with regards to residential solar energy in Australia are covered elsewhere (Simpson and Clifton, 2015, Simpson and Clifton, 2014). Comments from survey respondents also recommended increased government support for renewable energy and energy efficiency research and development (15 comments) and encouraged governments to enforce the installation of residential solar energy systems in all new homes (8 comments). In particular, the mandating of residential solar systems in new homes has the potential to be a significantly more cost-effective way of increasing the penetration of residential solar energy systems.

While a previous study (Gross, 2007) found that community members only slightly affected by a decision prioritised procedural justice and those strongly affected prioritised distributional justice, this research found that procedural justice was perceived as important by both those who had installed systems and those who had not. Respondents chose not to install systems based on instability in government policy and a lack of industry regulation, while policy stability around feed-in tariffs for those who had already installed was important. In this case householders had sunk capital into residential solar systems, based on a clearly articulated government policy that was subsequently being seen as unstable – a form of procedural injustice. While these findings should be considered in the context of political instability in Western Australian policies relating to residential solar energy (Simpson and Clifton, 2015), the prevalence for changes in policy conditions to influence residential solar energy adoption profiles is evident in other countries (Leepa and Unfried, 2013, Cherrington et al., 2013). Respondents’ concerns around issues of procedural justice show that, in spite of its distributional nature and the complex ways people are ‘affected’ by residential solar policies, residential solar has much in common with large-scale renewable energy projects with regard to community perceptions of fair and reliable processes.

3.4.3 Policy recommendations

Academic literature regarding subsidisation of small-scale renewable energy systems has focussed on economic aspects of redistribution (Farrell and Lyons, 2015, Macintosh and
Wilkinson, 2011, Nelson et al., 2011, Nelson et al., 2012) and the cost-effectiveness of residential solar energy subsidies for increasing the adoption of solar systems (Bell and Foster, 2012, Bond et al., 2012). These studies assume that householders will behave as rational economic actors and that distributional equity is of highest priority when designing subsidisation policies. However, this research indicates there may not be substantive reason to believe that consumers are concerned with issues of distributional equity. Furthermore, rationalist economic policies applied in similar policy areas are increasingly being questioned as the impacts of these policies, including growing levels of social conflict, are recognised (Syme et al., 1999). Taken together, these studies stress the importance of developing a policy framework for ensuring aspects of procedural justice, even in cases where a ‘community’ is large, disparate and difficult to consult.

The current research suggests that it would remain difficult to consult directly with community members about their preferences for renewable energy policy, particularly given the heterogeneous perspectives regarding subsidies and the size and distribution of the ‘community’ affected. However, there is the potential for greater levels of public satisfaction with renewable energy policies by having governments maintain their commitment to incentive schemes and introduce a wider range of policy mechanisms to support renewable energy, including changes to regulations and building codes. Increasing communication to community members regarding opportunities to access subsidies, appropriate solar system selection, and the regulations and procedures governing industry conduct could all assist in enhancing perceptions of procedural justice and maximising adoption rates (Simpson and Clifton, 2015). This is particularly the case given the number of survey respondents who indicated that they could not pay for the installation of a system, which may not reflect the variety of loans, subsidies and other financial agreements available to assist with solar system installation in the absence of up-front capital (Solar Choice, 2015). The potential for public awareness campaigns to act as cost-effective mechanisms to facilitate the adoption of low-emissions products, such as voluntary carbon offsets, has also been noted elsewhere (Jacobsen, 2011). In order to maximise procedural justice benefits and the acceptability of policies, any communication with the public should be comprehensible and jargon-free in order to avoid potential misunderstanding and consequent resentment amongst community members (Nancarrow and Syme, 2001).
The findings from this research indicate that the subsidisation of residential solar energy systems is important from a personal, decision-making perspective. This is reflected in the proportion of respondents who would only install a system if it were subsidised, who indicated they would like to install a system but could not afford to, and that the decision to install a solar system is dependent on the technology being economically attractive. There are also positive externalities to renewable energy subsidies including the environmental benefits associated with increased penetration of renewable energy, and the positive impacts subsidies and associated policies may have on residential consumers’ attitudes towards renewable energy. The availability of rebates and subsidies may increase awareness and acceptance of these technologies, with payment for technology through electricity tariffs deemed acceptable in turn. The fact that there were so few comments around distributional justice issues indicates that subsidisation of residential solar energy may be deemed acceptable by the community. These findings indicate continued availability of subsidies, and information assisting householders with making financial decisions, could be important in increasing the acceptance of residential solar energy as a reliable, affordable and environmentally-friendly investment.

3.5 CONCLUSION

The objective of this research was to contribute to the academic discussion around community members’ attitudes towards justice issues in the expansion of renewable energy. This study examined different aspects of justice in relation to small-scale residential solar energy subsidisation, an area of renewable energy policy that in the past has been exclusively considered from perspectives of distributional justice and economic efficiency couched in terms of best-practice policy development. Therefore, this research could also contribute to the development of policy, enabling the consideration of a wider range of justice perspectives with a potential coincident increase in the acceptability of subsidisation policies.

The research identified that procedural justice is important in the way community members perceive ‘fairness’ in relation to residential solar energy policy, contrary to the preoccupation with distributional justice in the literature. While the quantitative survey results identified that some subsets of survey respondents choose to prioritise financial protection for low income earners above increased renewable energy, there was no clear
preference across the community for low income or renewable energy support. Instead, undirected qualitative comments indicated that, with the exception of individuals opposed to renewable energy and associated subsidies, most respondents identified concerns with aspects of procedural justice. In particular, government was not considered to be reliable and transparent in its policy decisions, and respondents requested additional support for renewable energy through research and development funding and stronger regulations.

The survey respondents’ attitudes towards renewable energy and its subsidisation, including for residential solar energy, was positive. However, the ‘community’ in this case is heterogeneous and therefore priorities around subsidisation of residential solar energy vary, complicating the process of identifying policies which could satisfy all community members. In spite of this, the vast majority of respondents favoured the subsidisation of residential solar energy, and a majority supported paying for renewable energy in electricity tariffs.

This research provides advice for policy practitioners in the field of residential solar energy subsidies and promoting energy efficiency technologies. Subsidisation of these technologies is supported by survey respondents, although efforts to reduce the financial impost on low income earners could result in enhanced levels of support for initiatives from some sectors of the community. Furthermore, continued subsidisation of residential solar energy is supported by the survey respondents, particularly given the proportion of respondents that indicated that they found it difficult to afford the installation of a solar system. More importantly, however, governments could play a role in increasing the perception of a ‘fair’ process by communicating policy objectives, timelines and funding schemes and then remaining committed to these clearly articulated parameters. Clear communication of policies could reduce resentment on behalf of community members, and could result in better value-for-money for subsidy schemes by empowering community members to select appropriate systems and report dissatisfactory interactions with industry.

The measurement of attitudes towards forms of justice in relation to residential solar energy was based on householders’ existing, and potentially limited, knowledge of the cross-subsidisation of solar and how it may be impacting low income earners. It is acknowledged that the proportion of respondents supporting each form of justice will be influenced by their own experiences in Western Australia, and is based on the financial implications of
subsidy schemes at the time of the study. Because of this policy recommendations relating to justice perspectives are general. Several research approaches could be used to expand on these concepts, including: ensuring information consistency by providing a hypothetical environment/social justice scenario and surveying people on their priorities; undertaking econometric research into a potential ‘acceptable’ level of cross-subsidisation for solar subsidies against the likely increase in emissions reduction; or surveying a range of different environment/society justice dichotomies. However, the research covered here benefitted from using an authentic example set in Western Australia, as exemplified by the richness of qualitative survey comments that informed conclusions regarding procedural justice.

3.6 REFERENCES


HOBMAN, E. V. & FREDERIKS, E. R. 2014. Barriers to green electricity subscription in Australia:“Love the environment, love renewable energy... but why should I pay more?”. Energy Research & Social Science, 3, 78-88.


CHAPTER FOUR: PROLOGUE

Chapter Three identified that residential householders support both the availability of financial incentives for the installation of residential solar energy systems, and payment for these incentives, including in their electricity tariffs. While there were differences in opinions between respondent categories across the sample set, there was no clear preference for increased financial support for higher levels of residential solar energy or low income support within the entire sample. Together, these results suggest that residential householders do not perceive distributional injustice in cross-subsidies associated with incentives provided for the installation of residential solar systems. The results did indicate, however, a perception of procedural injustice, with government policies considered unreliable and industry insufficiently regulated. It is this final idea that the next chapter will focus on.

Chapter Four examines solar adopters’ satisfaction with their solar system, as well as their perceptions of government support and the reliability of industry. Ultimately, this Chapter aims to propose government policies that will assist with the continued adoption of residential solar energy systems, even in the absence of financial incentives. Therefore, this Chapter takes into account the perspective that institutional arrangements that support the adoption of solar systems can influence consumers’ perceptions and experiences with the technology itself, and therefore have implications for social acceptance of renewable energy. This portion of the research considers the perceptions of residential householders who have a solar system installed on their premises, including those who installed their system and those who moved in to a house with a pre-existing system. Conclusions are drawn based on the quantitative and qualitative responses to a mail-out survey undertaken between August and December 2013 (and different to that used in Chapter Three). Triangulation with government, industry and media reports and data has been performed to substantiate comments made by residential householders. An addendum to the Chapter is provided on its conclusion, giving an update on the status of the residential solar industry since the submission of the paper for publication.

The research primarily focuses on consideration of the socio-political dimension of Wustenhagen et al.’s (2007) ‘triangle of social acceptance of renewable energy innovation’ in that it seeks to draw out further conclusions on procedural justice issues in government
policy identified in Chapter Three. However, the research also includes consideration of the role financial incentives appear to have played in promoting adoption and therefore crosses to the market dimension. Both trust in continuation of government policies, and trust in intermediaries (solar suppliers and installers) are considered in the Results and Discussion sections of this Chapter.


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Simpson G., Clifton, J., (2015), The emperor and the cowboys: The role of government policy and industry in the adoption of domestic solar microgeneration systems, Energy Policy, 81, 141-151
THE EMPEROR AND THE COWBOYS: THE ROLE OF GOVERNMENT POLICY AND INDUSTRY IN THE ADOPTION OF DOMESTIC SOLAR MICROGENERATION SYSTEMS

ABSTRACT

While domestic solar microgeneration installations have increased in popularity, there is potential for their adoption to slow as financial incentives are reduced or phased out. This study uses a postal survey of 362 solar adopters in Western Australia to identify areas of policy improvement for the adoption of domestic solar systems. Research included quantitative analysis of Likert-type statements and analysis of qualitative comments by survey respondents, including testing the validity of inferences in comments using publicly-available data. While the vast majority of respondents were satisfied with their systems, satisfaction rates were lower for consumers not receiving the premium feed-in tariff and where information on systems was not self-sourced. Consumers considered governments to be untrustworthy and information provided by industry was perceived as inconsistent and inaccessible. Consumers felt they did not receive a fair price for electricity exported to the network and feared that changes in utility prices could render their investment uneconomical. Concerns regarding members of industry may be allayed by certification schemes, but these remain voluntary and limited in effectiveness. These findings underscore the need for increased government activity in providing independent information to consumers and regulating the solar industry, including commitments to long term policies and certification schemes.

4.1 INTRODUCTION

Australia boasts one of the highest rates of small-scale renewable energy system adoption in the world, with as many as 2 million households having ‘solar rooftops’ – with either solar water heaters (870,000) and/or solar microgeneration systems (1.25 million) installed
A confluence of factors led to an increase in the adoption of domestic solar microgeneration systems in Australia, including increasing household electricity tariffs, reduced capital cost of systems, public acceptance of microgeneration and in particular the availability of various subsidies, with installation rates rising with increasingly generous incentive packages (Climate Change Authority, 2012). Furthermore, whilst installation costs of solar microgeneration systems are steady at approximately AU$2/watt (Morris, 2014), household electricity tariffs continue to rise, rendering solar microgeneration systems a sound financial investment for many Australian households, even in the absence of financial incentives (AGL Energy, 2014).

Research into domestic microgeneration adoption has so far focussed on motivations and characteristics of adopters and barriers to household adoption (Faiers and Neame, 2006, Balcombe et al., 2014). Studies find that while installers are environmentally conscious, financial factors are instrumental in the decision to adopt solar microgeneration (Schelly, 2014b, Balcombe et al., 2013). The availability of generous feed-in tariffs (FiTs), the opportunity to reduce exposure to increasing domestic electricity tariffs and the ability to increase the value of homes act as primary motivating factors (Balcombe et al., 2014). On the other hand, a lack of transparent, reliable and independent information, transaction costs ('hassle factor') and distrust of the energy industry are seen as important barriers to installation (Eyre et al., 2010).

Research has also indicated the social context of adoption and lived experiences with technology will contribute to adoption profiles. Claudy and O'Driscoll (2008) analysed energy efficiency in domestic buildings and found that knowledge of economic benefits of energy efficiency investments alone would not necessarily incentivise technology adoption, but that policy developers should look 'beyond economics' to consider behavioural determinants, such as attitudes and social norms, that interact with consumer decision-making. As noted by Schelly (2014a), policy developers should be aware of the socially contextualised practices of people, because it is 'patterns of human engagement which ultimately shape policy success' (p 544). For example, according to Rogers' (2003) theory on the diffusion of innovations, as a technology diffuses through space and time an increased portion of technology adopters will gain information on a technology from friends and family, as opposed to sourcing their own information. In addition, negative experiences
with technology itself might impact on or prevent consideration of solar microgeneration installation (Claudy and O’Driscoll, 2008).

The objective of this research is therefore to document policy-related issues with the installation of domestic solar microgeneration systems, as identified by household adopters in Western Australia, with a view towards providing recommendations for improved policy delivery. Sections 3 (results) and 4 (discussion) use quantitative data from postal survey responses to assess adopters’ satisfaction with their domestic microgeneration system, with a focus on interactions between satisfaction, availability of incentives and sources of information prior to deciding to install a system. Section 5 draws on qualitative comments in survey responses to identify sources of consumer dissatisfaction, with the majority of comments highlighting issues around government policy and delivery in relation to domestic solar microgeneration (section 5.1), or industry performance (section 5.2). An overview of comments relating to general renewable energy and associated policies is included in section 5.3. Content analysis is used to verify findings from the survey analysis, with conclusions in each sub-section identifying potential areas of policy intervention that could enhance consumer satisfaction.

4.2 Methodology

Six geographic areas were selected to represent a range of adoption experiences in the state of Western Australia, including four metropolitan postcode areas and two regional communities. All study sites were in Western Australia to ensure the same policies were applied in each area. The four metropolitan areas were required to have a minimum of 200 systems installed, minimum of 1000 free-standing dwellings (appropriate for solar installation) and maximum of 25% rental rate in the 2011 census (Australian Bureau of Statistics, 2013). Using the Australian Bureau of Statistics index of socio-economic welfare, the metropolitan communities were chosen to include two higher and two lower socioeconomic status communities, each with one higher and one lower installation rate (Clean Energy Regulator, 2014a). Individual households in each postcode area were randomly selected for the postal survey using publicly-available aerial photography (Landgate, 2013), with the most recent solar systems installed in January 2013.
The survey comprised a series of Likert-type questions to assess householders’ attitudes regarding domestic solar energy (Bernard, 2006), factors motivating installation, the importance of incentives, sources of information, satisfaction with systems and perceptions of regulation. Demographic information, details on the installation/incentives accessed and an open text section were also included.

In order to maximise response rates to the postal survey, a three-stage process was undertaken (Dillman et al., 2009). This comprised the initial survey being sent with a cover letter and reply paid letter followed by a reminder postcard and then another copy of the survey, cover note and reply paid envelope. The importance of follow-up surveys for maximising response rates has been recognised in similar studies (Baskaran et al., 2013). An iPad Mini was provided as an incentive prize to increase the response rate. Surveys were sent to 959 households between August and December 2013. The survey methodology complied with The University of Western Australia ethical procedures.

A total of 362 fully completed surveys were returned. This response rate of 38% is consistent with a similar study in New Zealand (Baskaran et al., 2013). Location-specific response rates varied from 27% to 55%, with a lower number of mail-outs but higher response rate for regional communities. SPSS Version 22.0 (IBM Corporation, 2013) was used to undertake non-parametric analysis of the quantitative survey data (Field, 2013). 121 survey respondents provided qualitative feedback. 146 individual comments were analysed, given some respondents provided feedback on more than one topic. These comments were coded according to whether they were positive (supportive), negative (critical) or neutral regarding experiences with solar installation and government support for renewable energy. Inter-rater reliability between co-authors for coding of direction of support was moderate (Landis and Koch, 1977), with a Cohen's K of 0.478 (95% CI, 0.333 to 0.624, p<0.0001). All comments were then grouped into themes decided on by the authors after consideration of the full suite of responses. Again, the inter-rater reliability was moderate, with a Cohen's K of 0.411 (95% CI, 0.318 to 0.504, p<0.0001). Given only moderate agreement between co-authors was reached, co-authors collaborated to clarify theme descriptions and allocate all remaining comments to a theme.

Themes were used as a starting point for the content analysis (Mayring, 2004) of publicly-available data. Data from between 2010 and 2013, the period during which 81% of survey respondents (n=325) installed their microgeneration system, was considered and included
state and federal regulator data, federal government reports, government and industry media releases and news articles released. The websites of major solar microgeneration retailers were also reviewed. Triangulation of survey comments with multiple independent sources was conducted to determine whether respondent inferences could be considered accurate (Heras-Saizarbitoria et al., 2011).

4.3 RESULTS 1 – QUANTITATIVE SURVEY RESULTS EXAMINING SATISFACTION WITH DOMESTIC SOLAR ENERGY

Results from the survey indicated that consumers are generally satisfied with the installation of their system. A total of 88% (n=360) of respondents confirmed that 'if [they] purchased a new home [they] would install a solar system'. Furthermore, 83% (n=334) of respondents indicated that '[their] solar system is living up to [their] expectations', and 76% (n=332) of respondents found that 'changes to [their] bills after installing [their] system met or exceeded [their] expectations'. These findings are significantly stronger than elsewhere in the literature, with Caird and Roy (2010) reporting that only 46% (n=285) of UK respondents were satisfied that their fuel bills had been reduced to the extent expected subsequent to the installation of microgeneration heat technologies.

In our research, 86% (n=132) of respondents who installed their system 'after [doing] a lot of research into solar systems to make sure it was the best decision for [them]' indicated they were satisfied with their system as compared to 74% (n=203) of respondents who sourced their information from elsewhere (family/friends; installer; media), significant at the p<0.001 level (Kruskal-Wallis $X^2[5, n=335] = 22.54$). The link between satisfaction and source of information is further evidenced in that there is a statistically significant correlation between those who believed that 'some information available regarding solar systems and subsidies was misleading' and the level of dissatisfaction with systems (Spearman's rho = 0.229, n=324, p<0.001; two-tailed). 47% of respondents believed that 'some information available regarding solar systems and subsidies was misleading' and a further 24% were unsure (n=324). The lack of satisfaction in the solar microgeneration industry and government oversight is further evidenced in that only 40% (n=359) of survey respondents were 'confident the solar system industry, its advertising and delivery of rebates [were] appropriately regulated'. Furthermore, 84% (n=359) of respondents
believed that ‘educational assistance is needed to help people understand the real costs and benefits of solar’.

The Western Australian state government made a premium net feed-in tariff (FiT) available to consumers who installed domestic solar microgeneration systems prior to August 2011 (Collier, 2010), accepting customers onto the scheme from 1 July 2010. A total of 89% (n=227) of survey respondents receiving the FiT payment stated that their solar system met their expectations, compared with 71% (n=107) of respondents who do not receive the FiT (N=107), significant at the p<0.001 level (two-tailed Mann-Whitney U=9059.5). Furthermore, 14% (n=227) of respondents receiving the FiT indicated that changes in their bills post-installation did not meet their expectations compared to 24% (n=105) of respondents who do not receive the FiT, again significant at the p<0.001 level (two-tailed Mann-Whitney U=9329.5). In addition to this, only one of the 229 survey respondents who received the FiT said they would choose not to install a system in the next house they purchase, compared to 4% (n=131) of those who had not received the FiT.

4.4 DISCUSSION 1 – QUANTITATIVE SURVEY RESULTS IN THE CONTEXT OF CONTINUED SOLAR ADOPTION

The quantitative results in section 3 identified that while the majority of households were satisfied with their systems, there was a demonstrable link between satisfaction rates and information, both in terms of where information is sourced from and whether there is a perception that information is misleading. Findings also indicate reduced rates of satisfaction with systems in the absence of generous financial incentives.

The Australian government has made an up-front subsidy available to installers of domestic solar microgeneration systems since 2001, and is currently committed to providing financial support until 2030 through Australia’s Renewable Portfolio Standard, the Renewable Energy Target (Climate Change Authority, 2012). The value of the subsidy declined in a step-wise fashion on 1 July 2011, 1 July 2012 and 1 January 2013. These reductions in subsidies coincided with ‘peaks’ in installation, and resulted in boom-bust cycles for the solar energy industry (Simpson and Clifton, 2014). Importantly, however, the monthly rate of solar installation is now approximately equal to early 2010, prior to the implementation
of the state-based net FiTs (Figure 4.1). This data indicates incentive schemes are effective in promoting adoption of solar microgeneration, but may not alone contribute to the longevity of system installation and industry growth.

![Graph showing monthly installation of small-scale solar microgeneration systems in Western Australia](image)

**Figure 4.1: Monthly installation of small-scale solar microgeneration systems in Western Australia (Clean Energy Regulator, 2014a)**

It should be noted that installation rates during the ‘peaks’ may not correspond to a viable small-scale industry and that a return to historical installation rates, if stable, may be appropriate. However, sustainability of the industry relies on a consistent number of adopters and the question therefore remains as to whether a reliable customer base can be maintained in the absence of generous financial incentives.

In light of both reduced uptake of, and reduced satisfaction with, domestic solar microgeneration in the absence of generous incentives, there is reason to examine perceptions of the adoption experience to ascertain whether there are non-financial policy opportunities for increasing adoption and/or satisfaction rates. Section 5 analyses qualitative survey comments to highlight perceived problems with solar microgeneration adoption in Western Australia, using this information and publicly-available data to identify prospects for policy improvement.
4.5 RESULTS AND DISCUSSION 2 - QUALITATIVE SURVEY
RESULTS AND EXAMINATION OF POLICY ISSUES

This section focuses on qualitative comments included in the survey responses, and uses publicly-available data and information relating to microgeneration adoption in Australia to determine the validity of comments. Following coding of responses, three major response themes were identified (Table 4.1): firstly, perceptions of state government policies regarding microgeneration schemes (5.1), secondly, statements on the actions of the solar microgeneration suppliers, retailers and installers (5.2) and finally comments on government support for renewable energy generally (5.3). While the vast majority of comments provided were negative, and are considered in the following subsections, 12 comments from survey respondents were supportive of small-scale solar systems and the availability of incentives. Three comments noted that respondents would not have been able to afford a solar system in the absence of incentives, and others praised improvements in solar technology and the ease of transaction associated with domestic solar systems. A further 12 comments provided detail on the types of system installed/rebates received and are not relevant to this study.
Table 4.1: Coding categories of qualitative comments, with moderate inter-rater reliability. Cohen’s K of 0.478 (95% CI, 0.333 to 0.624, p<0.0001) for direction (positive/negative) of comments. Cohen’s K of 0.411 (95% CI, 0.318 to 0.504, p<0.0001) for grouping of comments into themes.

<table>
<thead>
<tr>
<th>State Government Policies supporting solar microgeneration (5.1):</th>
<th>Positive comments</th>
<th>Neutral comments</th>
<th>Negative comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Government commitment to existing policy</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>- Renewable energy feed-in tariff ‘Buyback’ rate</td>
<td>3</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>- Consistency, accuracy and availability of information</td>
<td>0</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>- Network operator charges for solar users</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solar Industry – suppliers, retailers, installers (5.2):</th>
<th>Positive comments</th>
<th>Neutral comments</th>
<th>Negative comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Trustworthiness of industry</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>- Quality of solar installations and installers</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Public Support for increasing renewable energy (5.3):</th>
<th>Positive comments</th>
<th>Neutral comments</th>
<th>Negative comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Requesting additional government support for renewables</td>
<td>0</td>
<td>14</td>
<td>26</td>
</tr>
</tbody>
</table>

| Supportive of installed system or price of technology           | 9                 | 2                | 0                 |
| Neutrally undirected comment (type of technology installed etc.)| 0                 | 14               | 0                 |

| 12 | 32 | 102 |

4.5.1 THE EMPEROR – STATE GOVERNMENT POLICIES

*I thought [reducing rebates prematurely] was unfair, and I was ever so pleased when the emperor got his tail twitched for it. – Survey respondent*

Eighty-four of the 102 negative comments related to the interaction between government, renewable energy and consumers. While the largest proportion of responses (26 responses) were critical of national and state governments’ commitment to increasing the penetration of renewable energy in Australia (see section 5.3) the greatest specificity in comment detail related to the Western Australian state government, which is covered in four parts in section 5.1. In particular, the Premier of Western Australia, the Honourable Colin Barnett, received specific scrutiny for his perceived role in creating uncertainty around solar policies and for favouring short-sighted political objectives, with one respondent referring to him as the ‘emperor’, reflecting the perceived unaccountability in his actions.
4.5.1.1 **Broken Promises – Is government committed to its policies?**

*The government should not go back on its promises – Survey respondent*

Eighteen comments were critical of Western Australia’s incentive-based net FiT scheme and the potential for the state government to reduce the FiT rate for existing customers in spite of an existing ‘contract’ confirming the FiT rate and the duration of the scheme.

The Western Australian state government net FiT scheme commenced on 1 July 2010 with a 40 AU cent per kilowatt hour (c/kWh) net feed-in rate (Collier, 2010). All customers applying to supply electricity to the network signed a 10 year ‘contract’ with the state-owned electricity retailer. On 21 May 2011, the state government announced the scheme would close when installed capacity of solar systems reached 150MW, and that the FiT rate would be reduced to 20 c/kWh for new applicants from 1 July 2011 (Collier, 2011a). Announcement of the reduction in FiT rate prompted a ‘rush’ of installations prior to 1 July 2011, leading to the initially proposed budget being exceeded (Parker, 2011). Furthermore, the rush of installations resulted in the cap being reached shortly thereafter, with the scheme closed to new applicants from 1 August 2011 (Collier, 2011b).

In response to declining financial conditions within Western Australia, the state government announced in its 8 August 2013 budget that it would be reducing the FIT rate of customers receiving the 40 c/kWh FIT initially to 30 c/kWh for one year, and then to 20 c/kWh thereafter (Buswell, 2013). This decision was likely to affect approximately 75,000 customers in the state (Medlen, 2013). Response to the announcement by the public was immediate, with approximately 9,000 Western Australians signing an online petition by the community-driven non-government organisation Solar Citizens (Solar Citizens, 2013) and others contacting their local members of parliament to voice their concern about the reduced rate (Edis, 2013). Four days later, on 13 August 2013, the state government reversed its decision to reduce the FiT rate, saying ‘we understand that this measure would have had an unfair impact on one section of the community and it has to be reversed’ (Barnett, 2013). Whilst the decision to break the feed-in ‘contract’ was rescinded, the fact that legal advice to the state government indicated termination of the contract would be lawful (Martin, 2013a), and that similar policy reversals had been completed in another state, New South Wales (Hartcher, 2011), led survey respondents to view the government’s commitment to maintaining the existing FIT with some degree of scepticism.
The implementation of this survey coincided with media attention associated with the ‘broken promise’ by government, and therefore it is unsurprising that it featured prominently in the qualitative comments. However, there is potential for distrust of governments resulting from the ‘broken promise’ of the FIT to impact future decision-making by consumers, with consumers protecting themselves from future investment disadvantages by avoiding participation in incentive schemes where commitments are delivered over an extended period of time. As one survey respondent stated:

_I would give a lot more consideration if any other scheme were to be introduced, knowing that you can’t trust any government to stand by their promise._

The variation in net FiT rates received by consumers could further inhibit future installation of systems, with previous studies showing that an awareness of inconsistencies between FiTs applied between neighbours and friends discourages some from adopting microgeneration systems (Schelly, 2014a).

### 4.5.1.2 ‘FAIR AND REASONABLE’ – CONTROVERSY AND THE RENEWABLE BUYBACK RATE

_For every unit [kWh] I put back in the system they pay me 8 cents, then they sell it back to me at 25 cents. What a rip off._ – Survey respondent

Similar to concern regarding the ‘broken promise’ of the reduced FiT rate, 18 comments were also critical of the ‘Renewable Energy Buyback Scheme’ tariff rate. The per unit value of the Buyback rate is calculated based on microgeneration systems receiving a ‘fair and reasonable’ rate (Department of Finance, 2014) for electricity exported to the network, as defined in an agreement between all Australian jurisdictions (Council of Australian Governments, 2008). This net FiT Buyback rate is paid to all customers and is additional to the incentive-based premium net FiT rate (40 c/kWh or 20 c/kWh) paid to customers installing systems prior to 1 August 2011 (Collier, 2010).

The 18 comments in the survey responses indicated customers did not see the Buyback scheme as fair, with survey respondents referring to the buyback rate as ‘not adequate’, ‘too low’, ‘pathetic’, and ‘fundamentally wrong’. This was due to the substantial difference
between the value received for each unit of electricity exported to the grid and the price electricity retailers charge for the same electricity to be consumed 'next door', with the Buyback tariff rate currently set at 32% of the domestic retail tariff (Synergy, 2014b).

The difference between the domestic retail tariff and the Buyback rate is justifiable because the former includes sales administration, transmission and legal costs that are applicable to electricity 'fed-into' the grid. The state electricity retailer indicates on its website that the Buyback rate is therefore equivalent to the cost of purchasing electricity from generators (Synergy, 2014c). However, the same website indicates elsewhere that the costs of producing electricity (the energy and capacity costs) contribute approximately 49% to the domestic retail tariff (Synergy, 2014a), which does not reconcile with the 32% of the domestic retail tariff paid under the Buyback scheme. Furthermore, the Buyback rate is not always recalculated when the domestic retail tariff is periodically increased. Consequently, the calculation of the Buyback rate is lacking in transparency, and as it stands could be interpreted as 'unfair' by domestic solar consumers. Combined with extended payback periods, this could contribute to a reduced likelihood of consumers installing solar systems in future. Increased transparency around the calculation of the Buyback rate and information provided to consumers on the calculation of the Buyback rate at each re-setting of the tariff could work to reduce dissatisfaction around this component of the scheme.

4.5.1.3 WHERE DID YOU HEAR THAT? – LACK OF CONSISTENCY IN INFORMATION PROVISION

There were twelve comments in survey responses criticising the availability and accuracy of information regarding solar installations and incentives (Table 4.2). Australia, like many other countries (Byrne and Kurdgelashvili, 2011), has made domestic solar incentives available through multiple tiers of government, with each incentive delivered through different agencies via varying administrative processes. As an example, Western Australian households installing solar received 'small-scale technology certificates' from the Renewable Energy Target (Climate Change Authority, 2012), which could be monetised through an up-front reduction in system capital cost from solar suppliers, immediate sale of the certificates through an independent online marketplace or on a wait-list through a federal government agency. They could also have received a post-purchase rebate through a state government agency (Collier, 2009) and the net FiTs (the premium FiT and/or the Renewable Energy Buyback Scheme tariff) through the state-owned electricity retailer.
Survey comments indicate the multiple layers of rebates, lack of clarity around timelines to access funds and information about connecting systems were seen as confusing and inconsistent.

Table 4.2: Survey respondent comments on the lack of transparent and reliable information available through government agencies.

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<tr>
<td>1</td>
<td>I am not involved in this industry but I found the multiple layers of state and federal information offices and rebate deals very confusing. There is no primary govt to household accessible information to assist in unbiased decision making.</td>
</tr>
<tr>
<td>2</td>
<td>Process was confusing when understanding rebates, feed-in tariffs and [small-scale technology certificates]. Government website poorly written.</td>
</tr>
<tr>
<td>3</td>
<td>Some of terminology in rebate forms is to (sic) complicated for the general consumer to answer the questions. The rebate schemes should continue, however, all the paperwork is carried out by the installer and most people do not know what rebate they got or were entitled to.</td>
</tr>
<tr>
<td>4</td>
<td>During my pre-purchase research I was given varied information by [industry] and often in conflict with the information obtained from [relevant Western Australian public sector office].</td>
</tr>
<tr>
<td>5</td>
<td>Info differed between [solar retailer], [network operator] &amp; [electricity retailer] re the need to immediately install a digital meter.</td>
</tr>
<tr>
<td>6</td>
<td>There is a very misleading part to the governments solar program. You are told that installation of the smart meter is to take the benefits of the solar installations. This is rubbish!</td>
</tr>
<tr>
<td>7</td>
<td>There was a lack of information regarding the rebate scheme and the size of the inverter.</td>
</tr>
<tr>
<td>8</td>
<td>Lack of government knowledge of available products and their reliability and installation.</td>
</tr>
<tr>
<td>9</td>
<td>I have registered my [small-scale technology certificates] and this has not resulted in any sale or return of funds as anticipated. I am constantly amazed by the stifling bureaucracy and procedural and security nonsense surrounding this useless and ineffective government body.</td>
</tr>
<tr>
<td>10</td>
<td>To get back rebate is very complicated and so long in the queue. Still waiting and so many thousand ahead of me. Queue moving very slow.</td>
</tr>
<tr>
<td>11</td>
<td>Outlaid approx. $15,000 still waiting for $7,000 when [small-scale technology certificates] are sold. Mislead (sic) to believe this would take place 3-6 months following installation.</td>
</tr>
<tr>
<td>12</td>
<td>Information available basically says getting solar panel (sic) will save you money and help the environment. The small amount generated from the panels gives very little financial benefit and they will never come close to paying for themselves.</td>
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</table>

Community education regarding solar microgeneration in Australia is primarily based around static website information (Hampton and Eckermann, 2013). While there were attempts by government agencies to create websites centralising information relating to these various schemes, three issues were identified during the content analysis process that could lead consumers to access unreliable information or be exposed to confusing organisational tiers. The first was the rapidly changing state of the government...
departments themselves, reducing the likelihood of the general public being familiar with relevant offices to approach. For instance, the federal government’s responsible department changed four times between December 2007 and September 2013 (Parliament of Australia, 2013). The second was the confusing interaction between information available through government-supported websites. As an example, the federal government established a Living Greener website (www.livinggreener.gov.au) to provide energy-related information to the general public, which interacted with the website of the public sector-based Clean Energy Regulator (www.cleanenergyregulator.gov.au), which in turn linked to the website for the government-endorsed accreditors of solar system installers, the Clean Energy Council (www.cleanenergycouncil.org.au), a peak body representing Australia’s clean energy sector. The train of websites could lead consumers to believe information promulgated by the Clean Energy Council, essentially a lobbyist group, represented the advice of the public sector. Finally, many private entities sought to capitalise on elements of successful information campaigns by mimicking website content and titles. For instance, while ‘Living Smart’ is a state-based website, ‘Energy Smart’ is the website of a solar installer.

The survey indicates respondents were generally uninformed about rebates or financial benefits they received through installing their system. For instance, 10 comments (in various thematic groups) suggested that consumers were not aware of the financial benefits of avoided electricity costs, focusing instead on FiT benefits (or lack thereof) alone. This is particularly the case where respondents noted ‘disappointment with amount of savings on electricity bill’ after installing a solar system, which probably reflects the fact that domestic retail tariffs in Western Australia increased by over 70% between 2009 and 2013 (Government of Western Australia, 2014), when most consumers installed their systems. Additionally, small-scale technology certificates were provided to all consumers installing systems between 2010 and 2012, with rebates generally accessed through an up-front discount on systems in exchange for consumers signing their certificates over to installers/retailers. In spite of this, 65% (n=256) of survey respondents installing systems between 2010 and 2012 stated they had not received this subsidy.

The lack of reliable, transparent and easily accessible information for consumers contributes to a lack of understanding around solar systems and ways to maximise benefits associated with solar installations and incentives. Furthermore, respondents noted that
information frequently differed between government, industry and utility companies (Table 4.2). There is evidence from the literature that inconsistency in information available to consumers, and an inability to determine a reliable information outlet, could lead to reduced investment in the future, with uncertainty in decision-making found to be exacerbated where information sources are contradictory (Broniarczyk and Griffin, 2014). This is likely compounded by the prevailing level of distrust of government and associated agencies, which results in an ‘information hurdle’, with information required to overcome possible scepticism on the part of community members (Claudy and O’Driscoll, 2008). Improved education and information provision could help householders install appropriately-sized systems and have expectations that better reflect likely outcomes of the systems they install, thereby increasing the likelihood of consumer satisfaction.

4.5.1.4 ‘Taxing the Sun’ – Charging solar users for network costs

People with solar panels are being accused [by utilities] of [gaining free benefit] off the system and forcing non-users to pay more for electricity. And governments appear to be agreeing with them and considering how to charge people with solar panels to pay more. — Survey respondent

The survey responses included ten comments relating to the interaction between solar consumers and network operators, and issues of inequity between customers. Six of these comments reflected media statements considering the potential for adjustments to charges for solar system owners. Adjustments would be made in response to changes in the cost-breakdown for network operators resulting from solar installations. The remaining four comments related to inequitable and time-sensitive access to network infrastructure and services.

Solar owners draw less electricity from the electricity network and therefore purchase fewer units at the domestic retail tariff, including the component allocated for network infrastructure. In spite of this, solar users remain reliant on this infrastructure and contribute to network costs, particularly where network augmentation is required to export electricity generated from solar systems (Western Power, 2012). The most likely response to reduced consumption of electricity will be to increase the network component of domestic retail tariffs to cover investment costs, with two possible outcomes. Firstly, this may result in a regressive form of taxation, whereby wealthier households install solar
systems to avoid increasing domestic retail tariffs and the increased charges fall disproportionately on lower income groups who are incapable of investing in solar (Nelson et al., 2011). In reality this may not be the case, with Australian data finding that most solar systems are installed in middle or lower income post code regions (Green Energy Trading, 2014). Secondly, increased electricity tariffs will prompt more householders to install solar technology, causing reduced consumption of electricity from the grid, followed by the need to increase domestic retail tariffs further to recoup investment costs in a process termed the energy ‘death spiral’ (Simshauser and Nelson, 2014).

To avoid regressive taxation and the ‘death spiral’ two potential market-based responses to reduced electricity demand were identified in the content analysis. One is to increase the ‘daily charge’ to all customers to ensure all consumers contribute to network costs regardless of demand (Martin, 2013b). This is contentious as the majority of network upgrades are associated with increased peak demand, and therefore higher per unit domestic retail tariffs are more effective in promoting demand-side response (load shifting or energy efficiency) than a higher consistently applied daily charge. Furthermore, this could still be considered a regressive form of taxation, with fixed network costs consuming a larger proportion of total income for low income households compared with wealthier households. The alternative option is to charge solar installers specifically, either through a solar-specific flat network charge, or a per-unit feed-in rate. Conservative Australian news outlets have promoted the idea of a solar-specific network rate, indicating that an annual AU$210 fee was under consideration by the economic regulator in the Australian state of Queensland (Queensland Competition Authority, 2013).

One respondent saw the potential for increased charges specifically for those customers using a ‘free’ energy source as unjust, referring to it as ‘taxing the sun’. One respondents voiced frustration that consumers decided to install solar microgeneration systems in response to government incentive programs only to be subsequently told that they are having a negative impact on the energy network and creating equity issues. While the cost implications of increased adoption of domestic solar systems to network operators is understandably serious, the implications of additional charges to customers is consistent with the ‘broken promise’ in section 5.1.1 and likely to result in significant consumer backlash and reduced support for similar schemes in future.
4.5.2 THE COWBOYS – SOLAR INDUSTRY SUPPLIERS, RETAILERS AND INSTALLERS

There were so many cowboy outfits when it was going crazy. – Survey respondent

Section 5.2 considers the interaction between solar microgeneration adopters and the small-scale renewable energy industry, with 18 comments critical of solar system retailers, installers and technologies available. This level of concern is reflected in the low number of survey respondents who believe the solar industry is well regulated (40% - see section 3). Anecdotal evidence indicates that concern surrounding the solar industry was particularly prevalent when financial incentive schemes were at their most generous, leading to a proliferation in industry players, with some respondents referring to ‘cowboys’ and ‘fly by night operators’. The following sections highlight areas of concern and potential for governments to increase regulation and the provision of advice, ideally improving levels of trust in the solar industry. This is particularly important in the continued adoption of domestic solar microgeneration systems, with literature indicating that an inability to find trustworthy suppliers prevents consumers from purchasing solar water heaters (Baskaran et al., 2013).

4.5.2.1 DODGY SUPPLIERS - CAN CONSUMERS TRUST THE WORD OF INDUSTRY?

Some of the solar panel sales people do not give the whole story (lie to get job). There is no regulation over sellers. – Survey respondent

Comments within survey responses provided nine examples of consumers who were dissatisfied with their interactions with the microgeneration industry, or who had concerns about the potential for corruption of federal and state-based incentive schemes by solar suppliers. Surveys indicated that solar retailers may be prone to dishonesty and that regulation of solar retailers is lacking.

Publicly available advice from consumer protection agencies provides further evidence of misleading information on behalf of solar retailers. The federal government’s consumer protection agency, the Australian Competition and Consumer Commission, supplied press releases detailing the investigation of at least seven instances of misconduct between August 2010 and June 2014 by ten retailers, some of which remain prominent in the solar industry (Australian Competition and Consumer Commission, 2010, Australian Competition
and Consumer Commission, 2011d, Australian Competition and Consumer Commission, 2011c, Australian Competition and Consumer Commission, 2011b, Australian Competition and Consumer Commission, 2012, Australian Competition and Consumer Commission, 2013b, Australian Competition and Consumer Commission, 2014). This is in addition to a joint statement by federal and state-based consumer protection agencies reminding solar power retailers that solar claims must be accurate (Australian Competition and Consumer Commission, 2011a). In particular the joint warning requests solar retailers ensure statements are “unambiguous and should not include technical or scientific jargon that suggests certain capabilities or effects that cannot be substantiated”. The Western Australian Government's Consumer Protection's details on complaints recorded through its 'Scamwatch' website indicated that solar products received the highest number of 'scam' complaints in 2012, with 234 unique complaints (Department of Commerce, 2012). Consumer Protection also released information on three Western Australia-based investigations of misconduct by another three solar retailers (Department of Commerce, 2013, Department of Commerce, 2014a, Department of Commerce, 2014b).

Misconduct by solar retailers recorded by consumer protection agencies generally involved misleading information; however, there were also complaints about the use of overly forceful sales strategies. The survey responses included four claims of misleading information by retailers, and five respondents noted concerns that solar system prices were increased in accordance with the availability of rebates, although this has not been substantiated by external information. However, with the reduction in price per watt for installed domestic microgeneration systems, retailers do appear to be encouraging the installation of larger systems. This is evidenced in the continued increase in average domestic installation size, even with a reduction in household electricity consumption over this timeframe (ACIL Allen Consulting, 2014) and in the absence of premium net FiTs (Figure 4.2).
In the absence of premium net FiTs, installation of over-sized systems by households will result in an increase in the payback period of systems. A review of the top 15 solar retailer websites on Google found that five encouraged oversized systems by equating the number of units consumed by households per day with ideal system capacity size, by excluding the time-of-day impact on electricity generation/consumption, and by assuming increased household consumption with increased microgeneration system capacity installed, contrary to research (McHenry, 2012). While many of these websites make their assumptions available, it is in fine print, relies on external advice not readily accessible and is too technical for the average customer to decipher. Furthermore, many of the larger solar retailers have a single website covering the entire Australian market, meaning any information relating to tariffs, incentives and even efficiency of systems will be inaccurate for different segments of the Australian population.

One respondent also raised issues of ‘hidden costs’ that were not disclosed by solar retailers. In particular, the cost of having an analogue meter converted to a digital bidirectional meter by the network operator and registering to ‘feed-in’ to the grid was often excluded from
information. At present this charge is between AU$216 and AU$316 (Synergy, 2014c), and according to the survey respondent was as much as AU$400. While there are no requirements for solar retailers to provide information on meter upgrades it should be expected that in the course of discussing the costs and benefits of solar that retailers would make this information known.

As a reaction to the perceived lack of trust in solar retailers, the Clean Energy Council, a peak body organisation, established a solar retailer ‘Code of Conduct’ in November 2013 (Clean Energy Council, 2013). While authorised by the Australian Competition and Consumer Commission (Australian Competition and Consumer Commission, 2013a), the Code is currently voluntary with only 17 retailers having ‘signed up’ (Clean Energy Council - Accredited Installer, 2014). Additionally, the Code does not capture a majority of retailers, with most of those signed up to the scheme (12 of 17) classed as ‘boutique’ retailers, and the other five classed as ‘medium’ retailers.

While the Code of Conduct represents progress towards creating an accountability framework for the solar industry, the scheme remains voluntary and little has been done to publicise it to the general public, hence demand for adoption of the scheme is likely to be relatively low. Sweetnam et al. (2013) indicate that governments should make a concerted effort to work with the microgeneration supply chain to increase the likelihood of siting and installation of systems meeting minimum standards. Additionally, Balcombe et al. (2014) promote mandating the use of certified systems and installers when accessing government-provided financial incentives. Therefore, wider government endorsement of the scheme by mandating it or establishing greater prominence through advertising would assist with increased adoption of the scheme. While there could be some objection to government support of an initiative established by a peak body organisation, that this same organisation is the government-endorsed accreditor of solar installers indicates an effective existing relationship. This scheme could increase trust in industry, awareness of and demand for certification schemes and require accountability frameworks for government agencies providing incentives. It would, however, constitute a considerable increase in administrative costs.
4.5.2.2 **DODGY SYSTEMS – ARE INSTALLATIONS UP TO SCRATCH?**

The government, state or federal, could guarantee a minimum standard of solar panel because... if you install all these cheap ones and then all these are breaking it becomes like a potential pink batts [Home Insulation Program] scandal. – Survey respondent

Nine respondents indicated that system performance was not meeting expectations, either in terms of the output of the system (including financial benefits) or in relation to components of the system failing. While some level of dissatisfaction is expected in a sample of this size it is worth considering whether there are legitimate concerns over the quality of installations, or whether dissatisfaction may be a continuation of an information gap for householders, exacerbated by misleading claims by industry.

Audits of installations are the most reliable avenue for determining whether systemic issues in the quality of installations are present. These are currently carried out on behalf of federal and state-based agencies. Under the federal Renewable Energy Target a sample of solar microgeneration systems receiving certificates are inspected by one of four independent agencies, with the number of inspections proportionate to the number of systems installed in each state (Clean Energy Regulator, 2013). In Western Australia a sample of every electrician’s work is inspected to ensure electrical work is meeting Australian Standards (Department of Commerce, 2011). The sample for each electrician varies between 10% and 100%, depending on the quality of previous electrical work. Inspections are performed by the network operator and check the safety of the system at connection points, wiring and labelling but do not check for functioning of the solar system.

Publicly available audit reports based on the inspection of systems are brief but regular in the case of the federal government and singular but comprehensive in the case of most state governments (Table 4.3). State-based audits in 2011 indicated high defect rates, particularly in the state of New South Wales. The federal government inspection results for 2012 and 2013 indicate a continuing, but declining problem associated with system installations. Minor defects were those relating to incorrect wiring/cabling, while major defects were those that were considered a safety/fire risk. The higher ‘minor defect’ results for state-based audits are likely the result of inclusion of mislabelling of systems in this category in the state-based audits (Department of Commerce, 2011, Fair Trading, 2011).
Table 4.3: Comparison of defect rates for audited systems. 2011 figures based on state-based audits for New South Wales (Fair Trading, 2011) and Western Australia (Department of Commerce, 2011). 2012 and 2013 figures based on federal audit statistics (Clean Energy Regulator, 2014b).

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<th>2011</th>
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<tr>
<td></td>
<td>Major</td>
<td>Minor</td>
<td>Major</td>
</tr>
<tr>
<td>Western Australia</td>
<td>defect</td>
<td>defect</td>
<td>defect</td>
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<tr>
<td></td>
<td>12%</td>
<td>38%</td>
<td>7%</td>
</tr>
<tr>
<td>n =</td>
<td>260 systems audited</td>
<td>513 systems audited</td>
<td>496 systems audited</td>
</tr>
<tr>
<td>New South Wales</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19%</td>
<td>63%</td>
<td>4%</td>
</tr>
<tr>
<td>n =</td>
<td>658 systems audited</td>
<td>1038 systems audited</td>
<td>457 systems audited</td>
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Whilst there are no standards defining an ‘acceptable’ level of defective systems, these data can be compared with audits of other Australian energy efficiency initiatives, particularly the 2009 Home Insulation Program. Evidence of fraud and the deaths of insulation installers during its implementation resulted in detailed audits of this program, which revealed that 16% (n=14,600) of installations showed quality issues and 7.6% displayed safety shortcomings. Comparison with the solar installation inspections therefore indicates that the latter were associated with greater levels of safety risk and poorly installed systems than the Home Insulation Program, which was subject to media and political scrutiny, being described as costly and detrimental to households and industry alike (Hawke, 2010).

There are opportunities for governments to advertise progress made towards ensuring the quality of solar installations in Australia, although these might expose governments to criticism as much as praise. For instance, highlighting the reduction in defects noted in solar audit programs would incidentally expose the high levels of defects initially experienced. The potential for concern, particularly for those installing systems in the relatively high-risk, high-installation period of 2010-11, to react strongly to information about audit results and request mass inspections has been indicated by the Clean Energy Council as a reason for not publicising the audit results more widely (Williams, 2011). Alternatively, given the federal audit program was initiated in 2011 and that state regulators appear to have robust inspection programs in place it would seem worthwhile to inform householders of the use of these services in order to assuage feelings of concern. The Western Australian network
operator, for instance, does not notify customers when a system has been inspected unless there are safety issues identified (pers.comm.). The potential for good will associated with installations may be increased where consumers have received positive reinforcement that their system has been appropriately installed, as opposed to exclusively highlighting examples of poor installation.

In addition to audits, the peak solar energy industry body, the Solar Council, is responding to concerns about the quality of solar systems and installation by initiating voluntary schemes, similar to that undertaken by the Clean Energy Council in relation to solar retailers (5.2.1). Like the Clean Energy Council program, the Solar Council programs are still in their infancy and therefore uptake from industry and consumer awareness remains low.

While the solar industry has so far avoided the negative media attention attributed to the Home Insulation Program, any future instances of media exposure to safety risks could negatively impact on consumer satisfaction and the potential for continued adoption of domestic solar microgeneration, with events that result in destruction more noticeable and easier to recall than positive events and therefore more likely to have a lasting impact on any investment environment (Greenberg, 2014).

4.5.3 SUPPORT FOR RENEWABLE ENERGY IN AUSTRALIA – AN APPETITE FOR CHANGE

The government should be doing more to encourage people to install solar systems –
Survey respondent

The preceding discussion regarding specific government policies relevant to solar microgeneration systems (section 5.1) and perceptions of trust in microgeneration industry and technology (section 5.2) does not include consideration of the 40 comments provided in survey responses requesting increased support for renewable energy, with 14 comments supportive of renewable energy in general and 26 comments critical of current government practices. While it is reasonable to expect bias towards renewable energy from those who have chosen to install microgeneration systems, the finding that members of the community respond positively to renewable energy is consistent with recent research in Australia which showed that 71% (n=1145) of Australians are supportive of the Renewable Energy Target (Stefanova et al., 2014). This includes 60% of respondents who supported an
expansion of the target to cover a larger proportion of electricity generation in Australia, even if this resulted in increased costs for consumers.

The 26 comments critical of current federal and state government policy were focussed on a perceived lack of commitment to increasing the penetration of renewable energy in Australia. Nine comments requested long-term commitment to domestic renewable energy, with a further two comments suggesting solar should be mandatory on all roof tops. Respondents felt that governments were short-sighted in their choices of policy, were overly generous in their provision of rebates and subsidies to some householders, and not generous enough to householders after financial incentives were wound back. Three comments expressed dissatisfaction with the level of commitment to diversifying renewable energy types in Australia, with another four comments requesting research and development around better integrating embedded renewable energy with the network. Furthermore four respondents felt that governments were not taking sufficient advantage of Australia’s plentiful renewable energy resources and associated opportunities for research and development.

This research survey was implemented following the September 2013 Australian federal election. The election rarely focused on renewable energy, with both major political parties supporting the continuation of the Renewable Energy Target, although the conservative opposition proposed a review of the scheme to consider modifications for the reduction of electricity costs for householders and industry (Staff Reporter, 2013). Additionally, the opposition put forward a ‘million solar roofs’ policy to increase the proportion of domestic solar microgeneration systems in Australia (Hunt, 2013). Subsequent to the election the newly elected conservative coalition retreated from the ‘million solar roofs’ commitment and attempted to dissolve existing renewable energy agencies aimed at supporting and expanding renewable energy ventures, including large-scale investment and research and development (Pears, 2014). Furthermore, the approach to reviewing the Renewable Energy Target, including appointing an anthropogenic climate change sceptic to chair the review board, led the renewable energy industry to believe that there will be considerable downgrading in the objectives of the scheme and has put an effective halt on large-scale renewable energy investment in Australia (Heath, 2014). The survey comments may therefore reflect realistic concerns relating to ongoing support for the renewable energy industry in Australia.
4.6 CONCLUSIONS AND POLICY IMPLICATIONS

As at December 2014, the policy framework to promote the installation of domestic solar microgeneration systems in Western Australia was limited to the ‘buyback’ net FiT and the federally-controlled Renewable Energy Target, providing ‘small-scale technology certificates’ to domestic solar energy installers. However, the Renewable Energy Target was under negotiation, including consideration of the small-scale component of this scheme (Edis, 2014). No state-wide behaviour change, education or energy efficiency programs were underway, with the exception of the mandatory energy rating labelling system for domestic appliances (Australian Government, 2014).

These policy settings largely reflect Australia’s on-going approach to domestic renewable energy and energy efficiency programs in that the provision of economic incentive packages which result in clear quantitative ‘deliverables’ (dollars spent, systems installed) are preferred to ‘softer’ policy options that promote knowledge development, increased trust and public commitment to implementation. This research indicates that an examination of economic barriers and policies aimed at quantitative ‘deliverables’ alone may not take into account ‘on the ground’ experiences that interact with consumer satisfaction and the likelihood of on-going adoption of solar microgeneration systems, particularly where market players are diverse and uninformed.

Central themes and policy recommendations coming out of this research are based around consistent and reliable government commitment to policies; transparency in decision-making surrounding policies and tariffs (where regulated); increased regulation around solar industry retailers, suppliers and installers, particularly through a high quality, enforceable and independently administered accreditation program; transparency around quality assurance programs (like audits) to increase levels of trust in the community, and associated with this transparency, clear government commitment to address issues that are uncovered in the process of completing audits. Finally, increased quality and accessibility of information is the backbone of addressing consumer dissatisfaction with solar microgeneration systems. While quality information is available (including on the audits of systems, potential to select accredited industry participants, and access reliable tools to determine appropriate installation size), this information is often overly technical, difficult to access and unknown to consumers. These findings, together with related analyses of
national energy policies and initiatives (West et al., 2010, Chubb, 2014), support calls for improving policy surrounding regulation, transparency and information in the domestic renewable energy and energy efficiency industry.

The literature surrounding domestic solar microgeneration adoption has repeatedly called for transparency in information, available through an independent agency. Caird and Roy (2010) promote the use of a ‘one stop shop’ for delivery of information regarding technology, incentives available, planning issues, and the installation, maintenance and effective use of solar microgeneration. Policy makers should aim to understand the beliefs and attitudes of potential consumers of small-scale microgeneration in an effort to target information and advice to appropriate audiences and overcome scepticism of technology and industry (Claudy and O’Driscoll, 2008). Information should include consideration of not only technology being applied, but information to support financially-sound investments (Islam, 2014). Winther and Ericson (2013) also stress the need to make information simple and straightforward, with their research indicating that overly complicated information resulted in ‘produced ignorance’, whereby consumers felt more confused and frustrated, and therefore distrustful, of technology after reviewing information than prior to receiving it.

While economic considerations may be more important when making the purchase decision, studies are generally unanimous that those who install systems are environmentally conscious, with adopters citing environmental benefits of installations as a primary motivating factor when choosing to install systems (Schelly, 2014a, Baskaran et al., 2013, Balcombe et al., 2014). Overcoming market barriers, particularly information barriers, in the portion of the population who are not influenced by environmental concerns may be a challenge for the solar industry. Therefore, campaigns could be targeted to appeal separately to those who are concerned with the environment and those who are concerned with economic characteristics of solar microgeneration investment (Vassileva et al., 2013).

Finally, while this research has focussed on improving strategies around ‘softer’ policy options it is recognised that there still may be a role for continued financial assistance for the installation of solar systems, with Eyre et al. (2010) indicating that improved availability of advice and access to financial incentives address different barriers to investment and therefore have synergistic benefits. In the case of Western Australia, increasing the transparency around the calculation of Buyback FiT rates could have the combined benefits
of addressing economic barriers to installation, increasing confidence in the domestic tariff pricing structure and establishing trust in the interaction between government, energy utilities and consumers.

4.7 REFERENCES


CHAPTER FOUR: ADDENDUM

Chapter Four was submitted for publication in the journal Energy Policy in October 2014. Since this time subsidisation of residential solar energy has continued in Australia via Small-scale Technology Certificates under the Renewable Energy Target. As a result of the availability of these incentives, and the continued decline in system prices, solar adoption continues at a rate of roughly 2,000 systems installed per month in Western Australia (Figure 4.1).

Figure 4.1: Western Australian small-scale solar energy installation rates, based on Small-scale Technology Certificates registered with the Clean Energy Regulator. Certificates can take 12 months to be registered, so rates from January 2016 are estimates only. (Clean Energy Regulator, 2016a)

Since Chapter Four was published ample time and opportunity have passed for Australian governments to improve the regulation and auditing of small-scale renewable energy systems and installations, with associated improvements in customer experiences. Similarly, given that the period of generous financial incentives concluded at the end of 2012, there is an expectation that the ‘cowboys’ identified in Chapter Four would have exited the industry. Unfortunately, publicly available data and information indicates that issues within the residential solar energy industry persist, with evidence suggesting that the provision of misleading information by industry, issues with poor quality systems, and substandard installation continue.
Evidence appears to suggest that consumers continue to access misleading information about solar systems and experience unethical treatment from members of the solar industry. A survey of solar consumers by an electricity retailer found that over half of their customers with solar systems believed they would receive maximum financial value from their system by exporting electricity to the network, even for those who had installed a system after the conclusion of the premium feed-in tariff (Vorrath, 2016b). This might be a result of peer-to-peer interactions with those who previously installed a system under premium feed-in tariff schemes, however the CEO of this company suggested that this might also be the result of unreliable information provided by installers, asking ‘what sort of conversation is happening between them and the solar installer that they think that?’ (Vorrath, 2016b). Misleading information provided by solar retailers was confirmed in Western Australia, with analysis by the author finding that the largest solar retailers in Western Australia provide information on their websites that encourages householders to install over-sized systems. In particular, these retailers continue to assume a consistent rate of ‘feed-in’ for each system size, instead of assuming that the ‘feed-in’ rate is likely to increase with increased system capacity. Furthermore, these websites make no mention of householders needing to consider their time-of-day electricity use patterns. The Western Australian consumer protection agency has also identified a continuing problem with dishonest interactions between solar retailers and householders. As recently as September 2016 one solar industry member was found guilty of fraudulent activity, in particular through pressuring people into sales, ignoring ‘cooling off’ contract periods and asking consumers to waive their right to a warranty on solar products installed (Department of Commerce, 2016).

In early 2015, there were increasing reports from industry stakeholders of high quantities of low quality, Chinese-manufactured solar systems being ‘dumped’ onto the Australian market. One media report identified solar installers in four Australian states as saying that the worst of these ‘Tier 3’ (low cost) systems fail within 12 months and ‘fall apart’ within two or three years (Aston, 2015). An industry member quoted in this report suggested making access to Small-scale Technology Certificates more stringent, recommending that Tier 2 and Tier 3 systems should not be able to generate certificates until their quality can be assured. The issue persisted in 2016, with the head of a wholesaling group saying that ‘the amount of rubbish that is being imported into the country is staggering’ (Parkinson, 2016a). In early 2016, the decision was made by Australia’s Anti-Dumping Commission to
reopen its investigation into the ‘dumping’ of substandard Chinese systems in Australia (Balinski, 2016).

The decision to discontinue the investigation by the Anti-Dumping Commission some 12 months previous, in early 2015, was supported by the Clean Energy Council (Clover, 2016). At that time the CEO of the Clean Energy Council maintained that there were no industry-wide issues with system installation (Clean Energy Council, 2015). However, the Council appears to have acknowledged a rise in poor quality systems with new rules introduced in early 2016. The Clean Energy Council’s new rules and standards for solar products include enabling the Council to ‘delist’ approved systems following random checks of system quality, undertaken by independent testing agencies (Clean Energy Council, 2016). In particular, the new Clean Energy Council rules were to target ‘fly by night suppliers’ and fraudulent activities, including the copying and ‘relabelling’ of panels to higher quality brands or alternate sites of manufacture (Parkinson, 2016a).

In addition to issues with solar system quality, installation quality has also been highlighted as an issue of increasing concern. The Clean Energy Council’s initial view in early 2015 that there were no issues with substandard solar systems was supported by the Clean Energy Regulator, which indicated that the long-run ‘unsafe’ system audit rate remained at a low 3.9% (Parliament of Australia, 2015). The Clean Energy Regulator’s decision in 2015 to use cumulative audit statistics, collected since the beginning of the Australian Government’s audit program in mid-2011, effectively hid state-based and time-specific changes in audit findings. For instance, Western Australian audit results reported in June 2015 showed a combined ‘unsafe’ and ‘substandard system’ installation rate of over 40% (Figure 4.2). Audit results in February 2016 indicate that ‘unsafe’ system rates alone were at 7.4% of systems installed (Clean Energy Regulator, 2016b).
Figure 4.2: Results of Clean Energy Regulator audits in Western Australia indicating that high levels of ‘substandard’ and ‘unsafe’ levels of system installation persist. (Clean Energy Regulator, 2016b)

The residential solar energy industry is also undergoing a rapid change with the introduction of household-scale battery storage devices. Issues identified here relating to poor quality systems, misleading retailer advice and potentially insufficient regulatory responses may be exacerbated with battery technologies entering the market. In particular, an Australian Standard for ‘new’ battery storage chemistries (e.g. lithium ion) is still in the process of being finalised (Standards Australia, 2016). It is estimated that 50,000 battery storage systems could be installed in Australia in the next 12 months; however the chief technical expert involved with developing the new Standard has noted that he ‘wouldn’t be putting chemistries inside a building until [he] knew it was inherently safe’ (Parkinson, 2016b). Another industry member has noted that the battery storage industry should take
the opportunity to learn from the solar industry’s experiences, saying ‘they’ve got an opportunity at the start to get this right’ (Vorrath, 2016a).

The research in Chapter Four identified that survey respondents believed that the solar industry provided misleading advice, were not appropriately regulated and that information was required to support effective decision-making. The research found that 47% of respondents believed that ‘some information available regarding solar systems and subsidies was misleading’. Evidence since the survey was undertaken in August-December 2013 indicates that misleading information continues to be provided to consumers, in particular in terms of information relating to the financial benefits of solar systems and consumer rights. Furthermore, the lack of satisfaction with government oversight of the solar industry was evidenced in that only 40% of survey respondents were ‘confident the solar system industry, its advertising and delivery of rebates [were] appropriately regulated’. That the Clean Energy Council and the Clean Energy Regulator continue to insist that there are no systemic problems with quality in the solar industry, in spite of industry stakeholders raising concerns, reinforce a public perception that the regulation of the industry could be improved. In particular, the Clean Energy Council’s role as both advocate/lobbyist for the renewable energy industry, and also the certifier of systems and installers, could be perceived as a conflict of interest that provides motivation for them to address issues within the industry without making them public. Time will tell whether the Clean Energy Council’s renewed commitment to increasing the robustness of system certification resolves some of the issues identified, however further initiatives are still needed to reduce the prevalence of industry members providing misleading information.

References:


CHAPTER FIVE: PROLOGUE

Chapter Four found that survey respondents perceived a range of procedural concerns in relation to the delivery of incentives. In particular, survey respondents perceived that: government policy was inconsistent; reliable and independent sources of information were difficult to access; and electricity retail tariffs (and therefore financial benefits of solar) were considered uncertain. Additionally, qualitative comments, alongside publicly available information on audit processes and accounts from consumer protection agencies, indicated a lack of trust in residential solar energy systems and installers. Together, these highlighted negative perceptions of the residential solar energy adoption experience. The results therefore suggest that the provision of financial incentives for residential solar systems by government is not considered sufficient for driving community acceptance of renewable energy. Instead community acceptance relies on socio-political support through policy consistency and sound regulatory processes promoted by government. In fact, Wolsink (2013) highlights that social acceptance of a technology alone is not enough to drive the adoption of renewable energy, instead social acceptance of the institutions and institutional changes required to support renewable energy are just as important. The prioritisation of improved regulations surrounding residential solar systems and installation is evidence that not only do residential householders accept changes to institutions, they demand it. Chapter Four also identified that there was a statistically significant difference in the satisfaction rates between those who received Western Australia's generous premium feed-in tariff and those that did not. Chapter Four found that, although financial incentives promoted the adoption of residential solar electricity systems, installation rates have returned to levels consistent with those experienced prior to generous financial incentives being made available in 2010-2012.

Chapter Five further considers the extent to which financial incentives are effective in promoting adoption. There is a growing body of research examining the motivations for the adoption of residential solar systems that has shown that householders choosing to install systems exhibit the characteristics of 'early adopters' in Rogers' Diffusion of Innovations Theory. That is, early adopters are generally educated, high income earners, who have excess capital to expend on experiments with new technologies. Additionally, solar systems are installed based on their technological value as well as for their environmental benefits. Early adopters are important links in the 'peer to peer' communication of the benefits of
technologies, with these early adopters accessing reliable information from industry members, but also acting as conduits for the ideas of technological innovations to the ‘early majority’ adopters. This research, however, seeks to consider the extent to which incentives themselves influence the adoption process. Based on further work by Rogers, this research examines the extent to which financial incentives promote adoption; whether this adoption is by a group of adopters different from those who would otherwise adopt; and whether adoption decisions are based on the benefits of the technology or the availability of subsidies. The research is based on the same mail-out survey used in Chapter Four and interviews with householders who installed a solar system prior to 2013, that is, during the period over which generous financial incentives were available to Western Australian residential solar adopters. Unlike Chapter Four, this research uses survey responses from householders who installed their own systems on their premises. This portion of the research therefore considers residential householders’ perceptions of the adoption process.

The research primarily focuses on consideration of the market dimension of Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy innovation’ in that it seeks to draw out further conclusions on the role of incentives to promote market acceptance in renewable energy, as identified in Chapter Four, with a particular focus on Rogers’ Diffusion of Innovations Theory and consumer segmentation categories. However, the research also includes consideration of the potential equity benefits associated with the provision of financial incentives and therefore crosses to the community dimension.


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Simpson, G., Clifton, J., Effects of incentives on the adoption of residential solar photovoltaic systems: Experiences from Western Australia
RESIDENTIAL SOLAR PHOTOVOLTAIC SYSTEM INCENTIVE SCHEMES PROMOTE DIFFUSION IN FINANCIALLY MOTIVATED ADOPTERS BY ACTING AS A ‘CUE-TO-ACTION’

ABSTRACT

Policies promoting the adoption of residential solar photovoltaic systems often include financial incentives. This research uses Diffusion of Innovations Theory to assess the effects of incentives on the adoption of residential solar systems based on three previously defined conclusions: that incentives increase adoption; that incentives promote adoption by a group of consumers different than those who would otherwise adopt; and that adoption to access incentives may reduce the likelihood of re-adoption. A mail-out survey of 338 householders who purchased a solar system was undertaken in Western Australia in 2013, followed by 26 interviews during 2013-2015. Financial incentives were prioritised in the decision-making process by 70% of survey respondents. Incentives promoted adoption by reducing the payback period of systems and also acted as a ‘cue-to-action’ for those who were considering adoption. The vast majority of survey respondents (82%) installed their solar system for financial reasons, representing a change in motivation away from the ‘early adopters’ who prioritised the technical and environmental aspects of solar. Survey respondents who educated themselves about solar and/or installed solar for environmental or technical reasons were more likely to readopt. Education around solar continues to be a barrier to adoption, with 85% of survey respondents indicating that education is needed to understand the costs and benefits of solar.

5.1 INTRODUCTION

A growing awareness of the harmful impacts of greenhouse gas emissions has led to investment in renewable energy technologies to replace fossil fuel-based electricity generation. While the majority of installed capacity of all renewable energy, including solar, is utility-scale, distributed smaller-scale generation has a role to play in increasing the penetration of renewable energy on electricity networks. Importantly, residential
householders are in a position to invest in small-scale electricity micro-generation units, typically in the form of solar photovoltaic systems (solar systems).

To date, much of the academic literature considering the adoption of residential solar energy has focused on the potential impact of peer-to-peer interactions on the adoption of solar, predominantly from a geographical point of view (Bollinger and Gillingham, 2012, Noll et al., 2014, Schaffer and Brun, 2015, Guidolin and Mortarino, 2010) and consumers’ motivations and barriers for adoption of solar energy (Balcombe et al., 2013, Faiers and Neame, 2006, Hobman and Frederiks, 2014, Karakaya and Sriwannawit, 2015, Baskaran et al., 2013). In particular, Rogers’ (2003) ‘Diffusion of Innovations’ theory has been employed to determine whether the widely applied categories of adopters relate to those adopting residential solar systems. Rogers’ (2003) theory hypothesises that an innovation will diffuse through society via different groups of adopters, each with a specific set of characteristics and role in the adoption process. Innovations are first adopted by ‘innovators’ and ‘early adopters’ (together representing the first 15% of adopters) before being adopted by the ‘early majority’ (35% of adopters). In the case of research into adoption of residential solar systems, the findings have confirmed the presence of early adopter characteristics, with early adopters or those intending to install solar systems being educated (Sigrin et al., 2015, Stedmon et al., 2013, Keirstead, 2007, Vasseur and Kemp, 2015), interested in the technical attributes of solar (Chen, 2014, Schelly, 2014, Haas et al., 1999), and coming from high socioeconomic groups, with disposable income available to invest in innovative technologies (Faiers and Neame, 2006, Sigrin et al., 2015, Islam, 2014, Stedmon et al., 2013, Keirstead, 2007, Vasseur and Kemp, 2015). Additionally, early adopters are concerned with the environment, choosing to install systems in part to reduce their greenhouse gas emissions (Baskaran et al., 2013, Chen, 2014, Leenheer et al., 2011, Haas et al., 1999). Research into a potential early majority group of adopters has identified that the financial attributes of solar are the most significant barrier to adoption, with the capital cost of systems perceived as outweighing the financial benefits of installing a solar system (Faiers and Neame, 2006). This is consistent with Moore’s (2014) theory on a ‘chasm’ that exists between the innovators/early adopters and the early majority, which often prevents an innovation from diffusing through society. The chasm is caused by a lack of acceptance of the relative advantage of a technology by the early majority, with early adopters often interested in the technical aspects of an innovation whereas the early
majority are concerned with the benefits (typically financial) they will receive from adoption.

Governments have established a range of policies to assist with the adoption of solar systems by residential householders. The extensive implementation of such policies by governments has resulted in a stream of literature examining the costs and benefits of incentives. In particular, studies focus on the relative benefits of different incentives, for example the merits of up-front subsidies that reduce capital costs (Andor et al., 2015) and feed-in tariffs that reduce payback periods (Cherrington et al., 2013). Additional support mechanisms, such as information campaigns (Rai and Robinson, 2013, Schelly, 2014), establishing social learning activities (Hampton and Eckermann, 2013), development of solar community organisations (Noll et al., 2014) and different market-mechanisms such as leasing options (Rai and Sigrin, 2013) have also been assessed. The literature identifies a number of potential negative outcomes of incentives, with studies showing that incentives are typically accessed by higher income earners (Macintosh and Wilkinson, 2011) and that funds used to pay for incentives are often regressive forms of taxation (Nelson et al., 2011), where lower socioeconomic groups contribute a higher proportion of their income to pay for incentives. Alternatively, research has found that residential householders support the subsidisation of residential solar systems, although levels of support are lower in lower income groups (Simpson and Clifton, 2016).

One aspect of Rogers’ (2003) ‘Diffusion of Innovations’ theory that has not received attention in the residential solar academic literature is the effect of incentives on the diffusion process. Based on his work on family planning innovations, Rogers (2003) suggests that the availability of incentives has three likely impacts on the diffusion process. First, ‘incentives increase the rate of adoption’ (p238) as they act to increase the relative advantage of the innovation or can act as a ‘cue-to-action’ for those considering adoption. Second, ‘incentives lead to adoption of an innovation by individuals different from those who would otherwise adopt’ (p238), given the improved relative advantage of a technology makes it attractive to the financially motivated early majority. Finally, Rogers (2003) suggests that incentives may have a negative impact on the continued diffusion of an innovation given that ‘although incentives increase the quantity of adopters of an innovation, the quality of such adoption decisions may be relatively low’ (p238) because
decision-making is heavily influenced by the availability of an incentive rather than an informed understanding of the innovation.

Rogers’ (2003) theory on the ‘Diffusion of Innovations’ suggests that where an innovation has financial benefits for the adopter there is the potential that the diffusion process could increase inequality because ‘individuals or other units in a system who most need the benefits of a new idea (the less educated, less wealthy and the like) are generally the last to adopt an innovation’ (p295). Therefore, if Rogers’ (2003) second effect of incentives proves accurate and generous incentives can encourage a different, potentially more disadvantaged, group of adopters to install systems there is the potential for a reduction in inequality. Alternatively, if Rogers’ (2003) third conclusion proves to be accurate, a period of generous incentives and coincident low quality in decision-making may be followed by a decline in enthusiasm for installing systems. The impact of public approval on an innovation’s adoption process is demonstrated by ‘Gartner’s hype curve’ (Linden and Fenn, 2003). Although the authors interpret this model as being developed in relation to media communication of expectations around a new technology, the authors believe its depiction of a rapid deterioration in levels of acceptance of a technology if unrealistic expectations go unmet is transferable. In the case of ‘Gartner’s hype curve’ this is referred to as the ‘trough of disillusionment’ (Figure 5.1), which states: ‘Because the technology does not live up to enterprises’ and the media’s overinflated expectations, it is rapidly discredited’ (p8). Rogers’ conclusions on the effects of incentives therefore have potential equity outcomes and implications for the success of policies to promote ongoing adoption of solar systems.

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Figure 5.1: Gartner’s hype curve, developed by Gartner Research, May 2003, demonstrating the ‘trough of disillusionment’ that can occur after unrealistic expectations of an innovation are communicated through society (Linden and Fenn, 2003).

At the time of writing Australia had the highest level of installed small-scale solar capacity in the world (Bruce and MacGill, 2016), with householders installing residential solar systems in Western Australia having had access to both state and federal incentive schemes. Discounts on the purchase price of systems have been available through the Australian Government for over a decade, including under the Photovoltaic Rebate Program, the Solar Homes and Communities Grant (Macintosh and Wilkinson, 2011) and most recently through the Renewable Energy Target. The Renewable Energy Target allows for renewable energy certificates to be generated based on an approximation of the electricity produced by a small-scale system over a 15 year period (Climate Change Authority, 2012), with a specific incentive for the promotion of residential-scale systems, the Solar Credits Multiplier (SCM). The SCM multiplied the number of certificates that could be generated for small-scale
systems, starting with a multiplier of five in June 2009 with stepwise reductions on 1 July 2011 (three times multiplier), 1 July 2012 (two times multiplier), and finally to one (no multiplier) by 1 January 2013 (six months ahead of schedule given oversubscription to the scheme (Climate Change Authority, 2012)). Under the assumption residential householders would purchase an approximately 1.5 kW system it was expected that the SCM would initially provide a subsidy of AU$7,500; around the value of the Solar Homes and Communities Grant it was intended to replace. During the period the SCM was active most Australian states and territories also introduced feed-in tariffs. In Western Australia a ‘premium net feed-in tariff’ was introduced alongside the pre-existing standard net feed-in tariff that paid for the wholesale cost of electricity fed into the grid (Collier, 2010). Together these feed-in tariffs paid approximately AU47 cents per kWh, compared with the residential retail tariff of approximately AU21 cents per kWh. The scheme was open to new entrants on 1 July 2010 and closed to new entrants on 1 August 2011 (Collier, 2011). Therefore, the period 2010-2012 represents an incentive-intensive period for the promotion of residential solar in Western Australia and a useful example for testing Rogers’ (2003) ‘effects of incentives’ conclusions. It should be noted that there has only been one period during which access to financial incentives for solar adoption has been means tested (available to lower income households only), from May 2008 until June 2009 (Macintosh and Wilkinson, 2010), when approximately 5,000 systems were installed out of a total of more than 175,000 systems installed in Western Australia (to end 2014).

The objective of this research is to consider the extent to which Rogers’ (2003) conclusions on the effect of incentives accurately describe the process of adoption of solar systems by residential householders in Western Australia. The findings assist in developing an understanding of the potential costs and benefits of incentive policies promoting the adoption of residential solar, with suggestions for enhancing the success of future policies. The Results and Discussion section is split into three parts, each reflecting one of Rogers’ (2003) conclusions: that incentives promote adoption; that incentives promote adoption by a new and dissimilar group of purchasers; and that adopters may install systems in order to access financial incentives rather than understanding the true costs and benefits of a technology, with implications for continued adoption.
5.2 METHODS

Six geographic locations in Western Australia were chosen for the study, including four metropolitan and two regional post code areas. The four metropolitan post code areas were selected to include two advantaged and two disadvantaged areas based on the SEIFA index of socioeconomic disadvantage (Australian Bureau of Statistics, 2013d). One high solar penetration and one low solar penetration area were included in each socioeconomic class, calculated based on the number of small-scale solar systems installed (Clean Energy Regulator, 2014) as a proportion of occupied detached, semi-detached, row or terrace housing (Australian Bureau of Statistics, 2013a). All metropolitan postcode areas were required to have a minimum of 200 systems installed, a minimum of 1000 free-standing dwellings and a maximum rental rate of 25%, according to the 2011 Australian census (Australian Bureau of Statistics, 2013a). The regional community of Carnarvon was chosen based on the presence of an informal solar community organisation in the town (Sustainable Energy Association, 2012), with Narrogin chosen as an alternative given its similar population size, socio-economic status and home ownership levels (Australian Bureau of Statistics, 2013b, Australian Bureau of Statistics, 2013c). Households to be surveyed were identified based on publicly-available aerial photographs matched with street address profiles (Landgate, 2013), with the most recent systems installed in January 2013. All households with solar systems in the low solar penetration and regional communities were surveyed, with a random sample from the high installation communities. The survey included Likert-type statements, categorical questions on information sources, decision-making processes and incentives accessed. The survey opened with demographic questions and a request for survey respondents to self-select for a potential future interview. Research received human ethics approval from The University of Western Australia.

A three stage distribution process was implemented, including an initial copy of the survey and ‘reply paid’ envelope sent out, followed by a reminder/thank you postcard, and then another copy of the survey and ‘reply paid’ envelope (De Vaus, 2002). The benefit of sending follow-up surveys to increase response rates has been identified elsewhere (Baskaran et al., 2013). An increased response rate was encouraged with a prize draw for an iPad Mini for those completing the survey and by including a hand-written Post It note with the final survey (Garner, 2005). Surveys were posted between August and December 2013. A total of 959 surveys were sent out with 362 surveys returned completed, a
response rate of 38%, consistent with similar surveys on solar adoption (Baskaran et al., 2013, Rai and Robinson, 2013). Response rates between geographic areas varied from 32% to 55%, with a lower number of mail-outs but higher response rate for regional communities. Of these 362 survey respondents 24 did not install the solar system on their premises, excluding them from further study and leaving a sample size of 338. The survey sample did not represent a particular bias towards the year solar systems were installed (Figure 5.2).

![Figure 5.2: Proportion of residential solar energy systems installed per year, by geographic location. A moratorium on new residential solar energy installations in Carnarvon prevented systems being installed post-2011.](image)

The survey was used to create a subscale of relevance to each of the three research hypotheses: that incentives promote adoption; that incentives promote adoption by a new and dissimilar group of purchasers; and that incentives may reduce the likelihood of readoption. Subscales were generated given the potential for increased reliability compared
with single statements, particularly when measuring intentions and attitudes (Leenheer et al., 2011). A modest pre-test of the survey was undertaken. Subscales were tested for internal consistency using Cronbach’s coefficient alpha and tested for unidimensionality using item-total correlation. A minimum item-total correlation of 0.30 and minimum Cronbach’s alpha of 0.60 were set, given the small number of Likert-type statements applied to each theme (Cortina, 1993). Individual statements that did not meet these requirements, or that had a higher alpha when excluded, were not included in the subscale and were analysed separately. The wording of individually analysed Likert-type statements is included in the results section. The ‘n’ values provided throughout relate to the number of respondents for that statement/subscale item.

Semi-structured interviews were undertaken to provide rich qualitative data to support the quantitative survey findings. Interview respondents were asked to reflect on their experiences with installing residential solar energy systems, including in terms of their motivation for installation, satisfaction with systems and questions around the transfer of information and perceptions of solar subsidies. A random 50% of self-selected survey respondents from the metropolitan communities were approached for interviews, with all respondents self-selecting from the regional communities contacted. 21 metropolitan community respondents were approached for the interview portion of the research, with 12 accepting. 18 regional community survey respondents were approached with 14 accepting. Three of these 26 interviews were conducted with heterosexual couples; the remaining interviews were all with the survey respondents of which 17 were male and six were female. Each couple had near-unanimous agreement across interview questions, so each of these interviews was treated as a single response. Three interview subjects in the random sample were working in the solar industry. Metropolitan interviews were undertaken by telephone during December 2013. Regional interviews were conducted in-person during May and June 2015. All interviews were conducted by the same interviewer and transcribed and coded in NVivo Version 11 (QSR International Pty Ltd, 2015). Coding was based on the pre-determined categories found in the literature review and under headings related to the three key research themes.

Given the quantitative survey sample was purposively selected to represent extremes in socioeconomic advantage/disadvantage, and qualitative responses may be influenced by region-specific circumstances, triangulation using publicly available industry and
government datasets was employed to increase the robustness of conclusions drawn from the researcher-generated data. Datasets included census data on socio-economic advantage and disadvantage (Australian Bureau of Statistics, 2013d), home ownership (Australian Bureau of Statistics, 2013a), solar installation adoption and installed capacity rates (Clean Energy Regulator, 2016), value of renewable energy certificates (Green Energy Trading, 2016, Australian PV Institute (APVI), 2015, Solar Choice, 2016) and out-of-pocket costs for systems (Clean Energy Regulator, 2014b).

Rogers’ (2003) conclusions on the effects of incentives do not provide advice on the expected level of influence of incentives on adoption processes, so a number of tests were used to determine whether these conclusions could be applied to the incentivisation of residential solar systems in Western Australia. Analysis of the survey data and publicly available quantitative data was performed using SPSS Version 22.0 (IBM Corporation, 2013). Qualitative interview comments were used to support the veracity of the quantitative findings and highlight additional themes of relevance to hypotheses.

The first hypothesis is that financial incentives would promote adoption. A subscale theme in the survey was used to determine whether incentives were perceived as important in the decision-making process. The subscale included five statements on whether: respondents would only install a system if it was subsidised by government, fewer people would install systems in the absence of subsidies; subsidies should continue to be available; respondents installed their system in order to access subsidies; and whether respondents ranked access to financial incentives as important in their decision-making. The subscale was both unidimensional (minimum item-total correlation of 0.32) and internally consistent (Cronbach’s alpha of 0.62, n=5). More than 50% of respondents returning an ‘agree’ or ‘strongly agree’ rating to this subscale was deemed as evidence of confirmation of the hypothesis. Publicly available data was also used to test the influence of incentives on installation rates. Pearson correlation tests were performed to determine whether there were statistically significant relationships between installation rates, average system cost prices, the value of incentives available (in the form of renewable certificate prices) and the average capacity of systems installed (in kW). Spearman correlation tests were performed between these features and the availability of incentives, including the number of months remaining until the SCM reduced. Through these tests it was possible to determine whether installation rates were influenced by the cost of systems (after rebates were taken into
account) or the availability of incentives, with the Spearman correlation using number of months remaining until a reduction in the incentive providing evidence of whether the time-limited nature of rebates acted as a 'cue-to-action'.

The second hypothesis suggests that financial incentives will promote adoption by a group of adopters different from those who would have otherwise adopted. Based on Rogers’ (2003) characterisation of adopters and the literature regarding adoption of residential solar energy, typical ‘early adopters’ install solar for environmental reasons and to experiment with a new technology, as opposed to economic reasons, and are educated and higher in socioeconomic status. A scaled item was used to determine whether survey respondents were concerned about the environment, including in relation to the adoption of residential solar systems. This subscale included statements regarding whether respondents would install solar even if it was more expensive than the grid, whether political parties with environmental interests are preferred, whether preparing for the reduced availability of finite fuel is important, whether anthropogenic climate change is a real and serious phenomenon and whether a reduction in greenhouse gas emissions contributed to respondents’ decision-making around solar. The subscale was both unidimensional (minimum item-total correlation of 0.33) and internally consistent (Cronbach’s alpha of 0.69, n=5). Further questions in the study examined respondent’s motivation for installing systems, including whether they installed because solar was a ‘new’ technology they were interested in or whether they installed their system for economic reasons. In this case less than 50% of respondents returning an ‘agree’ or ‘strongly agree’ rating to subscale/statements was deemed as evidence of confirmation of the hypothesis. Demographic data from the survey respondents was used to consider whether survey respondents installing a solar system were no more educated or higher in socioeconomic status than the communities from which they came, which would confirm Rogers’ (2003) second conclusion on the effects of financial incentives. It is difficult to dissociate whether the findings are representative of those householders who would choose to respond to surveys or choose to install systems. For this reason, the demographic profile of respondents was also compared with the respondent characteristics for a random sample survey undertaken in the same areas, within the same time period (Simpson and Clifton, 2016). The population characteristics of the two samples were combined for analysis (including respondents to this survey who did not install their own system). Additionally, the second conclusion on the effects of incentives on adoption suggests that individuals of
lower socioeconomic status may adopt a technology when financial incentives are available, with implications for equity in the diffusion process. In the case of this survey different socioeconomic status communities were purposively chosen in order to examine different adoption experiences, therefore the sample is not representative of the socioeconomic status of all solar installers. Because of this, a partial correlation analysis between postcode-level data for both installation rates and median household income was undertaken to determine whether lower income communities adopted solar preferentially to higher income communities during the incentive-intensive period, and compared with the subsequent time period in the absence of incentives.

Finally, the third hypothesis suggests that although incentives promote adoption the adoption decision may be influenced by the availability of incentives as opposed to an understanding of the technical (and in this case environmental) benefits of the technology itself, resulting in lower quality decision-making. This conclusion can be broken down into three sub-themes: that people install systems in order to take advantage of financial incentives; that people who install in order to access financial incentives will know less about the technology and therefore undertake poor quality decision-making; and that this can result in people having a lack of understanding of the true costs and benefits of solar and therefore choosing not to install a system in future (when incentives might not be available). A subscale was used to measure this final subtheme, whether those installing solar systems during the incentive-intensive period are likely to install a system in future. This subscale included statements regarding whether respondents would install a solar system on a new home, whether they recommend to others that they install a system, whether their system is living up to their expectations, whether changes to their electricity bills met their expectations and whether they understood how their bills would change. The subscale was both unidimensional (minimum item-total correlation of 0.40) and internally consistent (Cronbach’s alpha of 0.75, n=5). The subscale score for each respondent was used as the dependent variable in a multiple linear regression analysis against survey responses relating to a prioritisation of the technical and environmental benefits of solar or prioritisation of incentives available. A statistically significant model indicating an association between prioritisation of incentives (instead of environmental/technical aspects of solar) and lower satisfaction/readoption scores is considered confirmation of Rogers’ (2003) third conclusion on the effects of incentives on adoption. A further Likert-type statement, considering whether educational assistance is needed to help people understand
the real costs and benefits of solar, was used to determine whether research into solar is required to improve the quality of decision-making, or whether respondents believed the level of public awareness is enough to promote quality decision-making.

5.3 RESULTS AND DISCUSSION PART ONE – INCENTIVES
PROMOTE ADOPTION

The first section of the Results and Discussion focuses on Rogers’ (2003) assertion that financial incentives will increase the rate of adoption of an innovation by increasing the relative advantage of the technology and by acting as a ‘cue-to-action’. The quantitative survey responses support this theory, with more than 50% (70%) of respondents (n=338) indicating that subsidies were important in their decision-making process (scaled item). Furthermore, 60% of respondents (n=334) indicated they would ‘only purchase a system if it was subsidised by the government’ (included in scaled item). The survey results indicated both benefits of incentives identified by Rogers (2003), that incentives increase the relative advantage of an innovation and act as a ‘cue-to-action’, were influential in adoption. While it did not meet the minimum 50% respondent agreement stipulated in the methods, almost a majority of respondents decided to install systems because of changes to the cost structure of solar units, in terms of either an awareness that subsidies were reducing (i.e. 29% of respondents reacted to a ‘cue-to-action’; 97 of 338) or the cost of solar systems had come down considerably (i.e. 20% of respondents reacted to the increased relative advantage provided by financial incentives, 69 of 338). This is compared with those people who decided to install because of a discussion with an installer (4%), information in the media (15%), discussions with family (21%), increases in electricity bills (6%) or other reasons (5%).

The qualitative survey comments supported the quantitative findings in terms of the contributing role of incentives to solar decision-making, with 12 of the 26 interview respondents mentioning that the subsidy reduced the system price to an affordable level, with comments like:

‘Even before the rebates I was thinking it was a good idea... but then when the rebates have come in I've had a look at it and it looked obvious.’
'If we didn’t have the subsidy I don’t know if we would have been in the position to go ahead at the time.'

Other interview participants supported the theory that incentives act as a ‘cue-to-action’, with householders noting that the time-limited nature of the subsidies contributed to their decision-making process, with the future reduction or removal of incentives promoting installation for five interview participants. Comments included:

‘I mean I didn’t know much about it. And they both said that the schemes would run out so I had to get on to it quickly. And I had the money available so I just did it.’

‘It was really a decision based primarily financially and I looked at the rebates that were gradually dissipating and I thought no I might jump in at this stage because unless we do that now we’ll be in the next stage and it will be less again.’
Figure 5.3: Changes in features of the Australian small-scale solar energy market during reductions in the Solar Credits Multiplier incentive policy, with step-wise reductions from 5 to 3 certificates on 1 July 2011, 3 to 2 certificates on 1 July 2012, and 2 to 1 (no multiplier) on 1 January 2013. The figures demonstrate (a) a reduction in installation rate coinciding with a reduction in the availability of the incentive, (b) a reduction in certificate price coincident with the peaks in installation rates, (c) a reduction in installed photovoltaic system price over time, even without the incentive, and (d) an increase in the capacity of solar systems over time. (a) and (d) sourced from Clean Energy Regulator (2016), (b) sourced from Green Energy Trading (2016), (c) derived by authors from data sourced from Australian PV Institute (APVI) (2015), Clean Energy Regulator (2014b) and (Solar Choice, 2016).
Figure 5.3 highlights interactions between the availability of incentives, the price paid for renewable certificates, the installation rate and the capacity of systems installed. A strong inverse relationship exists between the installation rate (a) and the value of certificates (b) as higher-than-expected installations result in increased supply and reduced value of certificates on the market (Pearson’s rho = -0.70, n=60, p<0.01; two-tailed). Following the end of the SCM period (the Australian Government’s small-scale solar incentive scheme), the global reduction in photovoltaic system prices along with the strengthening value of renewable certificates (b) has seen a reduction in the price per kW (c) to levels equivalent to that experienced during the most generous subsidy period. However, this has not resulted in returns to the installation rates experienced during the SCM period (a). In fact, there was no correlation between the rate of small-scale solar systems installed in Western Australia and the per kW cost of systems (Pearson’s rho = 0.25 n=52, p=0.07; two-tailed). Instead, there is a moderate relationship (Pearson’s rho = 0.51, n=52, p<0.01; two-tailed) between the declining cost of systems and the increasing capacity of systems installed (d), which, in the absence of the premium feed-in tariff, would result in longer payback periods for many householders. Additionally, the data support the theory that the availability of incentives themselves, as opposed to their contribution to reducing the cost of solar systems, promoted the installation of small-scale solar systems. This was evident in that there was a strong correlation between the installation rate and the number of months until the SCM incentive reduced (Spearman’s rho = 0.60, n=61, p<0.01; two-tailed). This further suggests that incentives acted as a ‘cue-to-action’, and is evident in Figure 5.3(a), which shows pronounced ‘busts’ in installation rates coinciding with a reduction in the SCM.

The solar adoption literature presents some similar findings, with a reduction in the adoption of photovoltaic systems in the Japanese market thought to be associated with a termination of incentives (Chowdhury et al., 2014). The availability of financial incentives being a prerequisite for installation was also found elsewhere, with Haas et al. (1999) finding that over 35% of those surveyed would not have installed without incentives. Our findings support analysis from previous research in the Netherlands, which examined intentions to adopt solar and found that affordability is the best predictor for photovoltaic adoption (Vasseur and Kemp, 2015) but contradicts findings of actual adopters in the US (Schelly, 2014). Furthermore, reductions in the availability of subsidies led to similar ‘boom and bust’ installation rates in Germany (Karakaya et al., 2015, Leepa and Unfried, 2013) and the UK (Kay, 2015). In spite of these studies, there is no unanimous agreement in the
academic literature as to whether financial incentives are successful for promoting solar adoption. Early research, for instance by Faieers and Neame (2006) in the UK and Hampton and Eckermann (2013) in 2005 in Australia, all found that greater financial incentives were required to improve the perceived economic benefits of solar. Jager (2006) found that even with subsidies of up to 90% of the capital cost of systems uptake rates remained low. Alternatively, Australian incentive schemes in the period 2010-2012 were oversubscribed. Two potential reasons for this are evident in the interview responses: overly generous financial subsidies and peer-to-peer interactions.

The over-generous nature of the subsidies led to many householders acquiring systems at significantly reduced prices as a result of federal subsidies for solar installation, and significantly shortened pay-back periods as a result of the feed-in tariff. While Figure 5.3 provides an average per kW cost, the results from this research indicated that actual subsidy benefits varied substantially. Many of the subsidies received were exceedingly generous, with four survey respondents indicating they paid nothing for their system, and a further 12 paying AU$1,500 or less. Interviews with householders highlighted the overgenerous nature of the incentives, particularly in the regional community of Carnarvon, with one householder installing a system for AU$27,000 but with out-of-pocket expenses of AU$2,324 and another receiving approximately AU$87,000 from the sale of his certificates on an approximately AU$120,000 system, with revenue received through the feed-in tariff meaning the system was paid off within a 12 month period. Finally, one couple installed a AU$22,000 system and received over AU$25,000 on the sale of their certificates, making AU$3,000 on their installation, prior to additional financial benefits through the feed-in tariff. 15 of the 26 interview participants pointed out the overly generous nature of the subsidies, with statements such as:

'I couldn't believe how much money I was getting back.'

'At first the rebate they were giving out was much too much... my solar system cost nothing.'

'It was exceedingly generous.... as a person getting the feed-in tariff I'm wrapped with it, as a tax payer I think it's a gross waste of taxpayers' money.'
The quantitative results highlighted the influence of peer-to-peer effects, with 77% of survey respondents indicating ‘other people have requested advice from me regarding solar systems’ (n=336). This is significantly higher than elsewhere in the literature, with Yamamoto (2015) finding that only 44% of respondents to a Japanese survey were asked about their system. In particular in the Western Australian case, the awareness of the generosity of subsidies resulted in interview participants in the regional community of Carnarvon highlighting the social dimension of system adoption, with comments like:

'We were first through the door and everyone was ringing me going “how does this work? What’s the deal with the [solar credits] multiplier?”.'

'But a lot of it was all just word of mouth, you know, because a lot of people around town were just getting it done and then a few guys really jumped on the band wagon early.'

This section has identified that a large majority of respondents prioritised incentives in their decision-making and close to a majority of respondents cited a change in financial circumstances associated with incentives (an upcoming reduction in the availability of incentives or an awareness that system prices had reduced) as their greatest motivation for choosing to install a solar system. Furthermore, the largest group of survey respondents chose to install their system because of an awareness that rebates were reducing, which was supported by publicly available data that showed a strong correlation between installation rates and the number of months remaining until the SCM was reduced. Together these provide evidence of confirmation of Rogers’ (2003) first conclusion, and in particular that incentives acted as a ‘cue-to-action’ to promote installation. It appears likely that the overly generous nature of the incentives may have been important in peer-to-peer interactions promoting adoption.

5.4 RESULTS AND DISCUSSION PART TWO – INCENTIVES PROMOTE ADOPTION BY DIFFERENT CONSUMERS

The second section of the Results and Discussion focuses on Rogers’ (2003) assertion that financial incentives will ‘lead to adoption of an innovation by individuals different from those who would otherwise adopt’ (p238), which in this case is suggested to be the typical early adopter characteristics of solar adopters identified in the literature. The typical early
adopter characteristics include that early adopters install solar systems because of their environmental benefits and based on an interest in solar as a new technology. Early adopters are also more educated and higher in socioeconomic status than the general population.

In the case of this research a small majority of respondents supported the environmental benefits of solar, with 51% of respondents providing a positive response to the scaled item relating to the environmental benefits of solar energy (n=338). This contradicts Rogers’ (2003) second conclusion, however the survey responses show a lower level of support for renewable energy than other research in Australia with 71% (n=1145) of Australians found to be supportive of Australia’s Renewable Energy Target (Stefanova et al., 2014). Therefore, support for renewable energy innovations that improve the environment would no longer be considered a ‘fringe’ concern of the early adopters.

The literature suggests that later adopters installing solar systems prioritise economic benefits in their decision-making (Sigrin et al., 2015). The vast majority of respondents (82%, n=331) stated that they installed their system for economic reasons, and that other reasons were a ‘bonus’. 75% of respondents ranked ‘access to subsidies’ or ‘reducing electricity tariffs’ as more important motivating factors for installing their systems than ‘reducing greenhouse gas emissions’ (n=300), with only 17% of respondents placing ‘reducing greenhouse gas emissions’ as their most important motivating factor (n=302). Furthermore, of all those that did agree with the value of renewable energy and the environment, 77% still installed for financial reasons (n=166). The value of the financial aspects of solar acting as motivation is reflected elsewhere in the literature, with Schelly (2014) finding that ‘environmental values alone are not enough, and not always necessary, to motivate adoption’ (p183) and Balcombe et al. (2014) finding that incentives led a new, financially-motivated subset of the community to install solar.

In terms of early adopters choosing to install solar based on its technical attributes, the survey found that only 34% of respondents installed their system ‘primarily because it was a new technology [they were] interested in’ (n=328). Additionally, the proportion of respondents installing a system based on its technological value was higher prior to the incentive-intensive 2010-2012 period, with 45% of these respondents installing their system because it was a technology they were interested in (n=60) compared with 30%
during the incentive-intensive period (n=254), significant at the p<0.01 level (two-tailed Mann-Whitney U=6110.5).

Survey respondent demographic data was used to consider whether those who installed solar systems were more educated or had a higher household income than the general population (Australian Bureau of Statistics, 2013a). Survey responses indicated that those installing solar systems were more educated than the general population in three of the six geographic locations surveyed (Table 5.1). However, when compared with the demographic characteristics of the respondents to an associated survey distributed to a random sample of households in the same geographic locations there was no difference in education levels (Table 5.1). This suggests that there is a bias towards more educated members of the population responding to surveys on solar research, as opposed to more educated individuals necessarily installing solar systems. Furthermore, the highest proportion of survey respondents had only a primary or secondary school education, at 41% (n=335). Therefore, there is no conclusive evidence suggesting that those who install systems are more educated than the general population.

Geographic locations for this survey were purposively chosen to reflect a range of socioeconomic statuses. The survey results indicate that survey respondents were consistent with both the underlying population and the average survey respondent in each postcode area (Table 5.1). Given an Australian Government analysis of youth disadvantage indicated that postcode-level SEIFA severely miscalculated 40% of the sample (Lim and Gemici, 2011), it is heartening to see that installation at income-level in the survey responses is broadly representative of the distribution of income at the population level. Based on this finding it was deemed appropriate to analyse data representing installation rates and household income for all postcodes in Western Australia.
that as median household income increased the number of systems installed in that region increased as well. This pattern was observed in all areas except for Carnarvon, which did not have a statistically significant correlation between income and the number of installations.

Table 5.1: Mann-Whitney U comparisons between (a) survey respondents and general population and (b) survey respondents who installed their own solar system and those that did not (from two surveys by the authors) for each of the six geographic regions, according to the 2011 Australian census

<table>
<thead>
<tr>
<th>Region</th>
<th>SEIFA Score</th>
<th>Installation Rate</th>
<th>Education</th>
<th>Household Income</th>
<th>Education</th>
<th>Household Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>High SEIFA / High installation rate (Kingsley and Woodvale)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (population)</td>
<td>15933</td>
<td>6721</td>
<td>N (system installed)</td>
<td>117</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td>N (sample)</td>
<td>86</td>
<td>83</td>
<td>N (no system installed)</td>
<td>45</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U statistic</td>
<td>600049</td>
<td>277627</td>
<td>Mann-Whitney U statistic</td>
<td>2336.500</td>
<td>2275.500</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.032*</td>
<td>0.940</td>
<td>p value</td>
<td>0.251</td>
<td>0.179</td>
<td></td>
</tr>
<tr>
<td>High SEIFA / Low installation rate (City Beach)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (population)</td>
<td>4466</td>
<td>1897</td>
<td>N (system installed)</td>
<td>95</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>N (sample)</td>
<td>77</td>
<td>74</td>
<td>N (no system installed)</td>
<td>57</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U statistic</td>
<td>97725</td>
<td>65413</td>
<td>Mann-Whitney U statistic</td>
<td>2576.000</td>
<td>2225.500</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.000*</td>
<td>0.280</td>
<td>p value</td>
<td>0.606</td>
<td>0.399</td>
<td></td>
</tr>
<tr>
<td>Low SEIFA / High installation rate (Maddington and Orange Grove)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (population)</td>
<td>7859</td>
<td>3391</td>
<td>N (system installed)</td>
<td>68</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>N (sample)</td>
<td>52</td>
<td>49</td>
<td>N (no system installed)</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U statistic</td>
<td>181560</td>
<td>77584</td>
<td>Mann-Whitney U statistic</td>
<td>538.000</td>
<td>503.500</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.105</td>
<td>0.409</td>
<td>p value</td>
<td>0.125</td>
<td>0.140</td>
<td></td>
</tr>
<tr>
<td>Low SEIFA / Low installation rate (Alexander Heights, Girrawheen, Koondoola, Marangaroo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N (population)</td>
<td>21541</td>
<td>9064</td>
<td>N (system installed)</td>
<td>93</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>N (sample)</td>
<td>66</td>
<td>62</td>
<td>N (no system installed)</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U statistic</td>
<td>554845</td>
<td>247639</td>
<td>Mann-Whitney U statistic</td>
<td>795.500</td>
<td>765.000</td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.000*</td>
<td>0.096</td>
<td>p value</td>
<td>0.279</td>
<td>0.525</td>
<td></td>
</tr>
</tbody>
</table>

* = statistically significant findings

A partial correlation analysis between the number of systems installed and the median household income was performed, controlling for the number of detached or semi-detached houses that were owned or mortgaged in each postcode. During the incentive-intensive period there was a small but statistically significant correlation between household income and the number of systems installed (p<0.02, r= -0.137, two-tailed), which explained 1.9% of the variation in the number of systems installed. The direction of the correlation suggested that as median household income increased the number of systems installed in that area also increased.
postcode area declined, consistent with Rogers’ (2003) assertion that financial incentives can promote adoption by lower income consumers as opposed to typical ‘early adopters’. Alternatively, there was no relationship between household income and number of systems installed during the two years (2013-2014) subsequent to the incentive-intensive period \( (p=0.34, r=-0.047, \text{two-tailed}) \).

Geographical responses supported the value of subsidies in lower income areas, with 78% of respondents in the lower socioeconomic metropolitan areas \((n=119)\) prioritising the availability of incentives (scaled item) compared with 66% in all other regions \((n=219)\), significant at the \( p<0.05 \) level \( (\text{Kruskal-Wallis } X^2[5, n=338]=11.9; \text{category differences found using pair-wise Mann-Whitney } U) \). This, therefore, contradicts some findings in the literature, including in the earlier days of incentives available in Australia \( (\text{Macintosh and Wilkinson, 2011}) \) and more recently in Hawaii \( (\text{Coffman et al., 2016}) \), where incentives were found to favour middle-high income earners. The interview responses reflected increased adoption by disadvantaged groups with two of the solar industry members suggesting a preference for installations in low income areas:

‘Well the biggest uptake of solar is in lower socioeconomic areas, you know they’re the people who can see the benefit, they want to access the funding, but most importantly they want to insulate themselves from rising costs and they’re prepared to spend it. Whereas, the people who can afford it the most do it the least because they don’t really see the need to do it.’

‘I mean we work in different areas, in areas that have money and in areas that don’t have money and when the rebate was really big the people in the lower income areas got onto that a lot quicker and you know virtually had a free PV system.’

While Rogers (2003) suggests the adoption process has the potential to increase inequality between socioeconomic groups given high income earners will adopt first, generous incentives that see preferential adoption in lower socioeconomic groups reduce levels of inequality. Evidence of this can be seen in the case of solar adoption in Western Australia, with the postcodes representing the most disadvantaged 20% of detached or semi-detached residences that are owned/mortgaged continuing to have the highest levels of solar penetration, even after the discontinuation of solar subsidies \( (\text{Figure 5.4}) \). Therefore, in spite of previous research finding that incentives provide benefits to higher income earners,
the very nature of incentives and the influence they have on lower socioeconomic communities has the potential to generate equity benefits. Equity benefits to more disadvantaged community members were reflected in the interview comments, with some respondents noting that the reduced cost pressure associated with electricity bills allowed them to increase their comfort levels and be less concerned with their electricity consumption:

‘[Solar has] dropped our average [electricity] account down to about $80 now. So, without solar panels I don’t think we could live.’

‘Yeah, we’re saving about $1,000 a year. Which is good, you don’t feel guilty for turning on the air [conditioner].’

This increasing adoption by lower than average householders has been noted in the Australian media (Neales and Taylor, 2012, Vorrath, 2016). However, it should be noted that these benefits are limited to those who are in the position to own/mortgage their own home.

This section confirms that the vast majority of survey respondents installed their system for economic reasons, with respondent levels of support for renewable energy and its environmental benefits less than cited elsewhere for the general Australian population. Similarly, a minority of respondents chose to install solar primarily because it was a technology they were interested in. Furthermore, there was not adequate evidence to support that solar adopters were more educated than the general population, and survey respondents had incomes consistent with those in the general population in their postcode. An analysis of Western Australia-wide postcode data found that there was a small but statistically significant relationship between lower income levels and higher rates of solar installation. Given that Rogers’ (2003) ‘Diffusion of Innovations’ Theory suggests that the first 15% of adopters should be characterised as ‘innovators’ or ‘early adopters’, the finding that the majority of respondents do not necessarily match key innovator/early adopter characteristics suggests that incentives have resulted in a ‘different’ group of adopters.
Figure 5.4: Evidence of ongoing benefit to disadvantaged postcode areas after the subsidy intensive period, with disadvantaged areas maintaining high numbers of small-scale solar installations. This graph uses all postcodes that appear on Australian Bureau of Statistics (2013d) and Clean Energy Regulator (2016) data, with postcodes ordered based on ranking of disadvantage and then with each 20% based on 20% of total detached or semi-detached houses in Western Australia that are either owned or mortgaged (i.e. the number of households deemed likely to install solar is constant within each percentile group).

5.5 **Results and Discussion Part Three – Incentives Can Negatively Impact Readoption**

The third section of the Results and Discussion focuses on Rogers' (2003) conclusion that those adopting an innovation in the presence of financial incentives may do so in order to access the financial benefits associated with the incentive, as opposed to understanding and benefitting from the technical advantages posed by the innovation. Without understanding the costs and benefits of the technology, these adopters would be less likely to re-adopt the
innovation in the absence of incentives. This section examines whether those installing a system while financial incentives were available are likely to re-adopt, and the extent to which their readoption and satisfaction with their system is related to how informed they are about solar and their prioritisation of incentives in decision-making. While the multiple linear regression model used to explain satisfaction with solar and future adoption likelihood was statistically significant (F(8,286)=7.060,p<0.001) it explained only 16% of the variability in satisfaction ratings (Adjusted R²=0.165). Five of the eight predictor variables were found to have a statistically significant influence on satisfaction ratings (Table 5.2).

Table 5.2: The unstandardized and standardised regression coefficients for the variables entered into a multiple linear regression model with satisfaction with system installation/likelihood of future installation (subscale item) as the dependent variable

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised coefficient</th>
<th>Standard Error</th>
<th>Standardised coefficient</th>
<th>Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>3.196</td>
<td>.292</td>
<td>.000*</td>
<td></td>
</tr>
<tr>
<td>Received the Western Australian premium net feed-in tariff</td>
<td>.249</td>
<td>.073</td>
<td>.191</td>
<td>.001*</td>
</tr>
<tr>
<td>‘I did a lot of research into solar systems to make sure it was the best decision for me’ (dichotomous variable)</td>
<td>.191</td>
<td>.068</td>
<td>.156</td>
<td>.006*</td>
</tr>
<tr>
<td>Education level</td>
<td>-.023</td>
<td>.025</td>
<td>-.054</td>
<td>.359</td>
</tr>
<tr>
<td>Income level</td>
<td>-.010</td>
<td>.023</td>
<td>-.025</td>
<td>.670</td>
</tr>
<tr>
<td>Support for environmental benefits (scale from 3.2)</td>
<td>.113</td>
<td>.047</td>
<td>.134</td>
<td>.017*</td>
</tr>
<tr>
<td>‘I installed my solar system primarily because it was a new technology I was interested in’</td>
<td>.106</td>
<td>.032</td>
<td>.188</td>
<td>.001*</td>
</tr>
<tr>
<td>Support for financial incentives (scale from 3.1)</td>
<td>-.068</td>
<td>.051</td>
<td>-.073</td>
<td>.187</td>
</tr>
<tr>
<td>‘The time it took to pay off my system was more important than whether I received a rebate’</td>
<td>.081</td>
<td>.030</td>
<td>.148</td>
<td>.008*</td>
</tr>
</tbody>
</table>

R² = 0.16, p<0.001, N=286, * = statistically significant findings

The subscale included statements regarding: whether respondents were satisfied with the financial benefits of their system; whether it worked according to their expectations; whether they recommended to others that they install a system and whether they would install a system in future. Based on this research, continued adoption of solar systems in Western Australia appears likely, with the vast majority of survey respondents (88%,
n=338, scaled item) and all 26 interview participants indicating satisfaction with their solar system, in contrast to Rogers’ (2003) third conclusion on the effects of incentives on the adoption process. However, it should be noted that respondents’ perspectives on the financial benefits associated with installing a system would be influenced by the incentives they received. In particular, access to the premium net feed-in tariff scheme has the potential to create unrealistic expectations of the financial benefits of a solar system in the absence of financial incentives. This is supported in that the model indicates that those who had access to the premium net feed-in tariff had higher satisfaction scores than those who did not (Table 5.2). In fact, access to the premium net feed-in tariff had the largest influence (standardised coefficient beta) on satisfaction ratings in the model.

The quality of the decision-making was considered to be a reflection of respondents’ efforts to educate themselves on the costs and benefits of solar, and the extent to which respondents’ believed that education on the costs and benefits of solar were required. Only 40% of respondents indicated that their primary source of information was the result of ‘a lot of research into solar systems to make sure it was the best decision for [them]’ (n=337). The model suggested that the propensity for solar adopters to undertake their own research, and therefore undertake quality decision-making, was associated with higher dependent variable (satisfaction with solar system and likelihood of readoption) scores (Table 5.2). It is worth noting that undertaking research is not necessarily required to promote quality decision-making where the costs and benefits of a technology are well understood by the general population. However, this research identified that the vast majority of respondents demonstrated low confidence in their understanding of solar, with 85% believing that ‘educational assistance is needed to help people understand the real costs and benefits of solar’ (n=335). A low level of understanding of the incentives themselves was also demonstrated in the research. While the vast majority of respondents (95%) stated that they received a financial subsidy (n=338), only 35% of respondents installing their system between 2010 and 2012 stated that they received renewable certificates, even though all householders would have had the opportunity to access this incentive (n=256). This indicates that consumers may not be fully aware of the incentives they receive, and the discount on system prices these subsidies afford. This is certainly influenced by interactions with solar retailers who did not make information on these financial incentives explicitly available, and who were also deemed to be providing misleading information to potential customers (Simpson and Clifton, 2015). This was
reflected in the qualitative research, with 18 respondents highlighting a lack of understanding or need for education relating to solar systems, particularly in relation to financial incentives:

‘I mean, when we went into this solar stuff, we really didn’t know what we were getting into, besides that it makes power, so maybe if [the government] were to educate people and say the whole gamut, what the costs are, what the savings could be and that you could see it all laid out and have a good background on it, I think that there would be more people [installing solar].’

‘I mean [the subsidy] was really reasonably generous but exactly how it worked I’m not sure.’

Considering respondents were more educated than the general population in three of the six geographic regions surveyed the potential for the rest of the community to have a lack of understanding of both the costs and benefits of solar energy and the incentives they receive is high, particularly given Brounen et al. (2013) found a correlation between level of education and level of energy literacy. Furthermore, there is an increasing body of literature that suggests a low level of energy literacy in the general population, with Baskaran et al. (2013) finding that educated, high income earners did not have a good understanding of future energy requirements and Sovacool and Blyth (2015) finding that 63% of a Danish sample of householders did not know the per kWh price of their electricity tariffs. Consistent with these studies neither the level of education of respondents in this research, nor their income level, had an interaction with a belief that education is needed to understand the costs and benefits of solar (p=0.73, Kruskal-Wallis $X^2[4, n=332]=2.0$ and $p=0.72$, Kruskal-Wallis $X^2[4, n=317]=2.1$ respectively) or with the dependent variable in the model (Table 5.2).

Finally, motivations for people installing their system (including to access financial incentives) and interaction with system satisfaction and likelihood of readoption rates was considered. The multiple linear regression model identified that respondents who installed their system for environmental reasons or because solar was a technology they were interested in had higher satisfaction rates, indicating a relationship between motivation for installation and the likelihood of re-adopting solar (Table 5.2). Alternatively, there was no relationship between prioritisation of incentives in the decision-making process (scaled
item from 3.1) and satisfaction/re-adoption scores in the model (Table 5.2). A likely reason for this is that financial incentives made solar system installation possible for some survey respondents who would otherwise have been prevented from doing so for financial reasons. This group of respondents did not choose to install a system to take advantage of financial incentives; instead financial incentives provided the opportunity for this group of respondents to take advantage of residential solar energy systems. The academic literature has highlighted this group of solar consumers, with Rai and Sigrin (2013) suggesting that the availability of solar leasing options opened the prospect of solar adoption to ‘cash-strapped but information-aware segments of the market’ (p6). This is reflected in that of 62% of the survey respondents who had undertaken research to inform their decision-making process (and were therefore more likely to undertake quality decision-making) prioritised the availability of financial incentives in their decision-making process (n=133). These findings can be contrasted with responses to a single Likert-type statement that compared the importance of system payback period (‘the time it took to pay off my system’) with access to incentives (‘whether I received a rebate’). In this case, the findings supported Rogers’ (2003) third conclusion on the effects of incentives on the diffusion of an innovation, with the model finding that prioritisation of access to financial incentives above the payback period was correlated with lower system satisfaction/readoption scores (Table 5.2).

This section indicates some support for the application of Rogers’ (2003) third conclusion on the effects of incentives on solar system adoption. While, in contrast with Rogers’ (2003) third conclusion, the vast majority of respondents were satisfied with their system and would install a system in future, the evidence suggests that: satisfaction was influenced by ongoing access to the premium net feed-in tariff; a minority of respondents undertook quality decision-making by doing their own research (which influenced satisfaction scores); and, those respondents who prioritised access to financial incentives above the payback period of their system had reduced satisfaction/readoption levels.

5.6 CONCLUSION

This research considered the extent to which Rogers’ (2003) purported ‘effects of incentives’ proved to be consistent with the adoption of residential solar systems in Western Australia. To some degree all three of the conclusions drawn by Rogers (2003)
proved accurate in this case, with incentives increasing the rate of adoption of solar systems, the majority of survey respondents displaying characteristics different to those of early adopters in the academic literature, and a multiple regression model showing that prioritisation of access to incentives was associated with lower satisfaction and likelihood of future adoption scores. Further, and in agreement with Rogers (2003), financial incentives were found to have the dual benefit of acting as both a means to increasing the affordability of systems to research participants and also as a ‘cue-to-action’ to people considering installing solar, because subsidies are time-limited in nature. Where other research has found that financial incentives have not always been helpful in promoting solar (Jager, 2006), the generous nature of subsidies, alongside peer-to-peer interactions informing householders of the benefits of solar, are believed to have contributed to the high level of adoption in Western Australia.

The provision of incentives appears to coincide with the survey respondents displaying ‘early majority’ adopter characteristics, in particular with respondents primarily choosing to install their system for financial reasons. This is evidence that the incentives provided were effective in bridging the ‘chasms’ between the early adopters and the early majority adopters, as identified by Moore (2014). The majority of research participants were found to be satisfied with their solar system; however a majority of respondents also believed that education was required to help adopters understand the costs and benefits of solar. The research also identified associations between lower levels of satisfaction and likelihood of re-adoption and adopters not having undertaken their own research, not having accessed the premium net feed-in tariff and prioritising access to rebates above the payback period of systems. A reduction in the availability of incentives, alongside a lack of informed understanding on the costs and benefits of solar, could therefore result in peer-to-peer engagements that do not promote the continued adoption of solar. In this way, the authors believe that public perceptions of solar could enter something similar to the ‘trough of disillusionment’ found in ‘Gartner’s hype curve’ (Linden and Fenn, 2003). While the high levels of satisfaction in the case of solar, and its general acceptance in society represented by high adoption rates, indicate this is unlikely to be the case this research does emphasise that incentives promoting the adoption of an innovation should be accompanied by information to ensure adopters undertake high quality decision-making.
One outcome of the application of incentives to promote solar systems is the potential for the availability of generous incentives to 'crowd out' the financial benefits of solar systems in the absence of solar subsidies. This appears to be the case in Western Australia given the current rate of solar adoption is below that experienced during the incentive-intensive period even though the cost per kW of systems is equivalent to this period. In this case, the lack of education around the financial benefits of solar combined with the removal of incentives could coincide to signal reduced benefit in installing a system, which could explain the stagnant adoption rate post the incentive-intensive period. A parallel study on solar adopter experiences in Australia found that the continuation of solar adoption could be encouraged with increased transparency and consistency in government policy and network tariff arrangements, effective and transparent regulation of the solar industry (including solar systems and installers), in addition to independent, reliable and accessible information on the costs and benefits of solar (Simpson and Clifton, 2015).

This research makes a valuable contribution to the literature around the subsidisation of solar and equity outcomes. Literature has sometimes focused on the negative outcomes of the provision of solar subsidies, with criticisms highlighting that the recipients of solar incentives are from higher socioeconomic groups (Macintosh and Wilkinson, 2011, Coffman et al., 2016) and that the funds to pay for solar incentives are sourced from all electricity consumers, including those on a low income (Nelson et al., 2011). Together, this results in the poor funding solar systems for the wealthy. However, this research has identified an alternative scenario, where more disadvantaged communities appear to have benefitted from the availability of financial incentives to promote solar adoption. The financial benefits to those installing solar could see residential householders in lower income areas making relative gains in their financial performance compared to higher socioeconomic groups where solar has not been installed. A parallel piece of research considering respondents' preferences for support for solar or support for low income earners found that the majority of respondents supported the subsidisation of solar systems, with qualitative comments indicating respondents appeared to be concerned with the trustworthiness and reliability of government policy as opposed to cross-subsidisation (Simpson and Clifton, 2016). Together, these findings indicate that the subsidisation of solar may have some benefits to lower income earners and may not be the subject of public opposition. To further improve the equity outcomes of subsidisation policies incentives could be means tested and directed towards lower income groups, could be limited to prevent the overly generous outcomes.
experienced in Western Australia or the funds used to pay for incentives could be generated through a mechanism that will not result in a regressive form of taxation.

5.7 REFERENCES


QSR INTERNATIONAL PTY LTD 2015. NVivo qualitative data analysis Software. 11 ed.


Chapter Six: Prologue

Chapter Five found that financial incentives promoted the adoption of residential solar electricity systems by decreasing the capital investment required by householders, but also by acting as a ‘cue-to-action’ to promote adoption decision-making. Householders adopting solar during the incentive-intensive period exhibited different characteristics to the early adopters, in particular that the vast majority of installers, at 82%, installed their system in order to access financial benefits, as opposed to installing for technical or environmental reasons. The previous Chapter also found that there was a relationship between people installing their systems primarily to access financial incentives, receiving information from friends and family, and having reduced levels of satisfaction with their system installation. Together, these suggest that the adoption of residential solar energy systems reflects Rogers’ statements on the effects of incentives on the adoption process. Incentives promoted adoption, particularly by a group of individuals different from those who would otherwise have adopted, with an increasing proportion making decisions based on the availability of incentives and without seeking access to reliable forms of information when undertaking decision-making. The results of this research suggest that incentives were effective in promoting market adoption of solar systems, in the form of an increase in community members willing to invest in solar energy, but also indicated elements of community acceptance of renewable energy, with evidence of peer-to-peer interactions. Chapter Five, further identified that one regional community experienced higher rates of peer-to-peer interactions and also reduced-cost systems, which is the focus of the next chapter.

The next Chapter uses a case study comparison to consider the lived-experiences of this adoption process, assessed through the lens of Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy’. The research compares the experiences of adopters in the regional community of Carnarvon with adoption experiences in the demographically similar regional community of Narrogin (refer to Chapter Two for more details). Residential householders in Carnarvon can take advantage of higher financial incentives; however their adoption process may also be influenced by the presence of a ‘solar champion’ who has initiated a ‘solar community organisation’ called the ‘Fruitloops’. Alternatively, Narrogin has no overt community support for solar. In addition to using a social acceptance of renewable energy lens, this research also uses the growing literature around Community Renewable
Energy as a starting point to consider the extent to which Carnarvon’s community attributes have contributed to the success of residential solar energy in the region. The research uses semi-structured interviews to examine the perceptions of community members, renewable energy advocates in regional communities, members of industry, local government members, Members of Parliament and public servants to examine adoption processes in these regional communities.

The research primarily focuses on consideration of the community dimension of Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy innovation’ in that it seeks to draw out further conclusions on the role of peer-to-peer interactions in the promotion of renewable energy, as identified in the case of Carnarvon in Chapter Five. However, the research also includes consideration of the role that financial incentives played in the adoption of residential solar energy in these regional communities and therefore crosses to the market dimension. Trust in intermediaries (solar suppliers and installers) was considered in the Results and Discussion sections of this Chapter.


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Simpson, G, Community organisations, champions or incentive policies? Case studies on the adoption of residential solar energy in regional Western Australia
COMMUNITY ORGANISATIONS, CHAMPIONS AND INCENTIVE POLICIES: CASE STUDIES ON THE SOCIAL ACCEPTANCE OF RESIDENTIAL SOLAR ENERGY IN REGIONAL WESTERN AUSTRALIA

ABSTRACT

Research into renewable energy adoption is increasingly identifying that the successful implementation of renewable energy projects is influenced by a combination of market, community and socio-political acceptance of renewable energy technology. This research uses case studies of two regional Australian communities to examine the social acceptance of residential solar energy, in particular under the influence of financial incentives and social interactions. Communities were chosen based on their diverging experiences with residential solar energy adoption. 56 semi-structured interviews with members of the local community, industry and government were undertaken between May and October 2015. Respondents were asked about their perceptions and knowledge of solar energy and incentives to support its adoption, and their interactions with other actors important in the diffusion process. Responses indicated that financial incentives motivated the adoption of residential solar energy, however social interactions in the communities also contributed to decision-making. In one case study, a local 'solar champion' built a private solar farm to demonstrate the technical feasibility of solar before establishing an informal solar community organisation to help community members maximise the financial benefits of their solar installations. The other case study community, by contrast, had no such champion or local organisation and residents had experienced substandard installations leading to issues of trust in the solar industry. To support community renewable energy projects governments should be aware of the capacity of the local industry, the availability of local champions to support renewable energy and the potential for unequal access to government incentives.
6.1 INTRODUCTION

Approximately 33% of Australia's greenhouse gas emissions come from the electricity sector (Australian Government, 2016), with coal generation providing 61% of Australia's electricity needs (Australian Government, 2015b). In order for Australia to meet its international commitment of a 26-28% reduction in emissions from 2005 levels by 2030 (Australian Government, 2015a) Australia will need to reduce emissions associated with electricity use. While increasing energy efficiency has a role to play in reducing demand for electricity, the use of renewable energy to reduce the carbon intensity of electricity has been prioritised in Australian policy. Australia's longest-running policy for promoting renewable energy investment, the Renewable Energy Target, provides funding for small-scale systems (less than 100kW) and utility-scale renewable energy (Clean Energy Regulator, 2016b). No Australian governments have specifically sought to promote the development of community renewable energy (CRE) projects (Hicks and Ison, 2011). However, during the most recent federal election major parties proposed policies for the support of CRE initiatives (Australian Labor Party, 2016, Australian Greens, 2016).

CRE projects might be considered worthy of federal government support considering the contribution they can make towards renewable energy objectives and the myriad potential benefits that can accrue to regional communities from CRE projects. CRE projects have the potential to improve the structural cohesion of communities, developing trust in social networks while providing an opportunity for members to work together for a common purpose (Hoffman and High-Pippert, 2010). There are also economic benefits via the generation of employment for the local community (Walker et al., 2007), and potential financial returns on investment or reduced energy costs for those participating in a project (Dóci and Vasileiadou, 2015). Where community members are investing in the CRE technology itself, having a number of local participants can reduce costs by developing economies of scale or spread the risk in adopting an experimental technology (Dóci and Vasileiadou, 2015). Improvements in the supply of energy resources, including more reliable electricity or better quality heating or cooling, are additional potential benefits (Hoffman and High-Pippert, 2010). The communities also benefit environmentally from reduced carbon dioxide emissions and other harmful side-effects of traditional energy sources (Krupa et al., 2015). Participation in CRE projects may also develop the energy
literacy capacities of community members so they can undertake more effective decision-making regarding their own energy use (Devine-Wright, 2007).

The definition of CRE projects is contested within the literature (Allen et al., 2012, Nolden, 2013, Hufen and Koppenjan, 2015, Rogers et al., 2008, Becker and Kunze, 2014, Walker et al., 2010), with Hoffman and High-Pippert (2010) providing a range of interpretations, from residential-scale adoption of micro-generation systems, to groups of landowners receiving financial benefits from utility-scale systems, to community-driven urban networks of energy provision. Coinciding with the range of definitions of CRE projects, the definition of ‘community’ itself has varied in the description of these projects, from an existing culturally and geographically distinct group of engaged citizens, to the other extreme where developers will consult with local stakeholders in order promote a proposal as ‘community-oriented’ and increase its regional acceptance (Ruggiero et al., 2014, Bauwens, 2016). Walker and Devine-Wright (2008) proposed a widely-adopted model for assessing the extent to which a CRE project is representative of the community it is situated in. In this model CRE projects can be rated on the governance of projects being deemed ‘open and participatory’, in which local people are involved with planning, establishing and running CRE projects, and also whether outcomes are deemed to be ‘local and collective’, with benefits from the project accruing to the local community.

While these community organisations include a number of local members, the literature reiterates the integral role of leaders to promote CRE projects. Rogers’ (2003) seminal book on the diffusion of innovations highlights that the first to adopt technologies are referred to as ‘innovators’, however it is those with ties to social networks who have the greatest potential to communicate the benefits of a technology and ‘spread’ it. Rogers (2003) refers to these individuals as ‘opinion leaders’, however the CRE literature variously refers to them as ‘local level actors’ (Nygren et al., 2015), ‘front runners’ (Hufen and Koppenjan, 2015), ‘CRE champions’ (Allen et al., 2012) and ‘local champions’ (Ruggiero et al., 2014). The literature identifies that in order to be successful local champions must be trusted by the community and have a history of commitment to community interests (Noll et al., 2014). They must also be available to volunteer time and other resources (Ruggiero et al., 2014). A useful method for describing their input can be based on Sorensen and Epps (1996) who suggested that local champions can be ‘legitimisers’ and/or ‘effectors’. ‘Legitimisers’ are generally prominent individuals within the community who have the networks to influence
public opinion. Alternatively, ‘effectors’ are the professionals or technicians who have the capacity to facilitate change.

Where communities have lacked the capacity or funding to develop large-scale renewable energy projects, a proliferation of community-based organisations supporting the adoption of residential solar photovoltaic energy systems has emerged. Noll et al. (2014) describe these as solar community organisations, with two objectives. Firstly, these organisations provide advice and information on the benefits of residential solar energy. Secondly, these organisations act to promote the adoption of solar in their region, including through campaigning. Graziano and Gillingham (2015) provide quantitative evidence on the contribution these organisations can make to regional adoption profiles, with higher density of systems found in regions with a grassroots solar program. In particular, the ample financial incentives available to support the installation of residential-scale solar systems have the potential to be usefully harnessed by solar community organisations to promote increased penetration of residential solar systems.

In spite of government support for residential-scale solar systems and CRE projects, alongside local enthusiasm for CRE benefits, CRE projects face similar challenges to those experienced by all renewable energy ventures. Wüstenhagen et al. (2007) conceptualise these challenges under the banner of ‘social acceptance of renewable energy’, separated into three overlapping dimensions. Firstly, renewable energy projects require market acceptance, where consumers and investors generate demand for renewable energy resources. This relates to both electricity consumers having an awareness of the availability of renewable-based electricity supplies and being amenable to pay for it, and investors both perceiving sufficient demand for renewable-based electricity and having sufficient trust in renewable technology to support its adoption. Furthermore, intra-firm market acceptance, where incumbent energy market players transition from providing/accepting fossil fuel-based generation to renewable-based generation, is vital. A barrier to market acceptance of renewable energy is a lack of information on the technical and financial realities of renewable energy investment. In particular, CRE projects are reliant on technical knowledge for the deployment of projects, with some CRE project participants claiming they found it difficult to access reliable and unbiased advice (Allen et al., 2012, Park, 2012, Leaney et al., 2001, Adams and Bell, 2015, Rogers et al., 2008, Ruggiero et al., 2014).
The second dimension of social acceptance of renewable energy is community acceptance, and refers to the extent to which community members will support or oppose renewable energy projects. The literature largely frames this support or opposition in terms of procedural or distributional justice (Simpson and Clifton, 2016, Ottinger et al., 2014, Cowell et al., 2011, Gross, 2007). Procedural justice relates to the extent to which community members believe they have been appropriately engaged in decision-making around the development of projects; whilst distributional justice relates to the extent to which the ‘goods’ and ‘bads’ of renewable energy projects are distributed between community members. CRE projects are generally expected to achieve higher levels of community acceptance than conventional large-scale renewable energy projects given the inclusive nature of their development; however this is dependent on the extent to which the project is truly representative of the local community. Furthermore, community opposition to larger-scale projects has been linked to unequal access to the financial benefits of renewable energy, particularly where those adjacent to a project site have not had the means to invest in, and therefore benefit from, CRE projects (Adams and Bell, 2015). Lastly, community acceptance includes trust in renewable energy, not only in terms of its technical capacity, but in terms of the ways in which renewable energy projects can benefit the environment and society.

Finally, socio-political acceptance relates to the policies, regulations and institutions that not only support renewable energy but provide a foundation for its integration with existing energy frameworks. For example, limitations in socio-political acceptance have been identified in CRE projects where success has been stymied as a result of renewable energy policy instability (Allen et al., 2012, Adams and Bell, 2015, Ruggiero et al., 2014). Alternatively, incentive schemes, including loans, have been identified as important in helping CRE projects overcome financial barriers (Dóci and Vasileiadou, 2015, Klein and Coffey, 2016, Park, 2012). Additionally, socio-political acceptance includes the general public developing a level of awareness of the potential benefits of renewable energy technologies in order to support political initiatives for its promotion. Wüstenhagen et al. (2007) indicate that the socio-political dimension may be the most important in promoting the social acceptance of renewable energy given it is the development of policies that will create 'the institutionalisation of frameworks that effectively foster and enhance market and community acceptance' (p.2685).
Further to the difficulties faced by all CRE projects, regional communities experience additional challenges. Rogers' (2003) diffusion of innovations theory suggests that innovators key to the adoption of new technologies have higher levels of 'cosmopoliteness' than the general population, exhibited through varied communication networks. The potential for community members in regional areas to exhibit 'cosmopoliteness' is restricted considering access to varied communication networks is limited. Related to this, geographic remoteness in regional communities also inhibits access to technical experts to assist with the planning of renewable energy projects, and has the potential to limit competition between technology providers.

6.1.1 SMALL-SCALE RENEWABLE ENERGY AND WESTERN AUSTRALIA

Financial incentives for the installation of small-scale solar energy systems differ depending on whether applicants are connected to a major network, a regional network or are off-grid. In Western Australia, households accessing diesel generation through the regional network operator, Horizon Power, first had access to the federal Remote Renewable Power Generation Program, or RRPGP (Government of Western Australia, 2009). Until the scheme’s closure in 2007, 55% of the capital cost of a renewable energy system could be reimbursed, up to AU$550,000 (Government of Western Australia, 2004). During the same time period, customers in the metropolitan region could access funds of approximately AU$8,000 through the federal government’s Photovoltaic Rebate Program, later called the Solar Homes and Communities Grant (Macintosh and Wilkinson, 2010). On conclusion of these schemes, all Western Australian households could receive similar incentives via federally-based Small-scale Technology Certificates (STCs), under the Renewable Energy Target (Climate Change Authority, 2012). Certificates are sold through an open market therefore the value of the incentive varies over time.

Horizon Power customers received additional financial incentives above customers connected to the metropolitan Western Power network. While all householders installing a system prior to July 2011 could access the state government’s premium net feed-in tariff of AU40 cents per kWh, customers also received an additional cost-of-generation payment called the Renewable Energy Buyback Scheme (Government of Western Australia, 2016). Given the high cost of electricity supply on regional networks Horizon Power pays a higher Buyback rate than Western Power, with Horizon Power’s rate set at between one and seven times the value of Western Power’s (Horizon Power, 2016). Furthermore, systems on the
Horizon Power network were initially allowed to have a capacity of up to 30kW, compared with a maximum of 5kW on Western Power’s network (Collier, 2010), meaning greater revenue-raising potential in regional areas.

Financial incentives alone should therefore favour higher uptake of small-scale solar systems in regional areas compared with metropolitan areas. However, comparisons in the literature have shown that the rate of adoption of residential solar energy is not solely reliant on policy settings, levels of solar irradiation (Noll et al., 2014) or patterns of income (Graziano and Gillingham, 2015). Instead adoption levels appear to vary depending on a mix of these factors, combined with the influence of social characteristics, including local champions and the potential influence of solar community organisations.

Australian community members have responded positively to opportunities to install solar, with over 1.5 million small-scale solar generation units now installed across Australia (Clean Energy Regulator, 2016a) and the highest rate of household solar energy installations in the world at 16.5% of households (Bruce and MacGill, 2016). And while the number of successful utility-scale CRE schemes in Australia is small but growing (Hicks and Ison, 2011), it appears that some communities may be using social networks, alongside financial incentives, to promote investment in residential solar energy systems.

6.1.2 OBJECTIVES

This case study analysis is part of a larger project examining the social acceptance of renewable energy in Western Australia, with a focus on developing government policy to overcome barriers in the adoption of renewable energy. The research sought to examine: the ways in which an informal solar community organisation can influence the social acceptance of renewable energy, specifically small-scale solar energy; identify challenges to social acceptance in the presence of an informal solar community organisation; and the ways in which adoption of residential solar energy unfolds in a comparable regional community without a solar community organisation. While the academic literature considers the roles of peer-to-peer interactions (Palm, 2016, Bauwens, 2016) and the influence of solar community organisations (Noll et al., 2014, Graziano and Gillingham, 2015) on adoption profiles, they do not consider the extent to which regional communities in particular may be exposed to potential costs and benefits associated with solar community organisations and barriers to the social acceptance of renewable energy.
Additionally, this is the first paper to take a multi-dimensional social acceptance of renewable energy approach to considering solar community organisations in regional areas.

The results section of this paper highlights the key processes, interactions and experiences involved in the adoption of small-scale solar energy in two regional communities. The discussion section considers these two case studies as examples of the adoption of residential solar energy systems and its implications for the social acceptance of renewable energy in regional areas. The findings suggest that solar community organisations are effective in promoting market acceptance of renewable energy given they have contributed to increased adoption of residential solar energy. Alternatively there appears to be a high reliance on solar champions for the success of solar community organisations. Additionally, the findings highlight issues with community acceptance of renewable energy, with unequal access to solar energy adoption, grid connection and therefore the financial benefits of solar energy. Finally, in spite of the generous financial incentives available through federal, state and even local governments, adoption was hampered by issues in the socio-political dimension, including regulations for installers and limited access to the network. The conclusion section briefly summarises the research findings and uses these findings to suggest government policy interventions to increase the likelihood of positive outcomes for solar community organisations, and CRE projects more generally.

6.1.3 Background to case study areas

Two regional communities were selected based on their experiences with small-scale solar energy systems and their community profiles. The first community, Carnarvon, was chosen given it has a highly publicised solar community organisation and a reputation as a self-started ‘solar town’. Carnarvon had one of the first privately-owned solar farms in Western Australia (Carpenter, 2005), and has seen a further large-scale installation (Energy Made Clean, 2016) and a large number of small-scale systems connected to the grid (Mercer, 2011). This was in large part due to an active ‘solar champion’ who built the privately-owned solar farm and was featured in media descriptions of Carnarvon as a solar adoption hotspot (Sustainable Energy Association, 2012, Pownall, 2011, Martin, 2012, ABC 7:30, 2012). The town of Narrogin was selected as an alternative community, based on its similar population size, number of free-standing dwellings, median household wage and proportion of rental accommodation (Australian Bureau of Statistics, 2013a). Prior to undertaking this research there were no ‘renewable energy champions' identified in Narrogin. The rate of
adoption of residential solar systems differed markedly between the two regional communities (Figure 6.1).

![Cumulative installation of small-scale solar systems](image)

Figure 6.1: Cumulative installation of small-scale solar systems (less than 100kW) in the postcode regions of Carnarvon and Narrogin (Clean Energy Regulator, 2016a)

Carnarvon is a small coastal community approximately 900 km north of Perth, the capital of Western Australia, which had a population of 5,350 at the 2011 census (Australian Bureau of Statistics, 2013b). The largest sources of employment in Carnarvon are agriculture, forestry and fishing (Government of Western Australia, 2015) and employment in a local salt mine. Carnarvon is powered by a regional electricity grid operated by Horizon Power, with approximately 200 km of lines but only an average summer load of 6,800 kW (APVA/CEEM, 2012). The total rated capacity of all small-scale systems in Carnarvon is 1,025 kW, which means that these systems have the potential to contribute up to 15% of the generation required to meet the average summer peak load. Carnarvon’s solar experience began with the opening of the Solex Project in 2005 (Carpenter, 2005). The high cost of solar systems limited adoption in 2005; however, with the increase in subsidies and
reduction in capital cost of systems over time, Carnarvon experienced a rapid and early rate of solar adoption (APVA/CEEM, 2012).

Narrogin, situated 200 km south-east of Perth, had a population of 4,730 at the 2011 census (Australian Bureau of Statistics, 2013c). Narrogin is an agricultural community in the Wheatbelt region of Western Australia with employment in regional service industries such as retail, healthcare and training (Government of Western Australia, 2014). Narrogin houses a large transformer station and associated depot for Western Australia’s largest electricity network, the South-West Interconnected System, operated by Western Power. The installation of the majority of Narrogin’s solar systems occurred since 2010, with a total small-scale installed capacity of 1,200kW across 339 solar systems (Clean Energy Regulator, 2016a). The local government chose to install solar on government buildings (Infinite Energy, 2013), but no larger-scale solar facility exists.

6.2 METHODS

Semi-structured interviews with stakeholders of interest to each of the three dimensions of social acceptance were undertaken to analyse the social acceptance of small-scale renewable energy in regional communities. In order to gain an understanding of issues around the market acceptance of residential solar energy in these regional communities sixteen representatives from the electricity and solar energy industry were interviewed. Representatives could provide feedback on the ways in which demand for small-scale solar was unfolding in the region and the ways in which solar systems were supplied. Additionally, they could provide feedback on the effectiveness of socio-political strategies for small-scale solar adoption and associated barriers. Representatives were purposively selected based on their role in the local energy sector, their presence in media articles and searches of solar energy suppliers/electricians in the regional communities. The ‘solar champion’ in Carnarvon was approached for an interview, alongside two renewable energy champions in Narrogin identified during interviews with government representatives. The local electricians installing solar systems in each community were also interviewed. Two further installers of solar systems in a neighbouring regional town were interviewed after being identified by community members in Narrogin. A state-based supplier of solar systems involved with providing solar systems in both Carnarvon and Narrogin was also interviewed. A large-scale solar supplier was also engaged in Carnarvon. Each community
was serviced by a different network operator, each with local and state-based offices. A representative from the local network operator office in Carnarvon, Horizon Power, was interviewed, however the state-level office did not respond to a request for an interview. Two representatives from each of the local and state-level offices of the Narrogin network operator, Western Power, were interviewed. Two former CEOs of Western Australia’s renewable energy advocacy agency also participated in the research.

Community members were interviewed to gain an understanding of community acceptance of renewable energy in the two regional communities. In the case of small-scale renewable energy community members are not only relevant in terms of understanding the perceptions of procedural and distributional justice associated with solar, but are also relevant in terms of understanding the drivers for investment in the solar energy market. Community members to be interviewed were accessed after completing one of two mail-out surveys, for two other research papers (Simpson and Clifton, 2015, Simpson and Clifton, 2016). In order to understand motivations for adoption (market acceptance) and experiences with adoption, householders with residential solar systems installed were surveyed. Additionally, in order to gain an understanding of general perceptions of justice around the adoption of residential solar energy, a random selection of householders (with or without a system) were surveyed. At the opening of each survey respondents were asked to self-identify if they would be interested in being interviewed for further research. Surveys were sent between August and December 2013. All respondents who self-selected for further research were approached (42 from both surveys), with a total of 23 interviews performed across the two regions (55% response rate). Interviews included eight Carnarvon households who had installed their own system and four who had not. Similarly eight Narrogin households had installed their own system, while three had not. Four of these interviews were conducted with couples; however the two people within each couple had similar responses to interview questions, so each of these interviews was treated as a single response.

In order to gain an understanding of the socio-political aspects of renewable energy adoption in Carnarvon and Narrogin seventeen representatives from three levels of government were interviewed during the research. These representatives could provide information on government support for renewable energy, and issues experienced while delivering policies aimed at increasing the penetration of small-scale renewable energy in
Western Australia. Representatives interviewed included six public servants responsible for administering financial incentives, a representative from the regional-level Development Commission in Carnarvon and a representative from the Shire in Narrogin, along with two representatives from each of the town councils. A representative from the state-level consumer protection agency was also interviewed. Four Members of Parliament also participated in the research, with two chosen based on their association with these regional communities and the other two based on their interest in renewable energy. The Minister for Energy's office was also approached, but did not accept an interview.

The research process followed that of Allen et al. (2012), who examined local drivers, enablers, barriers and solutions to CRE projects in the Lake District National Park, UK. Consistent with the methodology used in Allen et al. (2012), key themes were identified in a background study and literature review prior to undertaking interviews ‘from a disparate group of individuals, ensuring that most, if not all, areas of consensus and contention were explored’ (p.9). Furthermore, consistent with this research approach: all interview respondents were asked the same questions so similarities and/or gaps between respondent types could be identified; questions were open-ended to allow respondents to elaborate on themes of interest; and follow-up questions were provided where responses required clarification. Respondents were asked about their personal opinions of residential solar energy, their own experiences with solar energy, their understanding of incentives available for, and connection processes relevant to, the installation of systems and any challenges associated with their implementation. Finally, respondents were asked about their interactions with members of community, industry and government regarding renewable energy. Responses to the set of questions relating to interactions with stakeholders were used to develop a ‘communication map’ for each regional area (Figures 6.2 and 6.4) to determine the extent to which those promoting renewable energy were able to act as ‘cosmopolites’ spreading ideas and information across community networks.

This research complied with The University of Western Australia ethics approval processes. Respondents were notified that all information gathered would be recorded, transcribed and analysed in such a way that maintained their anonymity, however some individuals may be identifiable given the small population size of the communities and particular characteristics of interview subjects. The vast majority of interviews took place face-to-face (53), with the remainder being phone interviews. Interviews lasted between 15 minutes
and 3 hours. All interview subjects agreed to have their interview recorded and transcribed, with the exception of the Horizon Power representative. Interviews took place between May and October of 2015, with a sole researcher conducting all interviews. NVivo Version 11 (QSR International Pty Ltd, 2015) was used to code survey responses according to the previously identified research themes (market, community and socio-political dimensions) with an iterative process for defining sub-categories of themes.

There were some limitations in the methodology. In particular, the time difference between when the surveys were returned and when field work was undertaken meant that householders installing systems after 2013 were not included in this research. Furthermore, the interviews had taken place well after householders had adopted systems and those in government had implemented policy, meaning a recall bias may be present (Yin, 2011). In all cases representatives were responding to the interviewer’s questions based on their own experiences, with their comments not necessarily reflecting the opinions or intentions of the agency they were representing, or the experiences of all representatives within that agency. In common with another study in Western Australia (Krupa et al., 2015), this research does not intend to develop generalisable conclusions so much as consider case studies with exploratory findings adding to existing theories in the literature.

6.3 RESULTS

The results section summarises the experiences of solar adoption in each community, considering the social and financial interactions that have contributed to the rate of adoption, and concluding with a summary of issues experienced by the communities regarding the installation of solar systems.

6.3.1 CARNARVON

The owner/operator of the Solex project was featured in mass media publications promoting not only the Solex project but community support for solar in Carnarvon (Sustainable Energy Association, 2012, ABC 7:30, 2012). Based on this media presence the owner/operator was identified by the researcher as Carnarvon’s solar champion. During his interview with the researcher the solar champion cited three primary objectives for promoting the adoption of solar systems: to test the connection of solar generation on a small regional grid, to reduce the costs of energy supply for community members and to
make Carnarvon the solar capital of regional Australia. The solar champion made use of connections with members of industry, local, state and federal government, network operators and members of the community to increase the adoption of small-scale solar energy in Carnarvon. Figure 6.2 demonstrates the extent to which the solar champion was a ‘cosmopolite’ embedded within a network of stakeholders that allowed him to progress his ‘solar town’ objectives.

![Communication network between state and Carnarvon-based solar stakeholders, government and community members. Interactions were identified during interviews with stakeholders. A solid line (no arrows) indicates that the interview respondents on both ends of the communication link identified interactions with the other stakeholder.](image)

The solar champion noted that he took advantage of links with media representatives developed while working in real estate to generate media interest in the opening of the Solex farm. Four community members and four government representatives (from the local and state level) indicated during interviews that information available in the media and the accessibility of the Solex site increased the awareness of solar energy in the community. In particular, the physical manifestation of the Solex farm was instrumental in forming perceptions of the potential of solar systems as a reliable form of electricity generation:
‘He built it. You could actually physically see what he had built, and he was able to physically show how it worked. It’s better than looking at paper. You can see it work. You can understand it.’

- Government representative

The solar champion had also invested significantly in his own system, which was seen as ‘putting his money where his mouth is’ and increased community members’ trust in the technology:

‘For [the solar champion] to put out a fairly large investment on something like that, it really piqued my interest.’

- Community member

The solar champion became known as the ‘go to’ person in Carnarvon regarding solar, with all but one of the community members (including those who had not installed systems) engaging in conversation with him about solar energy.

During the interview with the solar champion, it was noted that all installations he was involved with met compliance standards and regulations. He, alongside the local electrician, completed the Australian Clean Energy Council solar installation qualification and was therefore appropriately skilled to install solar systems. He also became a Fronius inverter service partner, enabling him to fix inverters within the town as opposed to having them sent back to the manufacturer. According to interviews with community members, Carnarvon benefitted not only technically from having a local Fronius inverter technician, but placed greater faith in the reliability of the systems given the salesman/installer was always easily located:

‘We stayed with [the solar champion] because if something went wrong we could whinge to him, because at least there would be someone to whinge to.’

- Community member
'Oh, we all knew where he lived so there would have been a picket line and torches if something went wrong!'

- Community member

While several community members suggested that the solar champion’s word wasn’t always reliable, his investment, demonstration and training in solar energy developed trust in the technology in the community.

Interviews with community members identified that access to financial incentives was critical both as motivation for installing solar systems, but also to make solar systems affordable. Community members initially accessed the generous RRPGP grants, with subsequent installers accessing STCs. The majority of people installing were residential consumers and therefore accessed the premium net feed-in tariff and the Horizon Power Buyback feed-in tariff. For those installing large systems (up to 30kW) this represented a significant financial windfall:

‘I mean basically we get free power plus three thousand dollars a year in round terms, which is absolutely wonderful.’

- Community member

The role of the solar champion in accessing these rebates should not be overlooked. According to community members he was valuable in being able to explain the schemes. Additionally, according to both community members and public sector workers, he engaged with the public sector operators to access funding on behalf of the community. He was also able to use his skills as an accountant to learn about the STC process, becoming an STC trader capable of maximising community members’ financial returns when selling certificates:
‘He kept letting us know what [the STC prices] were, they kept going up and down, you know what I mean. Some people got up to $30, and if you could sell them at the right time you could make a lot of money. Oh yeah, he was good like that. He had everything on his computer.’

- Community member

The solar champion also utilised contacts made during development of the Solex project to import solar panels and inverters to Carnarvon, selling them to community members at wholesale prices:

‘And we sold wholesale in there, and then their group of people did the install... The systems were very affordable. In terms of under a one year payback.’

- Solar industry member

By providing systems at wholesale costs, reducing installation costs and maximising financial returns he was able to provide a ‘better deal’ to those installing a system.

According to all stakeholder groups interviewed, as a part of the solar champion’s goal of making Carnarvon the ‘solar capital’ of regional Australia he sought to assist people with installing their own system under the proviso that the person installing a system then helped someone else install their system. Carnarvon householders’ involvement in the installation process led to an apparently high level of interaction with the technical aspects of solar systems, with three Carnarvon residents describing how they recorded the generation of electricity from their systems on a daily basis. Further benefits included that some vulnerable members of the community, including the elderly, had their systems installed by more able-bodied community members, thereby reducing their cost of installation whilst also ensuring equitable access to solar systems.

‘I mean, that’s like Joan, she couldn’t do it herself. So that’s why I put it up. And her son came over, he was here, I had to do all the frames and stuff like that, and he was here to take all the panels up.’

- Community member
Furthermore, the community members used local networks for the installation of systems, meaning the financial transactions associated with system installations remained within the Carnarvon community. This included the local electrician being hired to connect systems and the local refrigeration specialist providing cyclone-proof frames for panels:

‘I had to buy all my cyclone proof railings off [local refrigeration supplier] when I got that installed, because I did that myself, and the electrician has just connected the panels on.’

- Community member

The administrators of a regionally-specific incentive scheme, advocated for by the solar champion, saw this support of the local industry and community as a benefit of their incentive scheme. Interviews with Carnarvon community members, members of local and state government and members of the solar industry therefore identified that the solar champion made use of a number of skills/capacities to promote the adoption of solar energy in Carnarvon (Figure 6.3).
Figure 6.3: Interplay between the local solar champion’s capacities, partnerships, activities and outcomes. This representation of community elite characteristics, adapted from von Heland et al. (2014), indicates that beneficial ‘Outcomes’ for the community are a product of the elite individual’s personal ‘Capacity’ which can be used in ‘Partnership’ with other stakeholders to undertake ‘Activities’ with community benefits.

Some members of the community did not have faith in the benefits of solar energy, referring to those who installed systems as ‘Fruitloops’ – a derogatory term indicating that solar
installers were lacking in sound judgement (Simpson and Fullarton, 2016). In turn, the solar installers chose to adopt the term and it became a proxy for Carnarvon’s solar community organisation, with solar installers proud to call themselves 'Fruitloops':

'We were considered knit wits or Fruitloops. Eccentric really! But then the price of power started going up every six months or so and then people started saying 'bloody hell! I’ve got to get into this!' but then it was too late. But we still carry the name with pride.'

- Community member

This group did not have any formal charter, did not organise meetings and did have any stated objectives, instead they worked informally to help other community members install systems. Community members picked up and delivered solar components, built support structures for systems and installed systems on their own, or someone else’s, rooftops. According to data provided by the solar champion, the 'Fruitloops’ were a great success, with 87 of the 127 systems installed on the Carnarvon grid attributable to them.

Community members indicated during interviews that discussions about solar were taking place within large social circles, suggesting 'the people at the [salt] mine', 'the plantation owners' and 'all the people at work' discussed the financial benefits of solar energy. Furthermore, the rapid uptake of solar in Carnarvon was described in interviews as being the result of social cues, with respondents referring to the spread as ‘infectious’, ‘snowballing’ and indicating that ‘people were jumping on the bandwagon’.

While the Carnarvon model of residential solar adoption proved successful in promoting investment in local industry, a rapid rate of solar adoption and considerable cost savings for consumers, it was not without its disadvantages. The primary disadvantage was that the high capacity of solar as a proportion of the network load led to a decision by Horizon Power to place a moratorium on new solar systems connecting to the grid, starting in 2011 (Mercer, 2011), and with it an end to the dream of Carnarvon becoming regional solar capital of Australia. It was two years before the moratorium was lifted, and then only installations with costly generation management systems were allowed on to the network (Western Australian Parliamentary Debates, 2013).
The establishment of an informal solar community organisation as the primary vehicle for generating the installation of systems in Carnarvon resulted in those who were well embedded in the community network finding out about solar and installing it preferentially to those with looser ties to the community. While it was certainly never the solar champion’s intention to exclude community members from accessing solar, the ‘first come first served’ basis of allocation of a ‘spot’ on the network prioritised his social network. Furthermore, by maximising access to financial incentives, the solar champion encouraged the adoption of larger capacity systems. While this was important in terms of the objective of maximising the installed capacity of solar on the Carnarvon network it had issues for the ‘hosting capacity’ of the regional network, contributing to the moratorium on systems, which prevented other community members from having the opportunity to install their own systems. Several of the community members mentioned an awareness of people perceiving this inability to install systems as ‘unfair’:

‘I had a number of guys going ‘oh, we’ll see how it goes when it settles’ and sure enough when it settled Horizon Power just went ‘nup, no way’ and they shut the door and then everyone else is standing around pointing the finger and saying ‘you ruined it for all of us’.’

- Community member

‘I hear them going crook [getting upset] about how they’re not allowed to put [solar] on. It’s their own stupid fault. They should have jumped in when they had the chance. Some of them get real upset about it... they go ‘oh... you know... people have got too much’ but, well, the offer was there. And, OK, maybe they should have restricted it when the offer was first up, but they didn’t.’

- Community member

The solar champion noted during his interview that prior to the moratorium Carnarvon was experiencing a pause in solar installations as the town had run out of system components, there was a backlog of documentation and the installers were physically exhausted. The regulatory environment in Western Australia contributed to the solar champion’s excessive workload. During his interview the electrician noted that, while technically capable of installing systems and completing paperwork, he could not fulfil these requirements as he
had let his Clean Energy Council accreditation lapse. Maintaining the accreditation requires completion of ‘case studies’ and continuing education points, which proved to be difficult to maintain in regional areas where the number of installations is low and access to continuing education programs is limited.

6.3.2 Narrogin

During interviews with Narrogin stakeholders two individuals with interests in promoting solar were identified. The first was identified during interviews with local government representatives and the city-based installation firm that installed solar systems on government buildings. Subsequent to these interviews the individual was approached for an interview, during which he self-identified as a Clean Energy Advocate. According to interviews with this individual and local government members, this person lacked the technical skills to install solar but was able to influence local government through his connections as a former member of the town council. As a result of his introduction, the city-based firm was contracted to install systems on town council buildings. He subsequently developed an on-going relationship with the Perth-based solar installation company, which provides him with a small commission for systems installed in the region. The other individual with an interest in solar was approached for an interview given his position as a local electrician. During the interview he noted that he was technically qualified and experienced in solar installation but did not have a strong local presence as a solar installer and was not socially connected with local government members. This separation of capacities between the Clean Energy Advocate and the electrician resulted in both the local council and members of the community purchasing solar systems from Perth-based firms instead of the local electrician, causing money from within the local community to be diverted towards external solar firms. Two of the regionally-based solar industry players noted dissatisfaction with local governments choosing to support city-based firms, for example:

‘It hurts me to find out that the job has been lost to a city-based company when the income can stay in the community.’

- Regional solar installer
During interviews with community members only one householder in Narrogin mentioned the local Clean Energy Advocate and one other mentioned the solar installer. This was surprising given the Clean Energy Advocate had explained during his interview that he had attempted to promote solar in the region, including by hosting a community forum with his preferred city-based solar firm explaining the benefits of solar:

'We got about fifty people there, maybe a few more, but it was not as good as I expected. But the information that that group received has been disseminated in the community and now the uptake is increasing... Because [the city-based firm] were providing the technical information people would always go back to that point of information.'

- Clean Energy Advocate

Interviews did not reflect this outcome, although this may be a consequence of the small sample number and time lag between surveys and interviews. Interestingly, one of the Narrogin stakeholders was aware of the solar champion in Carnarvon, demonstrating his considerable impact in promoting solar energy in regional Western Australian communities. A full summary of interactions between stakeholders is available at Figure 6.4.
The lack of a clear local identity to promote solar apparently left Narrogin susceptible to ‘travelling salesmen’. The Narrogin electrician, solar installers in the nearby community of Bunbury and the city-based installer employed by the town council all expressed concern around the vulnerable nature of regional communities to these forms of ‘fly-by-night’ operators:

‘Narrogin is 100% [more vulnerable] to [low quality installers]. Without a doubt. Which is what drives me to go there and help because it just infuriates me. It just drives me mad... I know they've been ripped off. That's part of our problem not getting out to the market often. It's not [just] Narrogin, it's regional communities that are susceptible to it.’

- City-based installer
'It’s something I get quite protective about, the rural towns, because [solar installers] just treat us like we’re idiots. That we don’t know any better. They’re going to charge us $20,000 for a system that’s not worth $5,000, and they’ll hope that it never gets back to [people] in the city.'

- Solar installer in nearby community

The public sector workers, nearby installers and many householders were aware of stories of substandard installations in Narrogin, reporting experiences with systems that were substantially overpriced, faulty, poorly installed or experienced delays in system installation:

‘There was a flier that came out through the fax machine and when I saw it I thought ‘oh that sounds alright’ and it ended up being a hell of a hassle and I took them to court over the whole thing.’

- Community member

‘The installation was a disaster. [The solar company] sent this bunch of fly-by-night operators in and the wiring in the ceiling... the annoying thing was that I didn’t look at it myself, I didn’t go up into the ceiling until twelve months later and I saw bare wires up there and all kinds of nasty stuff.’

- Community member

This was reflected in that two householders had engaged the state consumer protection agency, with a formal complaint made against one of the out-of-town installation companies frequently mentioned by community members (Department of Commerce, 2014). Furthermore, even householders who had not installed systems perceived the large, city-based solar firms as untrustworthy. The local electrician noted that these issues were exacerbated by inadequate policing of the solar safety regulations, with network operators only looking at the contents of the meter box and solar systems from ground level:
'The local Western Power inspector comes out and do you know what they check? They're not allowed on the roof, and they check the labels, and that's it... He's literally told me that's all that Western Power inspects.'

- Local electrician

The Clean Energy Advocate acknowledged that negative experiences with solar electricity adoption in the town had damaged perceptions of solar, with an associated reduction in community confidence:

‘Some people have had bad experiences, and sometimes that's just because of a certain salesman, because everything is determined based on the deliverer of the information and the deliveree. You do get those problems. So I wouldn't say there aren’t issues.’

- Clean Energy Advocate

Narrogin community members also expressed a lack of understanding of where to turn when a system performed poorly, with one householder attracting the attention of a visiting installer’s car to ask questions, and another indicating she would ‘not know where to go’ if her system failed.

In the absence of visible community leaders and a solar community organisation, social engagement around solar energy was based on peer-to-peer interactions. Where householders in Narrogin discussed solar with other community members it was generally within small groups, for example one only spoke with a small group of friends who all installed solar together, another with direct work colleagues and three respondents only talked about solar with family members. Passive effects also contributed to increased awareness of solar in Narrogin, with householders mentioning that the visibility of systems themselves, or installers’ advertisement placards placed in the front yard of those installing a system, were useful in raising awareness about solar, and started discussions about solar systems:
'You would start to see solar panels appearing on people's house roofs and you'd think 'oh well, I wonder if that's any good'.

- Community member

Householders with solar systems in Narrogin cited financial benefits as the biggest motivation for installing systems, although many also reflected an interest in environmental benefits. The availability of financial incentives, in particular the premium net feed-in tariff that allowed electricity customers to accrue a credit on their utility bill, was important in decision-making. However, some householders did not appear to recognise the benefits of solar, including avoided energy costs, in the absence of incentives:

'Well if you didn't have the [premium feed-in tariff] it would be no gain to you. See because what it is now is, [the premium feed-in tariff] is paying off the winter time... Without the [premium feed-in tariff] it wouldn't be bloody worthwhile.'

- Community member

6.4 DISCUSSION

The results section highlighted the extent to which a solar community organisation, in the form of the Carnarvon 'Fruitloops', was capable of promoting the adoption of small-scale solar energy in a regional community. As a result of the work of the 'Fruitloops' community members: had an increased level of understanding of solar technology; generated improved social cohesion (demonstrated in that they were proud to consider themselves 'Fruitloops'); reduced diesel particulate and greenhouse gas emissions in the region; had financial benefits flowing back to community members in the form of reduced electricity costs; and contributed to the local economy. Alternatively, Narrogin did not experience the same suite of benefits associated with solar system adoption, even though system installation levels have now exceeded those in Carnarvon (Figure 6.1). These results provide evidence of the ways in which solar community organisations, local champions, peer-to-peer networks, incentive schemes; renewable energy industry players and the incumbent energy systems interact with, and influence, the social acceptance of renewable energy in regional communities. The discussion section draws on findings from the results and links these
with similar findings from the literature. However, this research differs from that available in the literature by demonstrating that regional case studies can be used to show that even residential solar energy system adoption takes place within a complex network of market, community and socio-political interactions.

6.4.1 Market dimension

There were multiple ways in which the 'Fruitloops' of Carnarvon were capable of increasing interest in solar investment and harnessing local capacities to promote market acceptance of solar energy, with benefits for the local community. Consistent with the findings by Palm (2016), the results suggest that, in spite of the promotion of innovations through mass media channels, the local context plays a vital role in influencing attitudes towards solar energy and adoption decision-making. However, an undue reliance on 'champions' has the potential to create barriers for continued adoption and investment.

*Solar community organisation facilitated innovation-decision process*

The Carnarvon example provided a useful model of adoption that led to an acceptance of solar in line with Rogers' (2003) theory on the innovation-decision process. The solar champion developed community members' knowledge of the technology by promoting solar technology in the local media. His private solar farm was available for community members to access, which led to the potential to persuade them of the validity of the technology. The 'Fruitloops' community organisation provided peer-to-peer engagement on the benefits of solar, which helped reinforce the decision to adopt. The 'Fruitloops' and the solar champion would then be available to assist with the installation of solar systems, and thereby implement the adoption. The solar champion was then available for discussion about systems and to address issues, resulting in positive confirmation of the technology. The success of this process was partly based on the opportunity for potential adopters to be able to engage with the technology in a meaningful way to kick-start the innovation-decision process, with Rogers (2003) emphasising the importance of the trialability and observability of innovations in the acceptance process.
Solar community organisation facilitated access to trusted solar installers

The existing literature on solar community organisations suggests that they are most effective in influencing the adoption of solar systems in local contexts where there is neither strong support for, nor opposition against, renewable energy (Noll et al., 2014, Palm, 2016). In this ‘middling context’ solar community organisations can persuade community members of the potential benefits of solar energy. However, in the case of this research, community members in both regional communities were aware of the financial benefits of solar adoption, with the greatest barrier to adoption instead being access to a trusted installer. The ‘Fruitloops’ of Carnarvon were instrumental in promoting adoption in local contexts favourable of solar adoption, whereas community members in Narrogin were not aware of the local electrician installing systems, had negative solar adoption experiences, and would not know who to talk to if their system failed. This demonstrates that a lack of access to market players has the potential to limit solar adoption in regional communities, even where there is interest in adoption. This provides evidence to support Wolsink’s (2013) theory that the prevailing focus on the ‘ABC’ of adoption (attitude, behaviour, choice) overlooks the influence of locally-relevant social practices, infrastructure and institutions on the market acceptance of renewable energy technologies.

Solar community organisation took advantage of local capacities

The success of the ‘Fruitloops’ in Carnarvon in part relied on their utilisation of existing capacities within the local community. In particular, community members installed systems on each other’s rooftops, the local electrician was initially used to connect systems to the electricity network, a local refrigeration specialist developed cyclone-proof framing and the solar champion used his accounting skills to navigate complex financial incentive policies. The use of these skills is evidence of what Fabrizio and Hawn (2013) identified as ‘complementary goods’ that assist with the effective diffusion of technologies. In the case of Carnarvon the capacity within the community, a form of complementary good, was such that systems could be installed without accessing an external solar industry representative. The use of these complementary goods not only reduced costs for those installing systems and promoted investment in local industry, but increased the visibility of solar technologies to community members in a range of industries and assisted with the harnessing of volunteer labour, facilitating market adoption of solar energy.
Reliance on champions for adoption

As a contrast to the benefits of promoting place-based renewable energy projects while using existing capacity, the heavy reliance on individuals in communities for market acceptance of renewable energy is a potential weakness in CRE projects. The results clearly highlight the pivotal role that the Carnarvon solar champion played in establishing the 'Fruitloops', assisting with the installation of systems and providing the 'vision' for Carnarvon as a self-started solar town. In addition to this, and of relevance to CRE projects to be developed in regional areas, the solar champion was an effective 'cosmopolite', engaging with various networks in both the local and wider community. The solar champion made connections with city-based solar wholesalers, engaged with the nationally-based Clean Energy Council, advocated for solar with state Members of Parliament and promoted the benefits of solar through various media channels. Furthermore, the solar champion in Carnarvon suffered from an over-abundance of skills and capacities, leading him to take on the majority of tasks associated with the 'Fruitloops', contributing to burn-out and a consequent pause on installations. It is worth considering the extent to which a CRE project will succeed in the absence of a champion. However, governments can make a valuable contribution towards supporting community groups by funding employees to manage the day-to-day activities of these groups. Examples of ways in which funded employees could help with the day-to-day activities include the facilitation of technical assistance when developing projects (Ruggiero et al., 2014) or development of a formalised governance structure that could reduce the burden on key individuals (Morris, 2013). In the case of Morris (2013) core actors had experience in energy or environment fields, but were supported by a group of individuals involved in the organisation of meetings, public events and political advocacy.

6.4.2 Community dimension

The results section highlighted the benefits of a solar community organisation to improving community acceptance of renewable energy, in particular through developing trust in solar technology. However, the moratorium on systems, and subsequent exclusion of community members from accessing solar generation, resulted in negative justice outcomes.
Maximising engagement with local networks and capacities has the potential to build trust in the CRE project itself, increasing community acceptance of renewable energy. The Carnarvon case study demonstrated elements of ‘thick trust’, where trust in a system is embedded in existing interpersonal relationships (Walker et al. (2010) referencing Williams (1988)). The solar champion was trusted considering his role in the community, his personal investment in solar energy, his availability to anyone needing assistance, his experience as a tax accountant and his position on the local council. Previous research has found that CRE projects that take advantage of existing social networks within a community are likely to benefit from ‘thick trust’ above those that employ outside stakeholders as primary agents of change. Park (2012) illustrated this, showing that external professionals are perceived as driving top-down agendas within communities, creating the impression of a lack of control over their own circumstances. This was emphasised in the Narrogin case study, with the city-based installation company engaged with the local government not trusted by community members despite their endorsement from the local elites.

The results indicate that social interactions were also important in the adoption of solar. In particular, social interactions helped community members increase their awareness and acceptance of residential solar energy. Outside of the impacts of the ‘Fruitloops’ and the community leaders, both communities demonstrated peer-to-peer engagement similar to that found in the literature (Hicks and Ison, 2011, Bauwens, 2016, Palm, 2016, Noll et al., 2014). People in both regions discussed their systems with other people in the community, particularly neighbours, enhancing trust in solar technology. This reflects the ‘clustering’ of systems reported elsewhere, where installations do not follow patterns of income or housing density, but instead the boundaries of policy implementation areas and the existence of social interactions, including community-based pro-solar programs (Graziano and Gillingham, 2015). The research also confirmed findings elsewhere on the impact of passive peer-to-peer effects (Palm, 2016), exemplified through interviewees in Narrogin describing the extent to which the visibility of systems on people’s rooftops and placards on people’s lawns contributed to their own awareness of solar systems.
**Procedural justice**

Procedural justice relates to the extent to which community members can feel as though they have had their opinions included in the decision-making around CRE projects. While the community members in Narrogin installed their solar systems under the conditions of externally imposed drivers (in the form of financial incentives) and facilitators (in the form of city-based installers), the community members in Carnarvon had a greater opportunity to be included in the ways in which solar adoption unfolded in their region. The ‘Fruitloops’ installed their own systems, choosing system capacity and configurations suitable for their own purposes, decided when to sell their STCs to maximise their own financial benefits and encouraged system installation in other community members. Therefore, the ‘Fruitloops’ of Carnarvon correspond to the definition of a ‘solar community organisation’ by Noll et al. (2014) in that they reduced barriers to the adoption of solar systems and that they encouraged adoption within the Carnarvon community. Furthermore, the ‘Fruitloops’ could be considered as an ‘ideal’ CRE project under the model created by Walker and Devine-Wright (2008), given local people are involved in both the organisation and establishment of the project, with the vast majority of benefits also accruing to members of the local community.

**Distributional justice**

Policies and initiatives to promote renewable energy should be mindful of the extent to which they may result in distributional injustices, providing benefits to a select few at the expense of others. The ‘Fruitloops’ of Carnarvon intended to minimise the distributional injustice resulting from a lack of financial capital restricting some community members from adopting solar energy. They did this by acting as a non-profit operation, purchasing system components at wholesale prices, undertaking their own installation and using accounting skills to maximise their financial benefits. Furthermore, helping less able-bodied community members to install their own systems prevented distributional injustices associated with fitness. Alternatively, the ‘Fruitloops’ and their installation of larger-capacity solar systems led to the unintended consequence of accelerating the point at which the ‘hosting capacity’ of the network was reached. Once the moratorium was in place other members of the community were prevented from installing a system, leading to distributional injustices within the community. Interview respondents indicated that they
thought it was ‘unfair’ that some community members received generous financial compensation for the electricity fed into the grid from their solar systems, while others were excluded from participating in the scheme. The distributional injustices in this case illustrate the theory proposed by Wolsink (2013) that energy networks can be viewed as common pool resources and therefore vulnerable to ‘subtractability’, which Ostrom et al. (1999) describes as where ‘exploitation by one user reduces resource availability for others’ (p278).

6.4.3 Socio-political dimension

The case study results provide evidence that socio-political mechanisms, including the availability of financial incentives and capacity of champions to influence local policy, promoted the adoption of small-scale solar systems. However, the results also suggest that, consistent with the assertion by Wüstenhagen et al. (2007), socio-political features have the potential to act as barriers to further adoption by preventing consumers from understanding the true costs and benefits of solar, restricting the availability of regionally-based solar installers and limiting access to the electricity network.

*Solar champions can influence socio-political pressures for adoption*

Based on the work of Sorensen and Epps (1996), the solar champion in Carnarvon had the capacity to act as both a ‘legitimiser’ and an ‘effector’, resulting in a more efficient process of adoption, compared with the separation of these positions in the Narrogin community. In particular, the solar champion’s position on the local government, and associated influence on regional strategies, influenced regional policies to provide additional support for residential solar energy. Similarly, the Clean Energy Advocate was able to leverage his network with members of the local government, developed based on his position on the town council, to promote the financial benefits of solar adoption to the local government. However, this research emphasises the importance of a champion exhibiting both ‘legitimiser’ and ‘effector’ characteristics. In the case of Narrogin, the Clean Energy Advocate acted as a successful ‘legitimiser’ of solar technology to the local government, and thereby promoted the adoption of solar systems on government-owned buildings, but did not engage with the local ‘effector’, the electrician, who could have installed systems and thereby increased acceptance of renewable energy by the local community and contributed to the local economy.
Financial incentives promote adoption – but may restrict future adoption

The most effective government policy for promoting adoption of small-scale solar systems was the provision of financial incentives, with financial incentives prioritised in the decision-making of solar adopters in both communities. However, there was evidence to suggest that community members did not understand the true costs and benefits of solar technology, with respondents indicating that solar systems would not be worth adopting in the absence of financial incentives, in particular the premium net feed-in tariff. This provides support for Sovacool’s (2009) assertion that ‘intentional market distortions (such as subsidies)... prevent consumers from becoming fully invested in their electricity choices’ (p4500). In the case of solar adoption, the provision of generous financial incentives without associated education of consumers on their costs and benefits could result in consumers choosing not to re-adopt solar in the absence of financial incentives, referred to as a ‘disenchantment discontinuance’ by Rogers (2003).

Solar installation regulations with adverse impacts in regional areas

The research highlighted that regulations were both restricting local industry and allowing substandard installations, with implications for community members’ trust in solar technology. The requirement by the Clean Energy Council for installers to undertake continuing development that requires frequent travel (with associated costs and loss of income) and complete a minimum number of installation ‘case studies’ in excess of opportunities in regional areas prevented regional installers from maintaining their installation accreditation. The continuing education system is therefore acting as an impediment to the maintenance of the local industry, meaning regional community members do not have access to a locally available, trusted installer. Alternatively, the interviews highlighted that regional areas lack policing of the extent to which systems are meeting regulations, which has enabled substandard installations to proliferate. This appeared to be of particular concern in Narrogin, where the lack of locally-based installers and increasing number of faulty systems was leading to reduced levels of trust in solar technologies. This is an example of a socio-political system that has been established to maintain high standards in the renewable energy industry, but has counterintuitive outcomes in regional areas.
Energy utilities have a role to play in CRE project development, with Carnarvon’s adoption profile stalled by the network provider placing a moratorium on new systems. While the CRE literature has indicated that network interactions can influence renewable energy project outcomes, for instance that issues with networks have resulted in project delays with ramifications for the profitability of investments (Ruggiero et al., 2014), this was the first identified case where a utility has placed a blanket moratorium on connecting small-scale solar systems to a network. While the network operator indicates that reasons for this moratorium were technical, the decision is likely influenced by the larger socio-technical system energy decisions take place within (Sovacool, 2009). That is, social decisions around risk, prioritisation of access to the network by incumbent generation sources and financial decisions associated with the cost of connection of renewable energy would all have contributed to the implementation of the moratorium. Difficulties associated with network utility decisions impacting on the acceptance of renewable energy onto networks, including network connections, pricing and the term of contracts, are likely to be exacerbated in future with the dissolution of network monopolies and fundamental changes to forms of electricity generation.

6.5 CONCLUSION

This research has used a ‘social acceptance of renewable energy’ framework to consider the contribution renewable energy champions and an informal solar community organisation can make towards market, community and socio-political acceptance of small-scale solar energy. The results indicate that solar community organisations, particularly where they appear alongside utility-scale solar projects and public information campaigns, can progress the innovation decision-making process, increase trust in solar installers and take advantage of local capacities to reduce solar costs and re-invest in local industry. However, the research also identified that the solar community organisation was heavily reliant on a single ‘local champion’. Government policies for CRE projects could mimic the benefits of solar community organisations by providing information to the public on renewable energy technologies, including through facilitating site visits to renewable projects. Furthermore, they could develop an understanding of the skills and capacities required to proceed with CRE projects and determine whether communities include citizens with these appropriate
skills. Finally, governments could provide funding for a CRE project manager capable of developing communication networks with community members, to reduce the burden on local elite volunteers.

The research underlined the extent to which CREs are dependent on the community within which they are situated, and therefore some policies may best be delivered at the local level where there is an understanding of community dynamics. Examples of this include the extent to which CRE projects should be developed in communities where there is an opportunity to take advantage of existing capacities, ‘thick trust’ in social networks and the skills of local champions who have the potential to act as both ‘legitimiser’ of the technology and ‘effector’ of its delivery. However, it is also noted that CRE projects have the potential to contribute to distributional injustices by excluding some citizens from the benefits of the scheme, which governments should be wary of if they are to provide resources to support the development of CRE projects. Finally, governments should be mindful of the extent to which the success of government-sponsored CRE projects may be influenced by external institutions, including inaccurate price signals in electricity markets (including financial incentives), regulations that produce perverse outcomes and interactions with energy utilities required to ‘connect up’ the renewable energy resource.

6.6 REFERENCES


QSR INTERNATIONAL PTY LTD 2015. NVivo qualitative data analysis Software. 11 ed.


Chapter Seven: Prologue

Chapter Six examined the processes of solar adoption in two regional communities, Carnarvon and Narrogin. The results suggested that the presence of a 'solar champion' was imperative for increasing Carnarvon's solar satisfaction rates. The 'solar champion' was effective in reducing the cost of systems for residential householders by purchasing bulk systems and by promoting community-based installations, with members of the 'Fruitloops' installing their own and then someone else's solar systems. The 'solar champion' was also available to inform residential solar energy consumers about the technical and financial benefits of solar, compared with the regional community of Narrogin, which lacked a visible solar champion or community solar organisation. As a result of this Narrogin was exposed to the practices of 'fly-by-night' or 'cowboy' solar retailers (characterised in Chapter Four) with many community members identifying their own, or someone else's, unsafe or substandard solar installation. Together, these mechanisms increased the market acceptance of renewable energy technology in Carnarvon, and were also found to have community benefits. Additionally, the 'solar champion' in Carnarvon played an important role in mediating between community members and the institutions that regulate, connect and fund solar energy projects. He was therefore effective in not only promoting acceptance of the solar technology within the local market, but creating windows of opportunity for socio-political acceptance of renewable energy at the local scale.

In spite of the 'solar champion' and support for residential solar energy adoption in Carnarvon, installation rates have discontinued in this community. This was as a result of the electricity network operator, Horizon Power, placing a moratorium on new solar grid-connections, citing concerns about grid stability. This highlights how government support for residential solar energy, either in the form of generous financial incentives or promotion of community renewable energy projects, does not always contribute to an increasing penetration of residential solar electricity systems. Network operators can act as external agents capable of 'blocking' the installation of further distributed generation (solar or otherwise), and prioritising the 'locked in' incumbent generation system.

The next Chapter therefore looks specifically at the question of whether there is a perception of a broader systemic problem with network operators 'pushing back' on increased levels of distributed generation, and their motivations for doing so. This Chapter
considers the activities of the network operators in the context of wider government objectives and therefore goes to the heart of social acceptance of residential solar energy in Western Australia by considering those institutions within the electricity sector that are capable of withholding socio-political support for renewable energy. The research is grounded in a socio-technical transitions framework analysis, which considers residential solar energy a ‘niche’ technology that is seeking to be inserted into an existing ‘regime’ of complex social and technological interactions. The research considers the perceptions of community members, members of local government, renewable energy advocates, public servants, Members of Parliament and network operators to highlight electricity regime interactions influencing network operators. The research concludes with consideration of what governments could do to promote a regime transition towards increasing penetrations of distributed and renewable energy sources.

The research primarily focuses on the market dimension of Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy innovation’ in that it uses the Carnarvon solar moratorium experience identified in Chapter Six as an opportunity to consider network operators’ intra-firm acceptance of distributed renewable energy. However, the research also includes consideration of the role that government should play in directing policies and regulations to promote network operator acceptance of renewable energy and therefore crosses to the socio-political dimension.


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Simpson, G., Network operators and the transition to decentralised electricity: An Australian socio-technical case study
NETWORK OPERATORS AND THE TRANSITION TO DECENTRALISED ELECTRICITY: AN AUSTRALIAN SOCIO-TECHNICAL CASE STUDY

ABSTRACT

Governments promote the adoption of small-scale, distributed generation through financial incentives with the expectation that these incentives will facilitate the wide-scale adoption of generation, with greenhouse gas emission and electricity bill reduction benefits. This research used a socio-technical transitions theory approach to consider the extent to which network operators in Western Australia are perceived as facilitating, or blocking, a transition towards a distributed generation-based network. A total of 48 interviews with community, industry and government representatives were performed in 2015. This research finds that network operators are perceived as ‘pushing back’ on distributed generation by increasing the complexity, cost and unreliability of connection applications and by requiring consumers to invest in technology for grid protection. Interview respondents suggest network operators do this because: distributed generation creates technical issues at the distribution-scale of the network; distributed generation can reduce financial revenue for the network operator; as a response to a lack of direction on how to respond to distributed generation; and as the result of a ‘risk averse’ engineering culture that rejects the unknown. Additionally, regulations can prevent network operators from taking advantage of distributed generation to improve network stability and reduce peak load. Government intervention may be required to direct network operators to address the technical implications of distributed generation, redevelopment of tariff models to allow fair cost recovery of network assets and to ensure that network operators have a mandate and culture supportive of distributed and renewable generation. However, there will likely be political and economic consequences to governments supporting this approach.

7.1 INTRODUCTION

This research considers the role of network operators in assisting with a transition towards a distributed and renewable generation system. The introduction starts by defining the
electricity industry as a socio-technical system and the important role that network operators will play in electricity sector transitions. The introduction subsequently identifies key policies driving change in the Western Australian electricity sector, before posing objectives for the research.

7.1.1 SOCIO-TECHNICAL TRANSITIONS AND ENERGY SUPPLY
The twenty-first century is characterised by many environmental issues, which are set to reduce human prosperity and negatively impact on ecosystem functioning. These environmental issues, such as anthropogenic climate change, pollution and deforestation, are largely a function of humanity's increasing levels of economic growth and associated increasing levels of consumption (Arrow et al., 1995). To reduce the negative externalities of humanity's consumption there is a need to transition towards cleaner processes of production that result in a dramatic change to the way humanity consumes products and energy. While environmental issues associated with modes of production may be the result of technologies, these technologies are embedded in financial, social and geographical frameworks that are often difficult to shift (Antonelli, 1997). Based on this, the socio-technical transitions framework has been theorised as a way to consider technological evolutions, with the suggestion that 'infrastructure' is not a physical utility in its own right, but instead is a combination of the technical and social organisational characteristics that make it 'active' (Guy, 2006, Wolsink, 2012). Patterns of behaviour within these organisational characteristics are in reality the institutions that define the 'rules of the game' of production and consumption (North, 1990), with these rules charting a status quo path of functioning. The incumbent actors within the socio-technical framework therefore reinforce the existing path, leading to 'lock in' of particular technologies or institutional practices (Foxon and Pearson, 2008). There are numerous theories on the ways in which innovations can be accepted into these socio-technical systems, including the 'multi-level model' theorised by Rip and Kemp (1998).

Rip and Kemp (1998) identified three hierarchical levels interacting with an innovation's adoption. The lowest tier is the micro-level technological niche, where a 'window' exists for a new technology to be trialled and accepted, including through learning processes, price or performance improvements and support from elites (Geels and Schot, 2007). The middle tier is the meso-level socio-technical regime, the incumbent system into which the technology will be inserted. This regime level is constituted by not only the existing actors
but the institutional ‘rules’ governing how actors interact (Rip and Kemp, 1998). It is at this level that a new technology receives regime-wide confirmation and experiences ‘lock in’, with institutional rules transitioning to support this new technology, often at the expense of other emergent technologies that could fill a similar niche (Wolsink, 2014). Finally, there is the macro-level landscape scale that provides over-arching direction or pressure for regime change or continuation. Landscape-scale factors change slowly (over periods of decades) and include society-wide influences, such as socio-political systems and environmental stresses (Geels and Schot, 2007). Each successively higher tier in the hierarchy is more resistant to change and is likely to impose pressures for change on the tier below it (Foxon and Pearson, 2008), however co-evolution occurs across all levels. In particular, technologies in the niche layer require ‘linking up’ with the incumbent regime (Elzen et al., 2004, Rip and Kemp, 1998).

The energy sector is an example of a regime that is currently undergoing a transition. Landscape-scale pressures from government and society to promote a more sustainable energy supply system are producing changes to electricity sector management, including an increasing focus on renewable energy and energy efficiency (Solomon and Krishna, 2011). These changes are experienced at a number of points in the regime, with renewable energy replacing incumbent fossil fuel generation and demand-side management increasing efficient use of networks. The socio-technical transition model has been used to describe many of these changes, in particular Wolsink (2012) focuses on the potential adoption of a decentralised electricity system ‘smart grid’ that will make use of distributed generation, batteries and Advanced Metering Infrastructure (AMI) to allow electricity consumers, retailers or network operators to dispatch electricity at different times. Using these technologies a decentralised electricity system can reduce the need for additional generation capacity to meet peak loads, increase energy efficiency by reducing line losses, and can facilitate the adoption of small-scale renewable energy generation (Zangiabadi et al., 2011). Various innovations (both hardware technologies and regulatory amendments) could accumulate to form an independent regime, however, efficiency of the system will be maximised if the existing electricity regime, including electricity retailers, rules, regulations, and network systems, is accessed. Such a transition could either ‘lock in’ a system with industry control over pricing and network usage, with coincident increases in monitoring of individual electricity consumption/generation, or could promote a ‘democratisation’ of the system that would have end-users as key actors in the electricity regime (Wolsink, 2012).
The adoption of distributed renewable generation, in particular small-scale solar photovoltaic systems, is often seen as the first step in transitioning towards a decentralised energy system.

7.1.2 The Western Australian Electricity Sector and Distributed Generation

The electricity regime in the state of Western Australia is influenced by two landscape-scale strategies promoted by successive governments: energy market reform to promote increased competition between private firms and an associated reduction in electricity tariffs; and increasing support for renewable energy generation to assist in meeting national carbon emissions abatement targets. As part of the first landscape pressure the former state government-controlled electricity utility was divided into three corporate entities in the form of Government Trading Enterprises (GTEs). The Western Australian Electricity Corporations Act 2005 (Government of Western Australia, 2016c) stipulates that the GTEs are to function under an independent Board and are to make decisions based on maximising commercial efficiency, in the interests of shareholders (the Western Australian public). The Minister for Energy can, however, direct the GTEs to perform functions and has oversight of GTE budgets. The three GTEs include Synergy, the metropolitan retailer-generator, Western Power, the metropolitan network operator, and Horizon Power, the regional electricity producer, which provides network, generation and retailer services. Synergy was established to promote competition with private generators and retailers, while Western Power is a monopoly with tariffs and work program budgets approved by the Economic Regulation Authority (Government of Western Australia, 2014). There is considerable cross-subsidisation between the metropolitan energy utilities and Horizon Power, with the Western Australian electricity sector expected to be subsidised by the State Government at a cost of approximately AU$430 million in 2016-17 (Government of Western Australia, 2016a).

The second landscape-scale strategy to transform the electricity regime is focused on increasing the proportion of electricity sourced from renewable energy generation. There have been numerous state and federal policies to promote renewable energy generation in Western Australia. The most prominent of these is the federal Renewable Energy Target, which includes a renewable energy certificate market with financial benefits for large-scale and small-scale systems (Climate Change Authority, 2012). The Western Australian State
Government has also made reimbursements (Collier, 2009) and premium net feed-in tariffs (Collier, 2010) available to promote residential solar energy. Additionally, the GTEs have trialled renewable energy generation and its interaction with the network (Western Power, 2012).

Initially, financial incentives for the increased adoption of distributed generation contributed to modest uptake of small-scale solar systems. However, a reduction in solar system prices associated with market competition, a glut of systems and generous financial subsidies, alongside increasing electricity tariffs, good solar resources and peer-to-peer interactions promoting solar resulted in a dramatic increase in installation rates in 2011 (Simpson and Clifton, 2015). This has resulted in Australia having some of the highest penetration of residential solar generation in the world, with Australia-wide penetration levels of 16.5% (Bruce and MacGill, 2016), and as high as 31% in the Australian state of Queensland (Australian PV Institute (APVI), 2016). This is already higher than the Western Australian network operator-initiated trials on the impact of ‘high penetration’ solar on the network, at 30% in 2011 (Western Power, 2012).

Despite this support for solar at the niche (household) level and also at the landscape level (the latter involving political support for environmental reasons) the ‘success’ of distributed generation in Western Australia, as measured in near-universal adoption, is not guaranteed. While there are niche-level limitations, in particular existing buildings that are incompatible with distributed generation installation, limitations are also placed on distributed generation in the form of resistance to change from the incumbent regime. The chief actors in this regime are the market operators, regulators, energy retailers, generators and the network operators. Distributed generation will influence forecasting of markets (McConnell et al., 2013), add another layer of energy supply for regulators to consider (Wood and Carter, 2014), act as a competitor to generators (Stock, 2014), and will change the financial dynamics for retailers by influencing wholesale cost prices (Simshauser, 2016). Network operators may be the most influential incumbent regime actors in the adoption of distributed generation and transition towards decentralised electricity systems. This is because it is the network operators that will be the technological interface ‘linking up’ distributed generation and the incumbent regime. Network operators act as ‘gate keepers’ to the network for all generation types and facilitate the transfer of power from the site of generation to areas of consumption, thereby contributing financial benefits for solar
‘prosumers’ (producer-consumers) but with direct implications for the network operators’ infrastructure and cost recovery models (Simshauser, 2016).

Government incentive policies promote the adoption of niche-level distributed generation technology, specifically small-scale solar photovoltaic systems. Financial incentives promote market growth, allow for ‘learning by doing’ (Van Benthem et al., 2008) and move the technology along the ‘Diffusion of Innovations curve’ (Rogers, 2003). However, financial incentives do not place direct pressure on the incumbent regime operators, in particular network operators, to transition towards acceptance of distributed and renewable generation and modification of their institutions. The question could be asked, then, as to whether government incentives alone can lead to this niche technology changing the electricity regime or whether landscape-scale pressure or intervention is required for a transition towards a decentralised electricity system.

This research takes a socio-technical transitions approach to considering whether there is evidence that landscape-scale pressures are required to encourage network operators to facilitate the ‘linking up’ of distributed generation with the incumbent electricity regime. Specifically, this research uses qualitative data on Western Australian stakeholders’ perceptions of network operators to consider:

1) Whether there is evidence to suggest that network operators are resisting a transition towards a regime change that will include higher levels of distributed and renewable generation
2) Potential motivating factors for network operators to restrict distributed and renewable generation
3) Ways in which network operators’ interactions with distributed generation have changed over time.

The results of this research are then used to consider whether there is evidence that financial incentives are sufficient to support a transition towards a distributed generation system and the extent to which a landscape-scale intervention, in the form of political interference, is required to promote increased penetration of distributed renewable generation.
7.2 METHODS

This paper was developed as the result of alternative research considering the experiences of residential solar photovoltaic adoption in two regional Western Australian communities. The two communities, Carnarvon and Narrogin, were selected based on their similar population sizes, number of free-standing dwellings, median household wages and proportion of rental accommodation according to the Australian census (Australian Bureau of Statistics, 2013). However, the two communities differed in their level of support for solar, with Carnarvon having an informal solar community organisation (Simpson and Fullarton, 2016).

The research sought to examine adoption processes, with a particular emphasis on the extent to which social networks influenced adoption. To achieve this, a range of stakeholders involved with promoting or installing renewable energy in each community were engaged for an interview, as well as key energy stakeholders at the state level. All interview subjects were asked about their opinions and knowledge of residential solar energy, government policies to promote its adoption, media reporting on solar and the level of support for renewable energy by network operators. These questions were asked to develop an understanding of the level of consistency in the way different stakeholder groups defined and described these components of solar adoption, and whether these definitions and descriptions were informed by interactions between stakeholders. The responses to these questions were largely consistent between stakeholder groups and with the academic literature, with the exception of comments relating to network operators. Comments in this case exposed a range of responses and prompted the decision to investigate treatment of distributed generation by network operators.

This research can be defined as grounded theory research given questions were not developed to consider pre-defined theories relating to network operators (Strauss and Corbin, 1994). Consequently, the lack of pre-defined themes or models reduces the likelihood of researcher bias towards a particular finding or outcome (Yin, 2009). Triangulation was performed to increase the robustness of findings (Heras-Saizarbitoria et al., 2011), with assertions made by interview respondents verified using publicly available information and data. This information and data relates to network operators/regional communities and was made available through government and industry reports, media
articles and submissions to government processes. Where external information and data has supported the claims made by interview respondents this information and data is presented in the results section. However, it should be noted that the experiences or opinions of network operators identified in this research may not be transferable to all jurisdictions or network operators and the findings should therefore be considered exploratory rather than predictive. Each interview respondent provided comments based on their own experiences and opinions as a member of a particular stakeholder group and did not reflect an authorised view of business or government. This research benefits from interviewing a disparate group of stakeholders (Allen et al., 2012), enabling access to a range of experiences at the local and state level, and from the perspective of policy-makers, political influencers, industry members and community individuals. Consistency was assured by having all interviews undertaken by the same researcher. Respondents were notified that all information gathered would be recorded, transcribed and analysed in such a way that maintained their anonymity. In the interest of ensuring respondents’ anonymity only the respondent category has been linked with themes and direct quotations. This research complied with and received ethics approval through The University of Western Australia.

Semi-structured, in-depth interviews with open-ended questions were performed between May and October 2015. A total of 48 interviews were performed, ranging in duration from 15 minutes to 1.5 hours. Sixteen interviews with householders with a solar system installed on their home were performed, from a total pool of 20 potential interviewees (80% response rate) self-nominating for an interview in a previous mail-out survey (Simpson and Clifton, 2015). Householders with residential solar systems were identified using publicly available satellite photography. While 16 households were interviewed (8 from each community), only 12 provided comments in relation to network operators and so the remaining four households were excluded from further study. Four Members of Parliament were interviewed, including the Member of Parliament for each regional community and two Members with an established profile in renewable energy policy. Two local and one regional government worker were interviewed in each community, in addition to six public servants involved with developing renewable energy policy advice for the state government. Members of the renewable energy industry were also interviewed, including the ‘solar champion’ in Carnarvon and two community members with an interest in renewable energy in Narrogin. Four regional solar installers were interviewed, in addition to two state-level
renewable energy companies who had installed systems in the regional communities. Two former representatives of a renewable energy advocacy agency also participated in the research. The two communities provide a useful natural comparison of the treatment of distributed generation considering a different network operator serviced each area, with Horizon Power servicing Carnarvon and Western Power servicing Narrogin. Network operators were approached for an interview at both the local-level office in each regional community and at the state-level office. Only one employee of the local Horizon Power office in Carnarvon was available for an interview, whereas interviews with two local employees and two state level employees were granted for Western Power. The Minister for Energy was approached for an interview, but his office did not respond during the period the research was undertaken.

All but two of the interviews were conducted face-to-face, with the remainder conducted by phone for convenience. All interviews were audio recorded, except for the interview with the Horizon Power employee who did not grant permission for the interview to be recorded. Interviews were transcribed for accuracy, with the first stage of analysis being close reading of the transcript text and notes generated during the interviews (Ruggiero et al., 2014). The significance of statements in the context of the researcher’s questions was analysed, focusing on the explicit meaning of the response, exploring repetitive concepts to develop consistent and coherent themes.

The findings presented in the Results section are the product of a thematic analysis of the perceptions of network operators identified in the interview transcripts, with the development of research themes the result of a manual and iterative process (Allen et al., 2012). Interview transcripts were coded using NVivo Version 11 (QSR International Pty Ltd, 2015), with an initially large number of highly specific themes emerging prior to clustering of similar themes and consolidation into the final over-arching themes (Nygren et al., 2015). These themes (detailed in the Results section) included: indications that network operators are resistant to accepting increasing penetration of distributed generation; four themes identifying perceptions of motivations for network operators to restrict connection; and evidence of perceptions that network operators’ interactions with distributed generation is changing over time.
7.3 RESULTS

The results are presented in three parts. The first part describes interview respondents’ perceptions that network operators were restricting the installation of distributed generation, preventing informed decision-making around the state of the network and highlights the case of Carnarvon, an example of distributed generation restriction and lack of information. The second part details the four different sources of motivation for network operators to restrict distributed generation, as reported by interview subjects. The third part acknowledges that interview respondents perceive that network operators’ attitudes towards distributed generation are in a state of flux. A summary of interview respondents providing comments on each theme is provided in table 7.1.

Table 7.1: The number of interview respondents providing comments on themes included in the Results section

<table>
<thead>
<tr>
<th>Theme</th>
<th>Network operators</th>
<th>Industry members</th>
<th>Renewable energy advocates</th>
<th>Members of Parliament</th>
<th>Public servants</th>
<th>Local government members</th>
<th>Householders</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Restricting distributed generation</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Poor information provision</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>3.1 Carnarvon moratorium</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>7</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>3.2.1 Technical challenges</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>28</td>
</tr>
<tr>
<td>3.2.2 Financial challenges</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td>3.2.3 Political influence</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>3.2.4 Culture of network operators</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>3.3 Changes in network operator attitudes</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>
7.3.1 Evidence of network operators restricting network access for distributed generation

Thirteen interview respondents provided comments indicating a perception that network operators restricted the installation of distributed and renewable generation, including through onerous application policies, long lead times in connecting projects, high costs for grid-connection assessments and a lack of certainty around acceptance of approvals. In relation to connection applications, three interview respondents referred to network operators, and in particular Western Power, as being ‘obstructionist’, ‘difficult to deal with’, ‘anti-renewables’ and stated that there was a lack of consistency in responding to applications, with rejection sometimes based on ‘spurious reasons’. Members of Parliament had received complaints from regional electricity consumers on the need for expensive evaluations (in the region of AU$35,000) and a requirement for ‘generation management’ systems (a short-term battery product). A renewable energy advocate claimed that these requirements were established as ‘technical codes’ but were tantamount to market restrictions. Industry members in particular reported difficulty in seeking approval for mid-range capacity systems of above 30kW, which were typically to be installed on commercial buildings. One industry member reported that a job of this size could take anywhere between six and twelve months to gain approval, by which time system component costs and the value of renewable energy certificates were likely to have changed. A media article reflected this, calling this range of installations a ‘dead spot’ in installation rates (Gifford, 2014).

External to the interview processes a number of other indicators of reluctance on the part of the network operators’ to accept increasing penetration of distributed generation onto their networks were identified. Extracts from parliamentary Hansard records confirm that the Western Power Access Code has meant that ‘generation businesses and customers are commonly subject to substantial connection costs and delays in the connection process’ (Western Australian Parliamentary Debates, 2016b). News sources highlighted a move by network operators and electricity retailers to introduce a ‘solar tax’ for households with a solar system installed (Gifford, 2015) and Western Power guidelines that would result in householders connecting batteries being disconnected from the network (Parkinson, 2015).

While one interview respondent acknowledged that they were not sure whether delays and inconsistencies were the result of a lack of economies of scale in dealing with systems of this
size or because the network operators thought ‘we are only connecting you because we have to’ a renewable energy advocate said:

‘I spent a long time trying to give Western Power the benefit of the doubt, I tried to persuade members that they really didn’t ‘have it in’ for renewables and to be honest I probably came out of that job thinking “they probably do have it in for renewables, actually”.’

- Renewable energy advocate

A lack of accessible, reliable and transparent information was perceived as further inhibiting distributed and renewable energy adoption, with 15 interview respondents claiming problems with information provision on the part of network operators. Two Members of Parliament reflected on a high level of secrecy around information, with one saying:

‘I’ve asked lots of questions about it and I have to say I’m none the wiser.’

- Member of Parliament

This was supported by householders seeking information to improve their own decision-making, with one believing network operators provide ‘spin’ without giving correct information. Alternatively, five interview respondents, including two local government members, confirmed problems not only with a lack of information for customers but also with information provided to them to assist with industry decision-making and the development of policy positions. One perceived connection policies as lacking in transparency, making it difficult to determine whether renewables were treated differently to conventional fossil fuel generation sources, and another said that different departments within Western Power provided conflicting information, with one department ‘making assertions that the data did not support’. Furthermore, Western Power has not submitted for publication their annual Statement of Corporate Intent, a document outlining corporate priorities and strategies for the coming year, since 2013, in spite of a legislative requirement to have the document tabled in parliament each year. Horizon Power delayed release of their Statements over the same period until the Minister was questioned about them in Parliament (Western Australian Parliamentary Debates, 2015b). In a submission to the
regulator, industry member ‘Community Electricity’ commented that Western Power was denying customers access to their own interval meter data, reducing their capacity to make informed decisions around solar, battery or demand side management practices (Community Electricity, 2015). Finally, a renewable energy advocate mentioned that:

‘The utilities occasionally use techno-babble to say something that is not true.’

- Renewable energy advocate

Three interviews with network operators identified an awareness of a lack of energy literacy in the general public, with one commenting that misinformation is a problem and the other two suggesting consumers did not have enough information regarding distributed generation, and in particular in relation to financial benefits relating to solar.

The regional community of Carnarvon provided an example of perceptions that network operators limit the penetration of distributed generation. Carnarvon experienced a rapid and early rate of distributed solar generation adoption, with a local community member acting as ‘champion’ for the technology and encouraging its installation by members of the local community and industry (Simpson and Fullarton, 2016). Furthermore, he also installed his own system, one of the earliest privately owned solar farms in Australia, and was instrumental in the development of a large-scale solar project in the region. Horizon Power, the network operator for the region, responded to the increased rate of adoption by placing a moratorium on systems in 2011. Solar systems without ‘generation management’ have not been installed since, in spite of perceptions within the community that this moratorium was temporary. While the local champion said that Horizon Power had committed to allow solar onto the grid after a backlog of connection applications was processed, the most common perception of householders within the community was that new solar systems would be allowed after the opening of a new power station. This was supported given the Managing Director of Horizon Power was recorded as saying:
'The intention of the design of the [power station] redevelopment is to make it ready for renewables penetration... The system is specifically designed to be flexible enough to take a very high penetration.'

- Managing Director, Horizon Power (Western Australian Parliamentary Debates, 2010)

The new power station was opened in 2014 (Horizon Power, 2014), however there was no opening to new solar customers without 'generation management'.

Horizon Power made a number of commitments to consider opening access to the grid to additional solar customers. For instance, the Managing Director said that the 'moratorium' could be shifted based on physical simulations of the grid (Western Australian Parliamentary Debates, 2011); one of the network operators interviewed maintained the system is re-evaluated on a three monthly basis; and the Minister for Energy committed to the installation of a large-scale battery installation 'to lead the way for a renewable future' (Nahan, 2015a) and 'overcome the capacity limits' (Western Australian Parliamentary Debates, 2016a). However, none of these projects have resulted in access to the network for non-generation managed systems. Three interview subjects described issues around generation management, in particular in relation to the large-scale solar farm. In this case, an industry member explained that the generation management system had cost the company AU$250,000 to install, and there was no evidence that it had been accessed, with another interview subject noting:

'A lot of their projections about the amount of instability that the intermittency of solar could create on the system were shown not to have actually transpired in real world situations.'

- Member of Parliament

Further, a member of industry stated that residential-scale generation management systems that met Horizon Power's specifications were not currently available on the market, thereby all but locking out the residential solar market from further installing solar systems in Carnarvon.
7.3.2 Network operators’ motivation for restricting renewable energy generation access to the network

Interviews with stakeholders identified a broad range of factors that may have contributed to network operators’ resistance in connecting distributed generation to their networks. Each of the major themes is considered in turn below, and supported by externally available information where available. Stakeholders perceive that network operators have technical, financial, political and cultural motivations for attempting to limit the penetration of distributed generation.

7.3.2.1 Increasing distributed generation poses technical challenges for network operators

The most widely perceived reason for network operators rejecting increasing penetrations of distributed generation was around technical limitations of the network. Stakeholders mentioned issues around the intermittency of solar, particularly the cloud shear effect where solar generation outputs can change rapidly, and how this might require spinning reserve to act to ‘fill the place’ of renewables, which can be particularly problematic in regional areas using diesel generation. Secondly, many respondents talked about power surges and voltage variability issues, both voltage creep from multiple solar systems on the same distribution network and ‘surges’, also associated with the cloud shear effect. Again, this has particular ramifications for regional communities with ‘thin’ networks, and where large capacity systems are on adjoining sections of the distribution network. Thirdly, the potential for excessive capacity of solar feeding into the grid was viewed as a problem. These technical issues are reflected in both technical reports in the Australian context (APVA/CEEM, 2012, Sayeef et al., 2012) and in the academic literature (Masuta et al., 2015, Brandao et al., 2011).

Three interview respondents, including two industry members, stated a perception that network operators were transferring any risk of grid instability to the customer, as opposed to addressing these issues within their own remit as grid operator. Risk was transferred in large part by requiring customers to install ‘generation management’ on their system:

‘There are definitely engineering challenges associated with high penetration of renewables, but what Horizon has done is they have put the onus on consumers to build systems that meet specifications to protect their grid from renewables. That has dramatically increased the cost
of installing renewable energy systems and severely dampened the interest in doing that. If you’re cynical you can say that that’s exactly what Horizon Power wanted to do, is slow down renewables until they had time to figure out what they should do.’

- Industry member

In spite of acknowledgement of these technical issues, the industry representatives maintained that technical issues could be addressed through a number of options, including: automatic tap-changing at the distribution-level transformer, battery integration to smooth generation availability and reduce voltage variability, cloud forecasting to address variability in supply or simply limiting the capacity of solar systems connected to the network. The potential for network operators to find solutions to these issues is not considered insurmountable, with Western Power’s Head of Asset Management saying that renewable energy poses no great challenges to the grid (Parkinson, 2016d), a perception reiterated by the head of South Australia’s network operator, in spite of South Australia having the highest renewable penetration in Australia (Parkinson, 2016c). The academic literature similarly reflects that the technological challenges of integrating solar generation with the network can be overcome (McHenry et al., 2016).

7.3.2.2 INCREASING DISTRIBUTED GENERATION HAS NEGATIVE FINANCIAL IMPLICATIONS FOR NETWORK OPERATORS

The second most frequently perceived reason for network operators to limit the penetration of distributed generation referred to financial implications of distributed generation, including a loss of revenue, an inability to recover the cost of network infrastructure and an erosion of the value of network assets.

Three of the Carnarvon householders perceived that the premium feed-in tariff was eroding Horizon Power’s income, with one respondent declaring that this was the true motivation for the Carnarvon moratorium. A member for the local government further suggested that cost recovery for the major investment in a new power station in Carnarvon would be prioritised over increasing penetration of solar. This was further reflected by a renewable energy advocate perceiving that:

‘[Carnarvon’s] success is probably what made Horizon [Power] get nervous very early, and so they probably moved more quickly than others to lock [solar generation] down at a time when,
back then, they would have been seeing dropping revenues as a consequence. It would have set alarm bells going.’

- Renewable energy advocate

Stakeholders interviewed explained that they believed the increasing penetration of solar in Horizon Power's regional networks would have financial benefits for Horizon Power given its dual role as network operator and generator and given high costs of electricity supply in regional areas. Interview respondents described that the high cost of supply is emphasised in location-specific feed-in tariff rates that reflect the cost of supply, which is frequently higher than the regulated retail tariff. However, two interview respondents explained that existing 'take or pay' contracts with gas suppliers mean that Horizon Power is obliged to pay for high cost fuel regardless of whether generation is reduced in regional communities. Western Australia, a net natural gas exporter, has a domestic gas reservation policy that requires 15% of all gas produced offshore to be reserved for internal use, providing a fossil fuel energy resource to industry and government (Government of Western Australia, 2016b). Therefore, the long-term 'take or pay' gas contracts, and a potential associated disincentive for increasing solar in some regional communities, is a function of external government policies.

A number of respondents identified the need for increasing network charges to recover the cost of the network with increasing adoption of distributed generation reducing demand for grid-supplied electricity. The most extreme outcome of this, a feedback loop where increasing network charges encourage more consumers to install solar systems, forcing networks to increase electricity tariffs further and thereby acting as further incentive for disconnection, has been referred to as the 'death spiral' (Simshauser, 2014) and was mentioned by one interview respondent. While the 'death spiral' is considered unlikely by some policy analysts, they too suggest that 'falling power use is likely to make some existing infrastructure redundant' (Wood and Blowers, 2015). Another interview respondent described a recent industry report that highlighted the conflict around asset cost recovery:

*Current regulatory approaches effectively presume future consumers will meet a substantial proportion of the capital costs of long-lived electricity and gas network investments made today. Yet changes in demand, technology and cost conditions make this historic presumption*
less certain and the current approach potentially unsustainable. Continuation of the current path of not addressing the issue risks an avoidable regulatory failure with adverse outcomes for the long-term interest of consumers.

- Energy Networks Australia (2015)

A further perceived financial impediment for increasing distributed generation on networks relates to costs associated with network augmentation to address issues highlighted in section 3.2.1. Interview respondents from all stakeholder groups except householders described issues with the costs associated with addressing technical issues. One industry representative and a local government member noted that they believe network operators are not upgrading equipment to be able to ‘handle’ solar, while a Member of Parliament reported that capital injection into regional community networks purely to facilitate increased adoption of solar is difficult to warrant. Interview respondents perceived network operators as being limited in their capacity to seek additional funds to improve network infrastructure to accept increasing penetrations of distributed generation given their position as GTEs that needed regulatory and State Government approval for budget increases. One local government member highlighted this point, stating:

‘They’ve already put systems in place, but at this stage, because of the budgetary constraints, they are now going to have to pull back on those things because they are all very taxing.’

- Local government member

Evidence of the financial constraints placed on network operators can be found in budget cuts of AU$1.4 billion to operating and capital expenditure programs (Beyer, 2015), amounting to a 15% reduction in Western Power’s five year regulatory approval period budget and associated redundancies to almost 500 Western Power employees (Gredley, 2016). The decline in availability of financial resources at the State Government level, a consequence of a post ‘mining boom’ economy (AAP, 2016), restricted network operators’ options for funding the improvement of assets to seeking upgrades directly through project proponents. The network operators interviewed for this research explained that this had resulted in the perverse outcome that residential householders connecting a AU$15,000
solar system to a portion of the distribution network suffering from voltage fluctuations could be requested to fund a transformer upgrade at a cost of approximately AU$40,000.

7.3.2.3 **POLITICAL LANDSCAPES INFLUENCE NETWORK OPERATOR DECISION-MAKING AROUND DISTRIBUTED GENERATION**

Interview respondents perceived that there is additional government influence external to budget restrictions, with interview respondents describing the ways in which government priorities influence the operations of GTE network operators and a lack of clearly identified objectives for network operator decision-making.

Interview respondents perceived government as being in a difficult position, having to choose between an evolution of the network towards a decentralised electricity system that would contribute to a reduction in the value of state-owned generation assets, and maintaining the status quo by limiting distributed generation and thereby protecting the value of assets. An industry stakeholder highlighted this conflict, stating that it is ultimately the Minister for Energy's mandate to protect the value of state-owned assets, however the Minister must also ensure security of supply, which might require further investment in the network.

Regulatory restrictions enacted by government on the GTEs, and in particular Western Power considering its role as a network operator, were also perceived as influencing decision-making to restrict distributed generation. An interview respondent drew attention to an example whereby, to reduce the likelihood of competition between GTEs, regulations prevent Western Power from owning generation assets. According to these regulations batteries are considered a form of generation rather than a potential tool for network stability. This has historically prevented Western Power from using batteries to address technical issues associated with increased distributed generation. Changes to regulations to allow network operators to utilise batteries have been proposed by a Member of Parliament (Western Australian Parliamentary Debates, 2015a) and the former General Manager of Western Power (Parkinson, 2016b).

The evolution of tariff structures required to maintain the financial sustainability of network investments that will be required for, and in some cases made more expensive by, distributed generation is also inherently political. The State Government is already meeting
resistance from solar advocacy groups over an intention to ‘tax’ solar households through increased network charges (Gifford, 2015), which must also pass regulatory tests. It is unsurprising that there would be public opposition to a decision by government to increase electricity charges for a portion of the population that chose to adopt a form of technology based on the availability of financial subsidies provided by that same government.

Interview respondents stated that even in the absence of political intervention they perceive the objectives of network operators as unclear. The lack of clarity around roles and objectives for network operators was emphasised with a network operator noting that:

‘We have legal obligations that require us to maximise the long-term value of the business and endeavour to make a profit. As always, competing political preferences influence the way a [GTE] operates. You can see that particularly in rural areas or in relation to state development. Are we simply a network operator in this business providing a service on commercial terms or are we an instrument of state development or social policy?’

- Network operator

In particular, interviews with the network operators highlighted a lack of clarity around where network operators should be directing their investment efforts and the need to await the results of market reform activities to continue with planning procedures. A network operator explained that conflicting time periods of implementation, from five years for Strategic Development Plans, a single year for Statements of Corporate Intent and then responding to ministerial directions on a day-to-day basis, reduced cohesive decision-making.

7.3.2.4 CULTURE WITHIN NETWORK OPERATORS REDUCES LIKELIHOOD OF CONNECTION OF DISTRIBUTED GENERATION

While interview respondents acknowledged that they perceived legitimate technical, financial and political drivers for network operators to restrict the access of distributed generation to the network, eleven interview respondents also perceived that the culture within network operators was impacting on network operators’ decision-making around distributed generation, in spite of four network operator interview respondents referring to themselves as ‘generation agnostic’.
Interview respondents asserted that network operators were inclined to restrict renewable distributed generators’ access to the network because of a lack of experience or knowledge in understanding how it would impact the incumbent system. A Member of Parliament said that there was an attitude within Horizon Power that they ‘understood diesel’ and that it was therefore prioritised, even in regional areas where distributed renewables had cost advantages. Similarly, a member of industry stated that he believed that restrictions were put in place while Horizon Power ‘figured out what to do’. These attitudes are symptomatic of what several respondents described as a ‘risk averse culture’ of engineers. The CSIRO, Australia’s leading research institution, provided support for the idea that moratoria for new renewable generation in some areas were not necessarily a symptom of technical limitations, describing moratoria as ‘a conservative response to a lack of information about network problems’ (Sayeef et al., 2012). In its most extreme form this was considered by one interview respondent as laziness and another had a perception that the attitude towards distributed generation was ‘that it’s in the too hard basket’. However, a Member of Parliament, among others, explained that there was genuine cause for network operators to be risk averse, with a sense that ‘if anything goes wrong then obviously it is on their heads’.

While the perceived ‘risk averse’ culture within network operators might be considered a rational response to increasing uncertainty, other interview respondents stated that network operators exhibited outright opposition to evolving the networks to support increasing distributed and renewable generation. Two industry members and a Member of Parliament said that network operators were ‘resistant to change’, another industry member referred to the negative culture as a ‘a systemic blockage in the way that those organisations are set up’, a Member of Parliament perceived that network operators had an attitude of ‘you’re going to make it hard for us, so we’re going to make it hard for you’. An example highlighted by this Member of Parliament was where he had been advocating for increasing renewable penetration in a regional community suffering from extensive and frequent electricity shortages. The response from Horizon Power was that ‘the grid couldn’t handle [more renewables]’ to which he responded ‘the grid can’t handle the electricity demand anyway!’ The head of Asset Management at Western Power confirmed this attitude amongst some members of network operator staff, saying that ‘there are also a lot of engineers valiantly defending the old model, when they should be changing’ (Parkinson, 2016d). Finally, a renewable energy advocate summarised all these perceptions of network operator attitudes towards distributed generation:
‘In some ways I would rather say that they were worried about their investment base, that they were worried about the future of their relevance, in some ways [I would like to say] that they saw a future where they weren’t necessary and therefore they were acting in a protectionist manner, but I actually don’t even think that is the case. I think it actually boiled down to individuals and a risk averse culture and overly bureaucratic engineers who like the status quo. I wish it had actually been some kind of conspiracy because that would have been far more interesting and in some ways easier to solve, if in some way it boiled down to the organisational culture and the way that they run their business.’

- Renewable energy advocate

Four interview respondents also maintained that they have worked with people in network agencies who sought to support increasing penetration of renewables and distributed generation. These interviewees all said that historically acceptance of projects was heavily influenced by which network operator employee was involved in project development. Two of the industry players also stated that the network operators’ attitudes appeared to be influenced by changes to the organisation. A renewable energy advocate explained a perception that a change to the organisational structure that resulted in renewable-enthusiasts being moved out of positions of influence over renewable generation reduced support for renewable energy across the organisation. Another industry member had a perception that retirement of ‘baby boomer’ engineers might reduce the human capital of the network operators but also remove those who might be resisting distributed generation. This was echoed by another interview respondent who said that some network operator employees could remember when their utility was not only the network operator but also the generator, retailer and regulator, and therefore resisted relinquishing control over the electricity system.

7.3.3 Network operator attitudes change over time – but why?
A large number of interview respondents perceived Horizon Power’s high cost of supply as acting as an incentive for Horizon Power to be initially supportive of both larger-scale renewable energy and small-scale distributed generation that would reduce reliance on diesel and gas generators. However, according to interview respondents, the increasing technical difficulties associated with connection of distributed generation on ‘thin’ regional
networks has apparently led Horizon Power to become increasingly restrictive in their approach to generation connection.

The opposite case was perceived by interview respondents in relation to Western Power. Numerous interview respondents said that Western Power was historically opposed to renewable generation, but in recent years has ‘come a long way’ towards facilitating connections. An interview respondent suggested that network operators are ‘trying to figure out the best way to respond’ to challenges, and another had a perception that Western Power has realised that distributed generation and an associated decentralised electricity system is ‘an oncoming freight train’. Interviews with Western Power network operators supported the idea that Western Power is in the process of considering a ‘transition’ to decentralised electricity, and thereby recognises that it will have an important role to play in this process:

‘The important bit for our role is that we never have a vested interest in any particular outcome. Our role and interest is the smooth transition from one status to a new status, and ideally in a situation where everyone wins.’

- Network operator

It is worth considering what has prompted this change in Western Power’s approach to distributed generation. A Member of Parliament and a renewable energy advocate both had a perception that the change was a response to the Minister for Energy’s increasing support for renewable energy. Previously a nuclear advocate and Executive Director of Australia’s right-wing think tank the Institute of Public Affairs (Nahan, 2005), the Minister for Energy, Dr Mike Nahan, has reportedly become a renewable energy ‘convert’. As part of this conversion he has driven a number of reforms to support distributed generation, leading one media outlet to refer to him as a ‘revelation’ (Parkinson, 2016a). Hansard extracts confirm that he has directed utilities to examine a number of alternative energy options (Western Australian Parliamentary Debates, 2014b); a marked deviation from the previous Minister for Energy who notably chose not to respond to an early report produced by Western Power (Western Australian Parliamentary Debates, 2014a) on the potential use of alternative energy tools (including small-scale solar, AMI and demand-side management). Increasing support for renewables and distributed generation is evident in the Minister
appointing a ‘renewable energy futurist’ to the Board of Horizon Power (Parkinson, 2014). Furthermore, in the twelve months since the interviews for this research were completed, a number of changes to the regulatory environment contribute to increased distributed generation adoption and a decentralised energy system. These include: allowing residential householders to connect batteries to the Western Power network (Nahan, 2015b); an amendment to regulations allowing power purchase agreements so households can pay for solar electricity from a third party’s installation (Nahan, 2016); new inverter standards to reduce voltage extremes (Standards Australia, 2015); and seven different decentralised electricity system trials (Parkinson and Vorrath, 2016). Furthermore, Western Power with support from the Minister for Energy has formally requested regulatory rule changes to allow increased diversity in network infrastructure investment options, including the provision of stand-alone generation/battery systems (Walsh, 2016, Davis, 2016).

7.4 DISCUSSION

This research identifies perceptions of interactions between network operators and distributed renewable generation, a disruptive niche-level technology tacitly supported at the landscape level through financial incentives provided by government. Network operators are perceived as ‘pushing back’ on distributed generation in various ways, including by: restricting information; implementing delays in application processing; transferring network costs to consumers in the form of transformer upgrades and generation management systems (in spite of potential benefits to network operators from distributed generation technologies); and by not encouraging regulatory change to promote distributed generation and associated decentralised electricity system infrastructure (including batteries). The perceived reasons for this ‘push back’ include that network operators face genuine technological barriers to adoption, in particular grid instability, and face financial implications of solar, including a reduction in network payments and restricted finances for network augmentation required to support distributed generation. There is also a perception that network operators have an internal, regime-level attitude that reduces the likelihood of connection, in particular through a risk-averse engineering culture. Furthermore, landscape-level pressures from government, in particular restricted budget and unclear objectives, may reduce incentives for network operators to tackle issues associated with connecting distributed generation. However, network operators’ attitudes towards distributed generation appear to be shifting with landscape-level Ministerial
support for renewable energy and a decentralised electricity system, partially encouraged by public support for renewable energy. There are doubtless technical difficulties associated with connecting distributed generation, however the extent to which these difficulties are insurmountable is hard to determine given network operators are perceived as providing stakeholders with incorrect or misleading information (Figure 7.1).

Figure 7.1: Diagrammatic representation of the factors perceived to be influencing network operators' restriction of distributed (solar) generation and the form that the perceived 'push back' on distributed generation takes. The figure highlights that factors promoting a resistance towards distributed generation adoption by network operators are sourced across the landscape, regime and niche level.

7.4.1 NETWORK OPERATORS AND DISTRIBUTED GENERATION
It is important to note that resistance by network operators to accepting increasing penetration of distributed generation may make sound financial and technological sense. Network operators, and in particular Horizon Power, were not perceived as resisting distributed generation when solar systems were first introduced to the market. At this point solar generation provided potential benefits to networks through reduced peak demand, and did not impose undue costs on the network given reverse feed-in from smaller
capacity systems was minimal. Initially, therefore, it seems that the incumbent electricity regime could withstand pressure from the niche-level innovation without detriment to its functioning. However, as time progressed increasing penetration of solar systems and increasing capacity sizes resulted in an apparent increase in issues for network operators. Additionally, there was a perception of diminishing returns for network operators in accepting distributed solar generation on to their network. The primary benefit to network operators associated with distributed solar generation (without battery and AMI) is a reduction in peak electricity demand, which drives much of network investment costs. As solar penetration increases the peak demand period is pushed later in the evening, and once the peak demand period occurs after day-light hours distributed solar generation will not reduce peak demand levels further (Byrnes and Brown, 2015). This suggests that there is a 'sweet spot' for network operators in accepting distributed generation, motivating network operators to connect solar to reduce network peaks (and therefore their costs) but only up until the point that network augmentation is required and diminishing network peak losses are reached (Sioshansi, 2016).

The results highlighted that several interview respondents perceive network operators as restricting the connection of distributed and renewable generation to 'wait and see' how these technologies will impact the network. In some cases it appears the socio-technical transition management literature recommends this approach (Kemp et al., 2007). In particular, support for the currently preferred forms of distributed generation (in particular unmanaged solar) may result in 'lock-in' of this form of generation, and all its attendant issues, as opposed to waiting for new technologies to move down the cost curve, increase in reliability and become a viable alternative. In particular, it may be prudent for network operators to resist connection of distributed generation until affordable solar-battery combinations are available, and a regulatory regime has been established, that could result in a more rapid transition towards a decentralised electricity system with potential network operator benefits. There might be those who would suggest that network operators should not have the power to resist increasing penetrations of distributed generation solely to protect their own viability. However, in promoting a timely transition towards a distributed electricity system network operators may also reduce the likelihood of an 'electricity death spiral' and associated cross-subsidies between consumers, creating long-term viability for the network that a decentralised electricity system is inherently reliant upon. Network operators could choose to change their business models to adopt the full suite of
decentralised electricity system infrastructure, including distributed generation, batteries and AMI, with considerable benefits to them, including reducing network infrastructure by reducing peak load and demand variability (Zangiabadi et al., 2011). However, in the Western Australian case the Electricity Corporations Act 2005 (Government of Western Australia, 2016c) prevents Western Power from owning generation assets, with batteries considered a form of generation, thereby preventing Western Power from changing its business model to foster increasing levels of distributed generation. It is therefore necessary that network operators identify to government and regulators that regulations may be restricting a best-case transition towards a decentralised electricity system.

The research also highlights a perception that the culture within network operators itself influences network operators’ relationships with distributed and renewable generation, which is likely to have an influence on whether network operators choose to pursue an alternative, potentially riskier, business model and focus attention on advocating for changes to regulations to promote their own long-term viability. The prevalence for the culture of institutions like network operators to maintain the status quo in a socio-technical regime has been highlighted by Nelson and Winter (2009) who suggest that engineers are typically limited to considering only those technologies they have experience and training with. However, in and of itself this should not be given as an excuse for inaction, with the UK Engineering Council (Engineering Council, 2011) identifying that risk aversion can lead to 'technological stagnation and deny society potential benefits' (p3). Furthermore, if there is landscape-scale pressure for a decentralised electricity system it would be in network operator engineer and market planners’ best interests to progress a transition agenda early, in the hopes of maintaining their own financial viability in a rapidly changing electricity system.

7.4.2 GOVERNMENT POLICY AND DISTRIBUTED GENERATION
The socio-technical transitions literature identifies two key models for a technological evolution (Elzen et al., 2004). The first, a ‘niche-based model’ of regime transformation, assumes that a niche-level technology is capable of disrupting the order of the regime and forcing a change in institutional arrangements. Alternatively, the ‘transition management model’ of regime transformation assumes that there is a landscape-scale ‘guiding vision’ that influences the transition process. The results in this research suggest that a transition management model will be most effective in promoting a transition towards a decentralised
electricity system. The Western Australian Government provided support for distributed and renewable generation in the form of financial incentives, promoting these niche-level technologies. However, interviews in this research confirmed a perception that this did not lead to wholesale acceptance of these technologies by the network operators. It was apparently only after the Minister for Energy made a number of high profile public commitments forcing the network operators to consider distributed and renewable generation that Western Power established trials to promote their increased adoption. Alternatively, Western Power previously produced a report that included recommendations for increasing technologies required for a decentralised electricity system; however this report did not receive a formal response from the former Minister. This appears to have contributed to a lack of government endorsement for options by network operators to examine mechanisms to increase the penetration of distributed generation and a move towards a distributed electricity system. This is just one example of the ways in which unclear priorities and a lack of objectives from government to network operators may have restricted resourcing of potential options to increase distributed generation, a theory supported by Johnson and Jacobsson (2001) who suggested that ‘blocking mechanisms’ for system transformation include uncertainty and a lack of political support.

There are two important requirements for a successful transition management model: the first is that the ‘vision’ generated to promote the transition is regime-wide and the second is that there is public support for the transition (Shove and Walker, 2007). While apparently simple, both these conditions will result in conflicting interests and are inherently political. If governments are to be successful in achieving an optimal transition towards a decentralised electricity system their ‘vision’ must include consideration of the economic and political ramifications of the transition process.

Firstly, a regime-wide ‘vision’ for the transformation of the energy sector towards a decentralised electricity system will have financial consequences for numerous state-owned generation assets and retailers, as well as for network operators. For instance, in Western Australia, best use of distributed generation might result in network operators drawing down and recharging batteries at opportunities that will result in best outcomes for the network, with potential financial implications for retailers or generators, including the GTE Synergy. Considering this, the transition to a decentralised energy system may proceed under the basis of majority control and ownership of investments by State Government.
utilities with the interests of the state’s ‘shareholders’ of primary importance, although this would generate a reduction in the value of state-owned assets and political opposition to a reduction in market competition. Furthermore, government objectives for alternate timeframes can compete with one another. For example, while in the long term it is likely a move towards a decentralised electricity system has the potential to increase network efficiency, the initial up-front capital required for such a transition may not be available within existing government budgets. In the case of Western Australia another landscape-level pressure, in the form of the end of the mining boom, eroded state revenue and therefore reduced government budgets with impacts on GTE functioning.

The complexity of enacting a ‘vision’ towards a decentralised electricity system should also not be overlooked. In order to shift the regime towards near-universal adoption of distributed generation changes must be made to all actors across the regime sector, which will produce a dramatic recalibration of the roles, responsibilities and potential earning power of incumbent institutions. Future demand on large-scale generation, line losses, carbon emissions and network investment will be minimised by a move towards a decentralised electricity system. This will require the incumbent generators to accept a reduction in demand (Stock, 2014), that regulations are amended to adopt a wider range of electricity industry processes (Wood and Carter, 2014), that infrastructure providers (particularly the solar industry) improve technologies’ and industries’ reliability and acceptability (Simpson and Clifton, 2015), and that retailers work with network operators to develop price packages that incentivise efficient use of the network and self-generated electricity (Khalilpour and Vassallo, 2015). At present in Western Australia, as in other parts of the world (Niesten, 2010), the lack of coordination between regime parties, in particular in relation to information supply, the institutional inertia around regulation changes and the cultural resistance within utilities are likely to create barriers to increasing distributed generation that a comprehensive ‘vision’ could overcome, with sufficient political support. In particular, this research highlights that individuals placed in strategic organisational positions within GTEs may be instrumental in driving acceptance of renewable and distributed generation.

Secondly, the process towards transformation of a decentralised electricity system with a high concentration of distributed generation appears to have public support (Simpson and Clifton, 2016). However, ‘the preferences and needs of citizens and society at large... are
subject to change’ (Kemp et al., 2007). In particular, this ‘vision’ does not acknowledge that the current system of adoption includes social inequalities, including cross-subsidisation in electricity tariffs (Simshauser, 2016). A transition to a decentralised electricity system in Western Australia will necessarily require a reformation of network charges, which could result in those who have previously installed a solar system paying more to access the network. The potential for voter backlash against this process in Western Australia is high considering many voters will consider that they only chose to install solar systems because of government policies promoting adoption.

This is the first article to consider an energy system transition towards distributed generation that takes into account the technical, financial, political and cultural implications of distributed generation for network operators. It is worth considering the extent to which the findings presented here are likely to be replicated across other networks. There is evidence to suggest distributed generation is causing technical (Masuta et al., 2015), financial (Oliva et al., 2016) and regulatory (Miller et al., 2013) issues for network operators elsewhere, and so the interaction between network operators and distributed generation may be a form of ‘coercive isomorphism’ (Roby et al., 2014), that is, network operators worldwide might perpetuate the same regime-level factors promoting resistance to distributed generation as experienced by network operators in Western Australia. Furthermore, it should be noted that conflicts between incumbent institutions are made more divisive in instances of corporate privatisation and weak regulation. This research highlights that network operators can be heavily influenced by government intervention, including in such a way that government can mandate that network operators accept more distributed generation at their own expense. Alternatively, in the absence of government intervention, the financial implications of distributed generation are more likely to influence ‘push back’ from network operators operating as independent businesses. This is particularly relevant in relation to the restriction on additional distributed generation to prevent the need for network augmentation, with studies elsewhere suggesting that privatised network operators will forego network investment to maximise shareholder profits (Short, 2015).
7.5 CONCLUSIONS AND POLICY IMPLICATIONS

While the experiences or opinions of network operators identified in this research may not be transferable to all jurisdictions or network operators, this research indicates that network operators are perceived to be in the position to actively discourage the promotion of distributed generation, and also have significant motivation to reduce adoption, even if, according to the network operators interviewed, they consider themselves to be 'generation agnostic'. This research suggests that government promotion of a niche-level technology alone, in the form of financial incentives for the promotion of distributed solar systems, may be insufficient in driving universal adoption of the technology, given the potential 'push back' from network operators for its connection to the electricity network. Landscape-scale intervention may be required to shift the incumbent regime operators to be accepting of distributed generation, however this may have implications for the voting public (through tariff redistribution policies to limit cross-subsidisation) and will also have political implications from incumbent industry members. In particular, financial consequences include that an increased use of distributed generation will result in the potential reduction in stated value of transmission assets under the state government's budget papers and require increased distribution-level network expenditure. In order for a shift towards near-universal adoption of distributed generation to occur, changes must be made to all institutions across the regime sector. This is perhaps best achieved through the development of a ‘vision’ at the landscape level underpinned by an evidence-based pathway to regime change which will prompt a recalibration of the roles, responsibilities and potential earning power of incumbent institutions.

7.6 REFERENCES


APVA/CEEM. 2012. Carnarvon: A Case Study of Increasing Levels of PV Penetration in an Isolated Electricity Supply System, a report by the UNSW Centre for Energy and
Accessed: 16 September 2016


QSR INTERNATIONAL PTY LTD 2015. NVivo qualitative data analysis Software. 11 ed.


SHORT, J. R. 2015. A perfect storm: climate change, the power grid, and regulatory regime change after network failure. Environment and Planning C: Government and Policy, 34, 244-261.


Chapter Eight: Prologue

Chapter Seven found that network operators are perceived as actively ‘pushing back’ on increasing levels of distributed renewable energy, including residential solar energy systems, by increasing uncertainty around connection application acceptance, by increasing connection queue times and by transferring network stability costs, in particular transformer upgrades and generation management, to customers wishing to connect distributed generation. Stakeholder perceptions suggested that governments, while supportive of residential solar energy adoption by providing financial incentives, could demonstrate increased levels of socio-political acceptance or support for renewable energy, and that in the absence of such socio-political acceptance network operators would have incentives to prioritise the ‘locked in’ incumbent electricity regime. Governments’ socio-political support for distributed renewable energy, including solar, might include the creation of a ‘vision’ for how a future electricity regime should look, and in particular modify regulations and support policies to see network operators make effective use of distributed generation. This could have benefits for customers, through reduced network investments and therefore lower costs, and also generate environmental benefits through increased energy efficiency and adoption of renewable energy. No such over-arching ‘vision’ for a regime-wide transition towards increased penetration of renewable energy exists in Australia. However, renewable energy adoption in Australia is guided by an Australian Government policy, the Renewable Energy Target.

The next Chapter considers stakeholder perceptions of the Renewable Energy Target to consider the extent to which it is functioning according to their expectations, in particular taking advantage of a 2012 Review Process to examine perceptions and government responses. The results are compared with earlier review processes to determine whether the Australian Government has improved its consultation-based policy development processes, or whether it maintains a tendency towards prioritising review processes in the place of policy reform. This Chapter therefore considers the effectiveness of the most significant tool for socio-political acceptance of renewable energy in Australia, and the potential ramifications of changes to this policy on industry. With particular relevance to the research in this thesis, the next Chapter also considers the extent to which the Solar Credits Multiplier, a policy included under the Renewable Energy Target, was an effective tool for the promotion of residential solar adoption. This Chapter examines industry, non-
government organisation, and other stakeholder submissions to the review process, grouping responses to create generalisable perceptions of this renewable energy policy. An addendum to the Chapter is provided on its conclusion, providing an update on the policy since the submission of the paper for publication.

The research focuses on consideration of the socio-political dimension of Wustenhagen et al's (2007) 'triangle of social acceptance of renewable energy innovation' in that it takes a detailed analytical view of Australia’s most long-term policy tool for the promotion of renewable energy, the Renewable Energy Target. Trust in continuation and reliability in government policies, including issues around sovereign risk, are considered in the Research and Discussion section of the Chapter.


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Picking Winners and Policy Uncertainty: Stakeholder Perceptions of Australia’s Renewable Energy Target

Abstract

Australia’s Renewable Energy Target (RET) mandates investment in renewable electricity generation through a renewable energy certificate market. A legislated national consultative review of the RET was carried out in 2012, resulting in 8,660 submissions. Respondents were invited to comment on the value of the legislated target, including whether the legislated target should be a fixed GWh target or a fixed policy-based percentage-of-demand target, and the impact of review processes on the renewable energy industry. This paper presents the first analysis of submissions and evaluates their implications for the future of this policy. There was a consistent alignment of opinion amongst respondents, with industry and fossil-fuel generation/retailer groups opposing the RET objectives, whilst these were supported by NGOs and the renewable sector. However, most respondents favoured maintaining the overall goal of providing 20% renewable electricity generation by 2020. Concerns were raised by most groups of respondents regarding policy continuity and excessive reviewing procedures. In its response to the review, the Climate Change Authority made a total of 34 recommendations, 18 maintaining the status quo. Only six recommendations were endorsed by the Australian Government that would result in changes to the scheme. It is concluded that such review processes can be significantly harmful to maintaining stability and certainty in an industry requiring long-term commitment for investments, and that the Australian Government continues to favour the status quo in responding to consultative review processes relating to renewable energy policies.
8.1 Introduction – The Renewable Energy Target Legislation and Review Processes in Australia

The role of renewable energy in replacing incumbent fossil-fuel generating electricity systems is assuming greater significance as governments are under pressure to reduce greenhouse gas emissions. The enduring question within the renewable energy policy framework is how much support (economically and otherwise) the renewable energy industry requires to thrive.

Australia has had three manifestations of national legislation aimed at promoting the renewable energy industry and, in turn, reducing greenhouse gas emissions. The measurable outcome of these policies is to see an increase in the proportion of ‘clean’ generation technologies in the electricity generation mix (Climate Change Authority, 2012a). This is done by requiring electricity retailers to source a proportion of the electricity for their customers from certified ‘clean’ generators through the purchase of renewable energy certificates, encompassing both large-scale renewable sources such as wind farms and small-scale sources such as household renewable technologies.

Periodic reviews of the schemes were included as a requirement of the legislation. The first of these reviews was the Tambling Review in 2003, which invited submissions on the functioning of the initial legislation (Climate Change Authority, 2012a). Subsequent to the Tambling Review were frequent additional review processes that considered the legislative framework, specific aspects of the legislation and the interaction between the legislation and other policy initiatives (Australian Government, 2013b). A review of the most recent incarnation of the legislation, to be undertaken by the independent Climate Change Authority, was initiated in August 2012 (Climate Change Authority, 2012a).

These review processes and the broader academic literature regarding renewable energy certificates highlight various issues with the development of such policies. These include the lack of appropriate consultation processes when developing legislation (Ross et al., 2012); the lack of certainty and consistency in renewable energy policies, in particular for small-scale renewable energy technologies (White et al.); and the on-going commitment to existing policies favouring the status quo and fossil-fuel generating industries in particular (Effendi and Courvisanos, 2012).
Kent and Mercer (2006) proposed that the submissions made available as part of the 2003 Tambling Review provided potentially the most comprehensive overview of the status of Australia's renewable energy sector. Ten years have elapsed since this review, with changes in Government, relevant legislation and industry over this time. An assessment of the submissions to the most recent review of the legislation, the 2012 Climate Change Authority's review of the RET, therefore provides insight into the current state of the renewable energy sector and perceptions of renewable legislation and associated policy development processes.

8.2 MATERIAL AND METHODS

The Climate Change Authority undertook a consultative review process, including the development of an issues paper for general comment, and a discussion paper that provided a draft of final recommendations for further comment. There were 8,660 submissions received in response to the Issues Paper (8,500 campaign submissions and 160 stakeholder submissions), with 54 responses to the Discussion Paper (Climate Change Authority, 2012a). Four roundtables and 60 one-on-one interviews were undertaken over the course of the review process.

This assessment of the Australian Government's Renewable Energy (Electricity) Act 2000 legislation and the associated Climate Change Authority Review of the RET follows a similar approach to Kent and Mercer's (2006) evaluation of the Tambling Review process. Submissions to the Climate Change Authority's Issues Paper were critically assessed against the questions posed within the Review Issues Paper. All submissions were assessed according to criteria as outlined in Kent and Mercer (2006), namely the type of stakeholder, their overall perspective of the legislation (whether they support or reject its value) and any particular issues of note to the stakeholder. Particular issues of interest were those surrounding the effects of uncertainty in the legislation on industry, including in relation to the GWh target, the effects of continual review processes, and perceptions of embedded policies favouring other technology types, including a certificate multiplier for small-scale photovoltaic systems. Information on the number of responses to particular themes was recorded by stakeholder type (peak industry group, corporation, academic, individual, environmental NGO), with supporting statements provided alongside each respondent's details.
The Final Review Report was released on 19 December 2012 (Climate Change Authority, 2013). The Australian Government’s formal response to recommendations outlined in the Final Review Report was released on 23 March 2013 (Australian Government, 2013a). The Climate Change Authority’s recommendations and the Australian Government’s response to the Climate Change Authority’s Review Report were examined. Analysis of the extent to which the Australian Government is prepared to undertake modifications to the legislation in light of the Climate Change Authority’s findings assisted in determining whether the review process is seen as beneficial to Australia’s renewable energy industry or whether it is an unnecessary disturbance.

Collection of data for the research was via the Climate Change Authority website (Climate Change Authority, 2013), which publishes all calls for submission, submissions from stakeholders and the Review Report itself. The Australian Government published its response to the Climate Change Authority’s Review Report and recommendations through the Department of Climate Change and Energy Efficiency website (Australian Government, 2013a).

8.3 Theory – Australia’s RET – Targets, Legislation and Reviews

The first of Australia’s renewable energy schemes came into force in April 2001 under the Renewable Energy (Electricity) Act 2000 (Kent and Mercer, 2006). The key measure of the Act was the initiation of the Mandatory Renewable Energy Target (MRET), which was to see a 2% per annum increase to renewable energy generation by 2010, from a 1996/1997 10.5% baseline. Energy demand forecasts at the time of setting the target were used to equate the additional 2% renewable generation to a GWh target, namely 9,500 GWh, which was the legislated target included in the Act.

Periodic reviews of the scheme were included as a requirement in the legislation. The Tambling Review in 2003 invited submissions on the functioning of the MRET (Australian Government, 2003). The review process determined that an increase in electricity demand between the scheme’s initiation and the time of review had resulted in the 9,500 GWh target equating to less than a 2% increase in renewable generation. The Review Panel’s recommendations included maintaining the 9,500 GWh target to 2010 and then increasing
the target to 2020 to promote industry investment. The Government supported the maintenance of the 9,500 GWh target but rejected the proposal to expand the scheme. The Review Panel also considered amending the legislation to state a fixed percentage target with a floating GWh value, as opposed to the fixed GWh target. The Review Panel recommended maintaining a fixed GWh target to ensure certainty for investors.

In August 2009, legislation was passed to implement the expanded national RET, which brought the former MRET and existing and proposed state and territory schemes into one national scheme (Jones, 2010). It expanded the previous MRET to a forecast 20% contribution to the electricity mix by 2020, set in the legislation as 45,000 GWh. The RET also included specific support for small-scale, rooftop solar photovoltaic systems, through the ‘Solar Credits Multiplier’ (Climate Change Authority, 2012a).

In June 2010, further legislation was passed to separate the expanded national RET into two parts, the Large-scale Renewable Energy Target (LRET), covering large-scale projects such as wind farms, commercial solar and geothermal, and the Small-scale Renewable Energy Scheme (SRES), covering domestic photovoltaic, wind turbine and efficient water-heating technologies (Climate Change Authority, 2012a). The legislation separated the 45,000 GWh target into 41,000 GWh by 2020 for the LRET and a minimum 4,000 GWh by 2020 for the SRES. The changes were designed to provide greater certainty for large-scale renewable energy projects, households and installers of small-scale renewable energy systems.

To date, the MRET and RET have resulted in renewable energy capacity almost doubling from 10,650 MW in 2001 to 19,700 MW in 2012 (Climate Change Authority, 2012a). In spite of this, due to an increase in demand for electricity within Australia, renewable electricity generation as a proportion of total electricity generation per year has not changed significantly since 2000/01, having grown from approximately 8% to 10%. Wind and solar photovoltaic (PV) technology make up the majority of new renewable generation as a result of the MRET and RET (Australian Government, 2012). Wind generation has grown under the RET from 200 GWh in 2000/01 to 5,800 GWh in 2010/11. Solar photovoltaic generation has increased over the same time period from 50 GWh to 850 GWh (Figure 8.1).
Under the 2011 updated legislation enacting the RET, the Climate Change Authority was tasked with completing a review of the scheme before the end of 31 December 2012 (Parliament of the Commonwealth of Australia, 2011). While the Climate Change Authority did not have a stipulated Terms of Reference for undertaking the review, any recommendation put forward by the Authority may not be inconsistent with the objectives of the Act, which were to a) encourage the additional generation of electricity from renewable sources; b) reduce emissions of greenhouse gases in the electricity sector; and c) ensure renewable energy sources are ecologically sustainable (Climate Change Authority, 2012b).

### 8.4 RESULTS AND DISCUSSION

All of the 160 stakeholder submissions were read and analysed according to areas of note within the Issues Paper. The 8,500 campaign submissions were derived from two key sources: GetUp, a grassroots community advocacy group (7,806 submissions); and Hepburn Wind, a co-operative implementing the first community-initiated wind farm in Australia (694 submissions). With each of these two groups of campaign submissions treated as a
single stakeholder submission, the total number of submissions assessed was 162 (Table 8.1).

The following discussion focuses on issues cited most frequently by industry and the public with regard to the RET and is applicable to other international renewable certificate trading mechanisms.

8.4.1 Real, Revised and Projected - Changes to the RET Target
A major focus of the RET review was the consideration of whether the Target should be increased, decreased or maintained at the current legislated level. The decision to reassess the target was largely in response to reductions in energy demand forecasts resulting in the 45,000 GWh target making up approximately 26% of expected electricity demand by 2020/21 (Climate Change Authority, 2012a). Reasons cited by respondents for the reduction in demand included increased small-scale renewable system installation, installation of energy efficient appliances, milder summers and winters and changes to the industrial nature of Australia (closing of manufacturing and processing plants).
Approximately 17% of stakeholders responding to this line of questioning (N = 132) requested an increase in the target to 2020. Respondents recommending an increase to the target were primarily non-government associations and individuals (17 responses), and renewable-focus corporations and industry groups (5 responses). The majority of these responses argued for an increase in the target to reduce greenhouse gas emissions within Australia, with many citing the Copenhagen Accord’s goal of a 5% reduction in emissions relative to 2000 by 2020 as a primary driver for the need to reduce emissions. A handful of respondents also focused on the need to invest in renewable energy generation to diversify Australia’s electricity generation system, avoiding the impacts of increasing fossil fuel costs associated with ‘peak oil’ and exposure to international gas markets.

Approximately 14% of respondents to this portion of the Issues Paper (N=132) argued for a reduction in the value of the 2020 target to match current demand forecasts. All but one of these respondents were from corporations or industry groups with a mixed-energy (fossil fuel and renewable) or fossil fuel focus. The majority of respondents noted increasing electricity costs associated with the RET as damaging for business and that the Australian Government should therefore endorse its initial commitment to ‘20% renewable energy by 2020’. Additionally, most stakeholders stated that the 2012 implementation of a carbon pricing mechanism in Australia meant there was no need for the RET. Respondents stated that the RET should only be maintained to 2020 in order to ensure investor certainty.

While some renewable-focused stakeholders supported an increase to the 2020 target, 89% of them requested that the current 2020 target be maintained (N=45). This is a counter-intuitive response given it is renewable-focused industry that is most likely to benefit from an increase in the target. A total of 63% of all respondents requested that the target be maintained (N=132), with responses spread across all stakeholder groups except fossil-fuel based corporations. The reasons for maintaining the target were varied, with many responses refuting reasons put forward to reduce the target to updated demand projections. It was noted that demand forecasting practices are inherently unreliable and that any number of changes in the future could alter the demand profile. There was considerable speculation that making significant changes to the RET as a result of the introduction of the carbon pricing mechanism may be unwise. It was suggested that Australia’s carbon pricing mechanism may not be able to facilitate investment in renewable energy as a result of its currently low value, the exposure of the carbon price to
international markets, and most importantly that the security of the carbon pricing mechanism is not assured. The Australian Government opposition party has vowed to abolish the carbon pricing legislation if it gains power following the September 2013 General Election (Fitzpatrick and Owens, 2013). Importantly, respondents noted that the Australian Government’s explicit policy commitment was to meet ‘at least’ 20% of electricity demands in 2020 through renewable generation, and that this did not provide for a maximum renewable commitment. Finally, 38% of respondents to this line of questioning (N=132) stated that the RET should be maintained at the current target level in order to maintain investor confidence.

Interestingly, only 6% of submissions responding to this line of questioning suggested unequivocally that the RET should be abolished. All but one of these submissions stated that the main reason for abolishing the RET was that it was no longer required as a carbon pricing mechanism had been established, and that the RET did not provide least-cost abatement. This is in spite of the fact that, of those respondents stating whether they supported or opposed the RET, 13% were against its inception. The difference between the number of stakeholders opposing the RET and the number recommending its abolition stems from the realisation that the RET has become a component of the Australian energy market, and that considerable investment by business has been made with regard to the RET. Both sides of the RET debate, those supporting and investing in renewables and those reliant on fossil-fuel generation, increasingly understand the importance of maintaining investor confidence in Australia by ensuring stability in policy. Increase in sovereign risk associated with changes to the RET, even if incremental, were deemed to extend beyond the renewable energy sector to other areas of the Australian industrial economy.

Kent and Mercer (2006) noted that the Tambling Review Panel recommended maintaining the legislated target to ensure industry certainty. Additionally, the Australian Government agreed to a GWh target in Parliament on three separate occasions in 2000 (Parliament of the Commonwealth of Australia, 2000), 2008 (Parliament of the Commonwealth of Australia, 2008) and 2010 (Parliament of the Commonwealth of Australia, 2010). The reasons behind this conclusion have not changed, and therefore there is reason to question why the target was reassessed given it was not specifically required within the Climate Change Authority’s remit. The removal of subsection 162(h) from the Renewable Energy (Electricity) Act 2000 (2009a), that the Review must include consideration of ‘the level of the overall target and
interim targets’, was included within the Renewable Energy (Electricity) Amendment Act 2009 (2009b). Though the explanatory memorandum makes no specific mention of why this requirement was repealed (Parliament of the Commonwealth of Australia, 2009c), its removal does indicate that consideration of the target’s value was deemed unnecessary.

Leading up to the initiation of the review process there was considerable scrutiny of the GWh value of the target within the Australian media. Media interest was driven in large part by fossil-fuel based generation corporations and high electricity consumers noting financial implications associated with the RET (Hepworth and Crowe, 2012, Manning, 2012). Renewable interest groups were then vocally opposed to the reduction of the target in response to industry demands, citing this as self-interested behaviour (AAP, 2012, Thornton, 2012). Kent and Mercer’s (2006) concluding remarks note that respondents will be inherently self-interested in their contributions to consultative policy development processes. The case of stakeholder responses to the target review is clearly an example of this assertion in practice, with the power of stakeholders and the media apparently influencing review panel decisions to the potential detriment of the renewable energy industry.

8.4.2 TO REVIEW OR NOT TO REVIEW? – FREQUENCY OF REVIEW PROCESSES

One of the most repetitive themes within submissions to the Climate Change Authority Review process was the potentially damaging impact of the Review process itself. The Review process was a legislative requirement of the RET scheme, however, the length of time between implementation of the most recent (2010) changes to the scheme and the initiation of the Review process was seen as unnecessarily short. 60% of respondents to the section of the Issues Paper requesting consideration of the frequency of reviews (N=70), from across the full spectrum of stakeholders, noted that the main concern in relation to future review processes was the need to maintain policy certainty and ensure minimal disruption to industry. 77% of stakeholders stated that the legislation should be amended so that there would be more than two years between each review process (N=70). An additional 9% of respondents indicated that it was not appropriate to change legislation to increase time between reviews, as this would create additional investment insecurity, but that the scope of future reviews should be limited considerably and should be made explicit well ahead of time. In particular, many respondents noted that there should be only a long-run fixed review timetable, limited to determining whether future targets were large.
enough to support on-going renewable energy investment, with smaller reviews undertaken only when a certain threshold had been reached, for instance when the shortfall penalty charge (which acts as a price ceiling in the certificate market) was being paid instead of purchasing large-scale renewable certificates.

The focus of submissions on the length of time between review processes was unsurprising considering the negative consequences of concurrent and frequent review processes was noted within the Tambling Review. The Parer Review, which was undertaken concurrently with the Tambling Review, examined the most cost-effective means of reducing greenhouse gas emissions and found that the MRET was inefficient and that an emissions trading scheme would result in greater environmental benefits (Kent and Mercer, 2006). These review findings, and the fact that both review processes were undertaken concurrently, were found to create a level of uncertainty within the electricity generation industry. This situation was later echoed with the finalisation of the RET legislation reportedly overshadowed by the release of the White Paper on the Carbon Pollution Reduction Scheme (the Australian Government’s emissions trading scheme) and associated claims by industry that such a scheme would increase electricity costs (Jones, 2010). The on-going lack of clarity in the relationship between review processes, potential subsequent changes to RET legislation, and the interaction between the RET and an emissions trading scheme creates long-term uncertainty for industry.

In addition to the recurring theme of uncertainty surrounding on-going review processes, stakeholders also noted ‘review fatigue’, with ten review processes specifically related to the RET in the last five years (Australian Government, 2013b), naught resulting in substantial changes to the policy framework. The Australian Government’s decision to provide opportunities for stakeholder feedback at multiple steps in the development of legislation is evidence of its preference for consultative policy-development processes, a system which is increasingly being questioned. Crase et al. (2005) found that such community consultation processes may be inefficient as successive consultation processes may contain unique questions and responses to the extent that each consultation process must be started anew, without an opportunity for policy-makers to learn from the outcomes of previous consultation processes. Contrary to this, the RET Issues Paper responses indicate that the opposite is true – stakeholders are growing increasingly frustrated with covering similar material, with the same outcomes, in on-going review processes. That the
previous review processes have been ineffectual in creating marked change to the policy environment, for the betterment of industry or with additional environmental benefits, indicates that these review processes are ultimately more likely to result in delays in investment and industry uncertainty. As one respondent to the Issues Paper put it, ‘constant review is not reform’ (AGL Energy, 2012).

8.4.3 ‘Picking winners’ in renewable energy policy – The Solar Credits Multiplier and other schemes
The Solar Credits Multiplier was introduced to the RET in 2009 by the Australian Government as a replacement for the oversubscribed $8,000 Solar Homes and Communities Grant (Climate Change Authority, 2012a). In creating the Solar Credits Multiplier the Australian Government was able to shift the financial burden of the Grant from their own budget to electricity consumers. The Australian Government initially designed the scheme with a five times multiplier, reducing each financial year to one (Climate Change Authority, 2012a). Additionally, each small-scale photovoltaic system received generation certificates based on a forecast 15 year 'deeming period' (Climate Change Authority, 2012a). The combination of the solar credits multiplier and the deeming period led to an initial upfront rebate equivalent to 75 years of generation. The 75 years of generation for a system at the initial certificate price was equivalent to approximately $7,500 (Climate Change Authority, 2012a), close to the value of the Grant the Solar Credits Multiplier was replacing.

The Solar Credits Multiplier was credited with increasing uptake of small-scale solar systems, with 18% of respondents to this line of questioning noting that the scheme resulted in substantial investment (N=68). However, a larger proportion of submissions criticised the use of the policy to stimulate investment. A confluence of factors was cited as causing the Solar Credits Multiplier scheme to become oversubscribed, including the initiation of generous state-based feed-in tariff schemes and increased demand creating scales of economies that reduced the price of systems. In response to the increased generation of certificates associated with the scheme the Australian Government decreased the multiplier ahead of schedule on two occasions (Climate Change Authority, 2012a), resulting in uncertainty for the small-scale solar industry. With regards to the Issues Paper submissions, three key criticisms of the Solar Credits Multiplier were proposed.
8.4.3.1 ‘PHANTOM CREDITS’
The Solar Credits Multiplier was unfavourably received by 18 respondents who noted that the multiplication of ‘real’, deemed certificates created ‘phantom credits’: certificates that did not equate to actual abatement and yet still contributed to the achievement of the target. There were even calls by some respondents that the RET target should be increased to take into account the generation of phantom credits. The exact number of phantom credits allocated under the RET between the initiation of the scheme in 2009 and the final generation of credits at the end of 2012 has not been made public. However, data available through the Clean Energy Regulator indicates that ‘phantom credits’ could have contributed approximately 66% of the certificates required to meet the RET target between 2009 and 2012 (Table 8.2).

Table 8.2 - Number of renewable energy certificates required under the RET 2009-2012, compared to an estimation of the number of ‘phantom credits’ generated in this period. Estimation of ‘phantom credits’ based on publicly available data on the number of systems installed by time period, postcode and average capacity of systems installed (Clean Energy Regulator, 2014).

<table>
<thead>
<tr>
<th>Certificate Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Energy Certificate / Large-scale Certificate Target (Clean Energy Regulator, 2013a)</td>
<td>47,763,000 Certificates</td>
</tr>
<tr>
<td>Small-scale Certificate Target (Clean Energy Regulator, 2013b)</td>
<td>72,786,000 Certificates</td>
</tr>
<tr>
<td>Phantom credits generated</td>
<td>79,605,000 Certificates</td>
</tr>
<tr>
<td>Phantom contribution</td>
<td>66%</td>
</tr>
</tbody>
</table>

8.4.3.2 BOOM-BUST CYCLES
The reduction of multipliers over time was found to create large surges in sales prior to the reduction of a multiplier, with householders attempting to take advantage of the higher rebates, followed by bust periods with reduced householder investment, resulting in boom-bust cycles noted by nine respondents. Data available from the Clean Energy Regulator (Clean Energy Regulator, 2014) reflect the reality of boom-bust cycles, with peaks in small-scale installation rates coincident with the end of multiplier periods (Figure 8.2). The boom-bust cycles were felt doubly by installers – not only were market sales of small-scale renewable systems experiencing fluctuations in demand but there were coincident
fluctuations in the value of generation certificates sold within the RET market. The drastic reduction in demand for certificates, and reduction in their value, led to several members of the small-scale solar industry entering receivership (Solar Energy Industries Association Inc, 2012). One submission also credited reduced installation quality and education of customers, including appropriate system choice and system orientation, with installers trying to rush installations through within higher multiplier time periods (Australian PV Association, 2012).

![Figure 8.2](image)

**Figure 8.2 – Number of small-scale solar systems installed in Australia and reductions in the Solar Credits Multiplier.** Reductions in the number of installations subsequent to reductions in the multiplier are indicative of ‘boom and bust’ cycles. Data collected from the Clean Energy Regulator (Clean Energy Regulator, 2014).

### 8.4.3.3 REC OVERHANG

The introduction of phantom credits, combined with the over-subscription to the scheme, resulted in an excessive number of certificates being generated. There were two closely associated outcomes: the larger than expected number of certificates generated through the market resulted in retailers purchasing enough certificates to cover their RET liability for several years, reducing future demand for certificates. The reduction in demand for
certificates led to a drop in the market value of certificates still being sold through the market, to the extent that the construction of new large-scale installations is no longer viable. This ‘overhang’ of certificates and the devaluation of RECs were noted by 18 respondents. While the crowding-out of large-scale renewable energy by excessive small-scale generation was remedied through the separation of the RET into the LRET and SRES, with separate GWh targets and certificate types, the REC overhang still exists, with many retailers still stockpiling enough RECs to meet obligations out to 2015/2016, essentially stalling investment in large-scale generation for the period between 2011 and 2015/16.

Kent and Mercer (2006) found that mandating of particular technologies (through multiple certificates and excess quotas) was near unanimously opposed in submissions to the Tambling Review, as it was deemed as a way of ‘picking winners’ in regards to technology types as opposed to allowing the most economically efficient technologies to advance. Claims by small-scale renewable energy industry in the media that the Solar Credits Multiplier was required to promote the installation of systems and support the small-scale industry (Ecogeneration, 2013) were ultimately off-set by responses to the Issues Paper that the Solar Credits Multiplier was inefficient and resulted in unnecessarily high increases in electricity tariffs. Ross et al. (2012) noted that renewable energy policies that generate high levels of industry growth over the short-term, but cannot be sustained financially, undermine long-term industry development. Furthermore, Valentine (2010) indicated that the Solar Credits Multiplier was harmful to the renewable energy sector in that it allowed small-scale systems to outcompete utility-scale development. The Solar Credits Multiplier then proved all these assertions correct: it was shown to increase the demand for small-scale solar photovoltaic systems to the extent that economies of scale were achieved, but it was also found to have negative, cascading effects across the renewable energy market and to all electricity consumers. That 87% of respondents referring to this line of question (N=68) either rejected the use of multipliers (or banding) in future, and/or noted the negative impacts of the Solar Credits Multiplier to the scheme, indicates that the Solar Credits Multiplier was ultimately deleterious to the RET scheme. Approximately 19% of respondents supported the use of multipliers (or banding), and then only in specific cases where generation of certificates was likely to be low, with many of these respondents also noting that the Solar Credits Multiplier had resulted in undesirable outcomes in the RET.
8.4.3.4 Incumbent Support for Other Technology Types

There was considerable criticism within Issues Paper submissions regarding the inclusion of two additional support mechanisms for technologies. The inclusion of waste coal mine gas received particular criticism from respondents, in particular because this is not an ‘ecologically sustainable’ renewable energy source, as is stipulated in the RET legislation. The inclusion of waste coal mine gas is as a result of the harmonisation of jurisdictional targets prior to the 2009 expansion of the RET (Climate Change Authority, 2012a), including New South Wales’ support for waste coal mine gas. As only waste coal mine gas generation systems built in New South Wales during its target scheme are supported competitive inequity exists between generators wanting to utilise waste coal mine gas. 64% of the respondents to this line of questioning (N=42) explicitly requested its removal from the RET, with only two respondents requesting that new waste coal mine gas be capable of generating certificates under the RET. The remainder of respondents all proposed maintaining the current arrangements, to provide on-going support to existing facilities or simply to ensure that the legislative framework remained unchanged.

The inclusion of technologies that do not generate electricity but may displace the use of electricity – so-called displacement technologies – was an area of contention within submissions, with 42% of respondents to this line of questioning supporting displacement technologies’ removal from the scheme, and 39% supporting its expansion to other technology types (N=31). The 2001 MRET included support for small-scale solar water heaters and heat pump water heaters as a way of promoting investment in these manufacturing industries in Australia (Gas Industry Alliance, 2012). While the majority of these systems are now imported into Australia the legacy of supporting this industry, particularly in light of its contribution to energy efficient technology uptake, has led to the view that support for this industry is still useful. The inclusion of solar water heaters and heat pump water heaters in the RET continues to be contentious, not only for the fact that these are not renewable electricity generation resources, but also because new displacement technologies, in particular cogeneration and ground source heat pumps, are not included in the RET.

The lack of alternative schemes to appropriately support waste coal mine gas generation and displacement technologies, and continuing concern that the carbon pricing mechanism may prove inadequate or be revoked, led the Climate Change Authority to recommend
retaining both mechanisms, with the outcome that inequity will continue to exist between waste coal mine gas generators and elements of the displacement industry.

Lindblom's (1979) 'disjointed incrementalism', where policy-makers pursue a limited range of well-analysed policy alternatives, is particularly relevant in this case, which sees an inherently conservative approach to policy-making preferred. Kent and Mercer (2006) found this policy development technique was typified in the development of the former Liberal (conservative) Government's MRET. Consistent with the incremental policy development process, the Liberal Australian Government's response to the Tambling Review's findings had emphasised a 'business-as-usual' policy framework, with fossil-fuel continuing to dominate the energy sector in future. In this case the Climate Change Authority has also favoured a 'business-as-usual' policy framework that favours both the incumbent renewable generators, but also support mechanisms that may not serve the objectives of the RET to provide least-cost renewable generation.

8.4.4 CLIMATE CHANGE AUTHORITY REVIEW RECOMMENDATIONS AND GOVERNMENT RESPONSE

On completing the consultation process, the Climate Change Authority produced a Final Review Report that included 34 recommendations for the Australian Government's consideration (Climate Change Authority, 2012a). Of these 34 recommendations, 18 supported the existing scheme, five recommended further review, consultation or assessment and 11 proposed changes to the scheme (Table 8.3). Of these 11 only six were accepted outright, with three of these accepted recommendations covering minor administrative components of the scheme (Australian Government, 2013a). The key recommendation accepted by the Australian Government confirmed that the periodical review process would be undertaken only once every four years. The other recommendation with appreciable effects on the renewable energy industry related to the decision to reduce the deeming of certificates from 15 years, however this will not come into effect until 2017.

The review process therefore supported relatively incremental changes to the policy. Given no great changes have been suggested to promote increased uptake of renewable energy, or conversely to provide additional support for electricity consumers suffering under the burden of the RET, the review process is likely to have caused more harm than good purely
by introducing a perception of policy uncertainty. While the outcomes of the review process suggest that the Climate Change Authority has taken heed of the advice from industry to minimise changes to the scheme, and the Australian Government has gone one step further to maintain the status quo within the Scheme, there may be value in determining whether the Review should have been undertaken at all, particularly given the Australian Government’s apparent preference for maintaining the status quo in the majority of review processes.

The case of the 2012 Climate Change Authority Review of the RET, and the Australian Government’s response, could therefore be considered ‘choreographed consultation’. Cheeseman and Smith (2001) found that a consultative policy-development process resulted in little actual influence on policy direction, but that the consultation process garnered support for policies already in train. If anything, the RET review process allowed the Australian Government to cite support from a variety of stakeholders, including industry and the general public, with regard to the implementation of policies to support renewable energy in Australia. In doing so, the Australian Government was able to rebuke claims from industry that it would be in Australian consumers’ best interests to support a decrease to the 45,000 GWh target.
Table 8.3 – Summary of the Climate Change Authority recommendations with regard to the Renewable Energy Target (including recommendation number), and the Australian Government response to these recommendations (Climate Change Authority, 2012a, Australian Government, 2013a)

<table>
<thead>
<tr>
<th>Recommendations for change</th>
<th>Accepted</th>
<th>Further work required</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Four years between reviews recommended (1)</td>
<td>- Large-scale consumers can ‘opt in’ to buy certificates directly from the market (13)</td>
<td>- Threshold for small-scale systems changed from 100 kW to 10 kW (6)</td>
<td></td>
</tr>
<tr>
<td>- SRES should be phased out by reducing the deeming period, starting in 2017 (8)</td>
<td>- Partial Exemption Certificates for Emissions-Intensive Trade Exposed Industries made tradeable (21)</td>
<td>- Clearing house to be converted to ‘deficit sales house’ (9)</td>
<td></td>
</tr>
<tr>
<td>- Over-surrendered certificates to be refunded (17)</td>
<td>- Changes to scheme administration (10,11,15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Adjustments to targets beyond 2020 (4)</td>
<td>- Self-generator definition amended to allow incidental off-take of electricity by community groups (24)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Level of Partial Exemption Certificate for Emissions Intensive Trade Exposed Industries considered by Productivity Commission (19)</td>
<td>- Further analysis into inclusion of Native Forest biomass in the RET (28)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Consider impact of RET on competitiveness of emissions intensive trade exposed industries (20)</td>
<td>- Align auditing between RET and other Commonwealth reporting measures (22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Align auditing between RET and other Commonwealth reporting measures (22)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recommendations for further review or consideration
- Adjustments to targets beyond 2020 (4)
- Level of Partial Exemption Certificate for Emissions Intensive Trade Exposed Industries considered by Productivity Commission (19)
- Consider impact of RET on competitiveness of emissions intensive trade exposed industries (20)
- Align auditing between RET and other Commonwealth reporting measures (22)
- Further analysis into inclusion of Native Forest biomass in the RET (28)

Recommendations for maintenance of existing characteristics
- 18 recommendations for no change (2, 3, 5, 7, 12, 14, 16, 18, 23, 25, 26, 27, 29, 30, 31, 32, 33, 34)
8.5 CONCLUSION

The submissions to the RET Issues Paper demonstrate that while the RET mechanism is increasing the penetration of renewable technologies within Australia, and stakeholders, including industry and the general public, are largely supportive of the Scheme, there are misgivings about some elements of the operation of the Scheme. Primarily, stakeholders perceive that the RET would be more successful if it was devoted to least-cost renewable technologies, and therefore sub-schemes that favour technology types should not be included under the Scheme. The overwhelming conclusion that can be drawn from the submissions, however, is that uncertainty within the policy environment remains the key threat to meeting the RET scheme Target. This uncertainty is felt through the unknown interaction between the RET and the carbon pricing mechanism, the frequent introduction of review processes that undermine investment certainty and the interaction between state-based policies and the renewable energy industry. The necessity of ensuring a set GWh target for the RET, and providing confidence to investors that this will not be amended, regardless of future potential review processes, cannot be overstated. While the Climate Change Authority's recommendation to maintain the current GWh target, and increase the time between reviews from two years to four years, goes some way to increasing confidence within the renewable energy industry, the potential renegotiation of the target and re-review of the Scheme should the Australian Government change hands in September 2013, undermines these efforts. In order for there to be true confidence in the Target, bipartisan support of the RET, and implementation of all agreed recommendations of the Climate Change Authority, is required.

8.6 REFERENCES


WHITE, W., LUNNAN, A., NYBAKK, E. & KULISIC, B. In press. The role of governments in renewable energy: The importance of policy consistency. *Biomass and Bioenergy*. 

CHAPTER EIGHT: ADDENDUM

Chapter Eight highlighted three key issues with the development and delivery of the Australian Government’s Renewable Energy Target Scheme and associated policies. Firstly, renewable energy policies are considered to be inconsistent over time; secondly, consultative review processes around energy policies create uncertainty in the renewable energy industry; and thirdly, governments favour the status quo when developing and implementing renewable energy policies. Chapter Eight concluded by indicating that potential renegotiation and re-review of the Renewable Energy Target if the Australian Government were to change hands in September 2013 would undermine efforts to increase confidence within the renewable energy industry. Three years have passed since the paper in Chapter Eight was submitted for publication and it is worth reflecting on whether there have been changes to the delivery of renewable energy policies since the 2012 Review.

Chapter Eight identified that the key change to the Renewable Energy Target coming out of the 2012 Review process was that the number of years between legislated reviews would increase from two years to four years. Unfortunately, the left-wing Labor party was not able to pass changes to legislation enacting an increase in years between reviews before it was subsequently defeated by the right-wing Liberal party in the September 2013 federal election. The Liberal Party emphasised continued support for the Renewable Energy Target in its suite of policy platforms approaching the 2013 election. However, the Liberal party at that time also noted industry complaints around electricity price affordability and suggested that the 2014 Review process was an opportunity to examine the cost impacts of the Renewable Energy Target, raising concerns in the renewable energy industry of future changes to the Renewable Energy Target policy (Arup and Hannam, 2013).

As part of a package of legislative reforms relating to ‘costly’ climate change policies, the incoming Liberal Australian Government attempted to abolish a number of climate change bodies, including the Climate Commission, the Australian Renewable Energy Agency, the Clean Energy Finance Corporation and the Climate Change Authority, which was the agency tasked with reviewing the Renewable Energy Target within legislation (Jotzo, 2013). Given the Government’s intention to abolish the Climate Change Authority, an ‘Expert Panel’, situated within the Department of Prime Minister and Cabinet, was created to undertake the 2014 Renewable Energy Target Review. The Chair of the ‘Expert Panel’, Dick Warburton,
was identified as a climate change denier, which led many in the renewable energy industry to foreshadow the Review’s findings (Arup, 2014). Additionally, the ‘Expert Panel’ chose to engage consultants who had existing ties with fossil-fuel based industries, further strengthening expectations that the review findings would not be favourable to the renewable energy industry (Parkinson, 2014).

The so-called Warburton Review was initiated in February 2014 with a lengthy consultation process, including more than 23,000 submissions and over 200 meetings with stakeholders (Warburton, 2014). Simultaneously, the Australian Government was unsuccessful in passing legislation to abolish the Climate Change Authority, so they too were required to undertake a legislative review in 2014 (Parliament of Australia, 2014). In order to reduce the likelihood of the ‘consultation fatigue’ noted in Chapter Eight, the Climate Change Authority decided to undertake its review using publicly available submissions from the Warburton Review (Climate Change Authority, 2014). Personal communication with a member of the team reviewing the Renewable Energy Target for the Climate Change Authority identified that the paper included as Chapter Eight, which was provided as an appendix in a formal submission to the Warburton Review (Appendix 4), contributed to this decision.

The two review processes put forward alternative recommendations. The Climate Change Authority’s Review, released in December 2014, recommended maintaining the existing GWh target but extending the timeline for meeting the target beyond 2020, noting that reduced investor confidence had stalled the development of renewable projects and that momentum in renewable energy project development would need to be recovered (Climate Change Authority, 2014). In contrast, the Warburton Review, released in August 2014, recommended closing the Large-scale Generation Scheme to new entrants or removing the GWh target altogether and replacing it with a new target wherein renewable energy generation would make up 50% of any new demand (Warburton, 2014). In other words, given that electricity demand in Australia was declining rather than increasing, this would also amount to no new renewable generation in the short term. Furthermore, the Warburton Review recommended that the Small-scale Renewable Energy Scheme be abolished, either immediately or rapidly over time by reducing the ‘deeming’ period of certificates and restricting access to the Small-scale Scheme to systems of no more than 10kW, down from 100kW. In response to these recommendations the government entered
into lengthy negotiations with opposition and cross-bench Members of Parliament. The Climate Change Authority received a response wherein the Australian Government ‘noted’ their recommendations (Australian Government, 2015), and the Warburton Review was met with considerable debate from both sides of politics, culminating with an unnamed source suggesting that Cabinet rejected all findings of the Review in October 2014 (Coorey, 2014).

![Figure 8.1: Investment in large-scale renewable energy (all technology types) in Australia. Bloomberg New Energy Finance, quoted in Hannam (2016)](image)

A lack of policy certainty surrounding the Renewable Energy Target in 2014 contributed to a number of negative outcomes for renewable energy industry participants, including an almost 50% reduction in large-scale renewable energy investments (Figure 8.1). Other evidence of policy uncertainty influencing the renewable energy industry included Suntech deciding to close its Australian Research and Development base, citing uncertainty in policy as a key factor in its decision (Hannam, 2014); and Silex Systems discontinuing its AU$420 million solar project (Smith, 2014). The uncertainty surrounding the Renewable Energy
Target was deemed to be affecting not only the renewable energy industry but high electricity users as well, with policy uncertainty considered so severe by some industry participants that unlikely allegiances were formed to advocate for policy certainty. For instance, in November 2014 the Australian Aluminium Council (a high energy user) and the Clean Energy Council united to release a joint media statement urging both political parties to resolve the ‘crisis’ around the Renewable Energy Target and agree to its future (Clean Energy Council, 2014).

In June 2015, almost nine months after the Warburton Review findings were released and more than six months after the Climate Change Authority's recommendations were provided, the 41 GWh large-scale generation target was reduced to 33 GWh by 2020, a new ‘real’ 20% target (Australian Government, 2015). All other elements of the Renewable Energy Target policy were retained, except for three amendments. Firstly, emissions intensive trade-exposed industries were to receive 100% exemption under the scheme, favouring fossil-fuel generation-linked industries. Additionally, the use of biomass generation from native forest wood waste was to be reinstated. Native forest wood waste generation was excluded from the Renewable Energy Target in 2011 (Climate Change Authority, 2012), and consideration of this measure was rejected by the then-Labor government following the 2012 Renewable Energy Target Review. However, the reinstatement of forest wood waste generation was an election commitment of the Liberal Australian Government (Australian Government, 2014). Finally, the requirement for biennial reviews of the Renewable Energy Target was removed from legislation in order to provide policy certainty to industry.

Since the changes to the Renewable Energy Target Scheme implemented in 2015, there has been evidence that the ‘REC overhang’, the stockpiling of certificates generated prior to the split of the Renewable Energy Target identified in Chapter Eight, is coming to an end. While the ‘REC overhang’ restricted investment in large-scale renewable energy given new projects were not receiving financial benefits under the Renewable Energy Target, it is currently forecast that the majority of electricity retailers will not have access to large-scale generation certificates once their stockpile is exhausted and will instead pay a certificate short-fall penalty (Edis, 2016). The Clean Energy Regulator commissioned a report into the future certificate short-fall, finding that the lack of certificates was not the result of a lack of ‘shovel-ready’ renewable energy projects but instead a lack of market features supporting
renewable energy investment (Ernst & Young, 2016). Among the four major constraints to market support for new renewable energy investment identified in the report was ‘concerns around longevity of the RET and policy stability’.

In the ‘vacuum’ of policy certainty created by review processes and perceived lack of support for renewable energy from the Australian Government, state-based Labor governments have initiated their own ambitious renewable energy targets. A reverse auction mechanism to reach 100% renewable generation by 2020 was implemented by the Australian Capital Territory (ACT Government, 2016), alongside a 50% by 2025 target in South Australia (RenewablesSA, 2016), a 40% by 2025 target in Victoria (Andrews, 2016) and a 50% by 2030 policy in Queensland (Queensland Government, 2016). The Australian Capital Territory’s scheme has been successful in promoting new large-scale renewable energy investment where the Renewable Energy Target has failed to draw interest, with the first two wind farms in 16 months contracted as a result of the Australian Capital territory's policy (Pitt & Sherry, 2016). Given project proponents receiving financial benefits under these state-based schemes are excluded from receiving support from, and therefore contributing towards, the Renewable Energy Target, these state-based schemes increase the likelihood that the Renewable Energy Target’s legislated GWh generation target will not be met. Therefore, the Prime Minister has recently suggested that the Renewable Energy Target should, again, be re-examined to consider the amalgamation of state-based schemes under its banner (Riordan, 2016). It should be noted that the expanded Renewable Energy Target established by the former Labor Government was the result of the amalgamation of a number of state-based schemes, which led to the inclusion of a number of generation types that were contrary to the Renewable Energy Target’s legislated objectives (for example the inclusion of waste coal mine gas generation in New South Wales).

Events since the 2012 Review of the Renewable Energy Target indicate that Australian renewable energy policy has continued to undergo challenges associated with policy inconsistency, issues with on-going and repetitive review processes and policies favouring the status quo. Inconsistency in policy delivery was emphasised with changes to the Renewable Energy Target’s legislative framework within only two years of the previous review process, as well as likely future changes resulting from responses to state-based schemes. The perception of repeated reviews was again reinforced with two concurrent review processes undertaken, neither used as the basis for decision-making by government.
Finally, after two review processes and almost 18 months of indecision surrounding the Renewable Energy Target, the mechanics of the policy and its timelines remained essentially unchanged. Furthermore, one of the four changes made to the Renewable Energy Target policy, the inclusion of native forest wood waste, is the product of a political decision to reverse the previous exclusion of this form of generation. As previously identified by Jones (2010), reviewing and amending the Renewable Energy Target Scheme continues to be typical of post-Machiavellian policy development in that it is highly politicised, considers the preferences of multiple players and sources of advice and is a highly incremental process, heavily influenced by previous initiatives. Furthermore, this research identifies consistent support for the status quo, with the Australian Government favouring a 'business as usual' approach to implementing the policy framework (Kent and Mercer, 2006) and the Australian Government also acquiescing to the requests of the fossil-fuel industry by expanding exemptions for emissions intensive trade-exposed industries (Jones, 2010).

References:


CHAPTER NINE: PROLOGUE

Chapter Eight found that stakeholders perceived the Australian Government as retaining a ‘status quo’ approach to renewable energy policies. The Solar Credits Multiplier, developed to promote the adoption of residential solar energy systems, was touted as driving a boom-bust cycle in installation rates with negative outcomes for industry members. The Solar Credits Multiplier also led to the generation of renewable energy certificates that were not reflective of actual increases in renewable energy generation. Additionally, the Solar Credits Multiplier generated renewable energy certificates used in the same certificate market as large-scale renewable energy generation, leading to large-scale investments being ‘squeezed out’ of the certificate market. Submissions to the Review process therefore proposed that governments reject future ‘banding’ of support schemes for particular generation types. The Review process concluded with a relatively low number of recommendations for change, with only six finally accepted by government, three of which were administrative amendments. The largest area of agreement between Issues Paper submission respondents was the need to increase the period of time between review processes. Review processes were deemed as creating uncertainty in the renewable energy industry and therefore reducing large-scale investment. There were also implications for small-scale industry members with the ‘deeming period’ for small-scale technologies (and therefore incentive value) under consideration during review processes. Together, these results suggest that while the government has a legislated policy aimed at promoting renewable energy there are considerable indications that support for renewable energy does not extend to full socio-political acceptance.

Federal governments, particularly the right-leaning Liberal party detailed in the Chapter Eight Addendum, prioritise the ‘locked in’ electricity generation system considering its potential to contribute to low electricity prices and thereby assist industry. The use of review processes, which could be considered an opportunity to promote aspects of procedural justice and thereby enhance community acceptance of renewable energy, appeared to instead be used as opportunities to ‘reset’ the target policy specifications to align with government interests of the day. This has both symbolic ramifications in terms of a lack of socio-political commitment for renewable energy, but real outcomes in terms of reducing market acceptance of the risks involved in large-scale renewable energy project implementation.
The next Chapter, the final research Chapter paper in this thesis, considers the use of review processes as a tool for consultative policy development. The paper concludes with policy recommendations applicable to any agency considering a consultative review process, rather than those explicitly engaging with the renewable energy industry. The findings from Chapter Eight are used as the basis for this short, commentary paper.

The research primarily focuses on consideration of the socio-political dimension of Wustenhagen et al's (2007) 'triangle of social acceptance of renewable energy innovation' in that it extends the findings in Chapter Eight around socio-political processes and the Renewable Energy Target. However, the research also considers the potential for community members to have a sense of ownership over policy direction and therefore crosses to the community dimension.


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CONSULTATION, PARTICIPATION AND POLICY-MAKING: EVALUATING AUSTRALIA’S RENEWABLE ENERGY TARGET

ABSTRACT

A Review of Australia’s Renewable Energy Target is used to contribute to the concept of negative externalities in consultation processes, including wasted investment by stakeholders and reduced investor confidence. The findings indicate that there is a need to establish clear consultation objectives. The paper concludes with a model for consultation agents to consider when initiating a consultation process. The model stresses the need to make objectives of the consultation process transparent to stakeholders, including the extent to which the outcomes of consultation are likely to result in changes to policy. Consultation agents and policy developers should seek to identify potential negative externalities at the outset of any consultation process, and address these within the consultation framework where possible.

9.1 INTRODUCTION

This paper focuses on the negative externalities of consultative processes with a focus on the 2012 Climate Change Authority Review of Australia’s Renewable Energy Target. It is clear that there are considerable benefits associated with the consideration of a broad range of stakeholder perspectives when developing policy and that consultation with stakeholders can increase the acceptance of policies once implemented. We do not seek to examine or introduce evidence to existing consultation typologies, nor is it our intention to advocate for exclusion of participatory methods in policy development. Instead we emphasise the critical importance of consultation agents and policy developers specifying the limits of the extent to which their participatory processes will result in changes to policy and practice.

Arnstein's (1969) ‘ladder of participation’ promotes the concept of ‘empowerment’; that citizens and community groups should have the potential to drive policy changes.
Alternatively, Thomas' (1993) perspective is that the level of consultation is dictated by the policy itself and political goals. In this case, there is no 'good' consultation; instead consultation processes should be appropriately matched to the objectives of the policy. These two conflicting views on the processes and outcomes of consultation activities are useful in determining whether consultation could deliver greater relative power to society (Arnstein) or to policy developers (Thomas). Neither of them, however, acknowledges potential negative externalities in consultation processes that may be addressed through the objectives of consultation being made more transparent.

9.2 NEGATIVE EXTERNALITIES OF REVIEW PROCESSES AND AUSTRALIA'S RENEWABLE ENERGY TARGET

Crase et al. (2005) identified the presence of negative externalities when examining a consultation process around water allocation within the Murray Darling Basin, South Australia. In this case, time invested by agencies and by stakeholders during consultation was considered a cost. Where the process had limited contribution to changes in policy, and investment by stakeholders exceeded any likely returns to them, it was deemed that there was a negative externality. Crase et al. (2005) found that consultation agents typically exhibit 'an inability to empathise with the externalities borne by others in the consultation process', indicating a preference for what Cheeseman and Smith (2001) refer to as 'choreographed consultation', aimed more at endorsing policy processes in train than recognising costs and potential benefits of a consultation process to stakeholders. The recent Climate Change Authority Review of the Renewable Energy Target (RET) provides useful examples of negative externalities in consultation processes.

The RET mandates investment in renewable electricity generation through a renewable energy certificate market. A legislated national consultative review of the RET was carried out in 2012, including four round tables, 60 one-on-one interviews, and 8,660 submissions to an Issues Paper (Climate Change Authority, 2012a). Respondents were invited to comment on all aspects of the scheme, including the GWh value of the legislated target, administrative functions of the scheme and the impact of review processes on the renewable energy industry. Concerns were raised by many respondents regarding policy continuity and excessive reviewing procedures. In its response to the consultation process,
the Climate Change Authority made a total of 34 recommendations, 18 maintaining the status quo. Only five recommendations were endorsed by the Commonwealth Government that would result in changes to the scheme.

Included within the Climate Change Authority's recommendations to Government was that further consideration be given to whether biomass generation sourced from native forest wood waste should be eligible to receive financial benefits under the RET. The Government rejected this recommendation, noting that considerable reviews on this issue had already been undertaken and that the Government was satisfied with the outcomes of these reviews. This immediately calls the consultative review process into question, with policy options considered by the Climate Change Authority that were never going to be agreed to by Government. While the Climate Change Authority, as an independent agency, is not required to submit its line of review questioning to the Government for consideration, the outcomes in terms of negative externalities in undertaking a comprehensive review where findings are not relevant to policy developers is extensive.

In particular, the GWh value of the legislated target was considered as part of the review process. This is in spite of the fact that the requirement to review this part of the scheme had been removed from the legislation. It is likely that consideration of the target was as a result of significant pressure from stakeholders who would benefit from curtailment of the scheme. There was considerable scrutiny of the GWh value of the target within the Australian media in the period leading up to the review. Media interest was driven in large part by fossil-fuel based electricity generation corporations and high electricity consumers noting the financial implications of the RET and requesting the target be reduced (Hepworth and Crowe, 2012, Manning, 2012). Considering that the requirement to review the target had been removed from legislation and the Commonwealth Government did not include consideration of the target in its letter of introduction to the Climate Change Authority, it may be suggested that the Government did not intend to amend the GWh value of the target, regardless of the recommendations of the Climate Change Authority. Consequently, the considerable investment by various stakeholders seeking to reduce, maintain or increase the target was always going to be ineffective.

In addition to the review including elements of the scheme that Government was not amenable to modifying, stakeholders also noted 'review fatigue', with ten consultation
processes specifically related to the RET in the last five years (Australian Government, 2013), none of which resulted in substantial changes to the policy framework. That the previous review processes have been ineffectual in creating marked change to the policy environment, for the betterment of industry or with additional environmental benefits, indicates that these consultation processes are ultimately more likely to result in the wasted investment of resources than in Government adopting consultation-driven change to policies.

The RET highlights three elements of consultation that can contribute to negative externalities in the form of wasted investment by stakeholders. The first is the action of undertaking consultation on elements of policy or practice that will not be amended, regardless of the outcome of the consultation process. The second relates to the potential for agents undertaking a consultation process to be manipulated by external forces with regard to the contents of consultation, with the result that elements of policy or practice that do not require consultative input are included within a consultation process. Finally, undertaking repeated consultation on similar issues, with similar or even exact findings in each consultation process, results in 'consultation fatigue'. Not only do stakeholders unnecessarily invest time and resources to contribute to consultative processes, they can also experience feelings of ill will towards the agents of consultation in that their contribution of resources and human capital is not valued.

Wasted time and resource investments by stakeholders represent one potential negative externality in a consultation process. The RET review includes a further negative externality in the form of reduced investor confidence. The Commonwealth Government indicated that ‘renewable energy investors have been assured by the Government of our ongoing commitment [to the RET], to provide confidence for their investment decision making (Climate Change Authority, 2012b)’. However, respondents from all stakeholder groups noted that review processes regarding the RET and associated policies were excessively frequent. The potential for changes to the RET policy framework were considered to undermine investor confidence, resulting in delays to renewable energy investment. Given that the RET review process has produced no great changes to promote increased uptake of renewable energy, or to provide additional financial support for electricity consumers to mitigate the cost of the RET, the review process is likely to have caused more harm than good purely by introducing a perception of policy uncertainty.
The RET also provides a valuable lesson with regards to the importance of interaction and understanding between both the consultation agent and the 'client' of the consultation process. In the case of the RET there was a clear disconnect between the consulting body (the Climate Change Authority) and the decision-making body, in the form of the national Government. This situation would have been resolved through the inclusion of a clear Terms of Reference for the consulting body and frequent liaison between the two parties, ensuring that the interests of the decision-making body are represented by the consulting body. This case did not exist with regard to the RET, where the legislation provided broad parameters for review but did not encourage an active dialogue between consultation agent and decision-maker to determine the most appropriate issues for consultation.

9.3 WHAT IS THE PURPOSE OF CONSULTATION AND IS IT REQUIRED? – REDUCING THE PREVALENCE OF NEGATIVE EXTERNALITIES

Using Australia's RET as an example of a consultative policy-development process, the evidence provided suggests there may have been negative externalities to stakeholders that could have been avoided had the extent of consultation been more thoroughly considered and if the potential to change policy and practice had been made clear.

This underlines the significance of establishing clear objectives prior to consulting. While the use of such objectives is now standard practice, these are generally couched in terms of specific questions or outcomes of policy as opposed to what the consultation process is trying to achieve. Alternatively, a consultation process could explicitly indicate those areas of policy where there is potential to change, as opposed to canvassing opinions on issues that will not be altered. This is not an entirely new concept, having been suggested elsewhere in the literature (Brackertz and Meredyth, 2009). Including clear objectives of consultation will assist stakeholders to tailor their contribution to the consultation process, reducing the potential for negative externalities, whilst also enabling them to adjust their expectations of the outcomes of the consultation process. For instance, Manwaring (2010) indicates that where participants in a consultation process were made aware that no radical changes to government objectives would result from a participation process, participants
were aware that ‘pragmatic’ or ‘measurable’ demands were more likely to be given consideration. In this case, ‘participants were aware of the extent of their influence’, presenting them with an opportunity to focus their efforts on areas of consultation likely to result in changes to policy and practice.

Providing stakeholders with a clear indication of such areas of policy assumes a positivist approach to policy and practice development, wherein the decision-maker believes in a single ‘correct’ decision outcome within a limited range of potential policy options. The use of a positivist approach to consultation, and policy-development more generally, may not be universally applicable as there may be cases where an iterative process, resulting in a fundamental shift to a policy paradigm, may be more appropriate. However, consultation agents should be aware of the administrative or policy frameworks within which consultation is undertaken. Boxelaar et al. (2006) warn of the complications associated with trying to introduce a constructive participatory process within a positivist administrative framework, complete with linear decision-making. Again, it is the consultation agents that must verify the likely outcomes of the consultation process and the extent for change and engagement, while remaining cognisant of the limitations of the existing policy or practice.

The proposed model of consultation, with a focus on limited elements of change, could be considered to reinforce passive models of decision-making by excluding stakeholders from the opportunity to contribute to wider discussion. Critics may argue that stating the intentions of the consultation agent at the outset of the consultation process, particularly where these intentions are focussed more to the ‘consultation’ as opposed to the ‘participation’ end of Arnstein’s (1969) ‘ladder of participation’, may result in reduced contribution from stakeholders, both in term of quality and quantity of responses. This conclusion inherently assumes that all contribution from stakeholders is both positive and necessary. However, Thomas (1993) noted that consultation with stakeholders ‘should be avoided unless (a) the public can provide necessary information and/or (b) public acceptance is necessary for implementation and unlikely without involvement’. It is therefore up to consultation agents to determine at the outset of any consultation process whether it is the number of stakeholders responding to consultation opportunities that is of greatest contribution, or it is the quality of information around viewpoints that is important. Misleading stakeholders with regards to their potential contribution to change or
'empowerment' in the interest of increasing stakeholder representation is not a viable alternative for avoiding negative externalities associated with unclear outcomes of consultation processes.

9.4 CONCLUSION

This analysis suggests that consultation agents recognise the existence of negative externalities associated with review processes. Negative externalities may include a loss of investor confidence with financial ramifications, and an investment cost relating to time and resources expended by stakeholders engaging in a process that exceeds any potential benefits that may accrue to them. This paper proposes that consultation agents develop a model for consultation that will result in more valuable contributions from stakeholders where extensive contribution is required, whilst simultaneously reducing negative externalities where the outcomes of consultation processes, in the form of changes to policy and practice, are likely to be limited. The key components of this model should include that:

- the objectives of any consultation process should be clearly stated;
- the extent of consultation required to meet objectives should be determined, with the contribution from previous consultation processes taken into account, and with consultation not extending beyond this limit;
- the decision-making and consultation agents, if different, should work together to identify objectives;
- the likelihood of change should be made obvious; and
- any potential negative externalities should be identified, and addressed wherever possible.

Ultimately, there is a need to match the expectations of stakeholders regarding a consultation process with the likely outcomes of the process. Identifying objectives at the outset of a consultation process will have benefits for the consultation agents, by way of reduced investment in consultation, and reduced negative externalities for stakeholders. The benefits of establishing clear objectives and being mindful of potential externalities will extend beyond the current consultation process, with stakeholders more likely to engage in future consultation processes where they perceive their investment is valued and where their contribution is used to inform change.
9.5 REFERENCES


CHAPTER TEN: CONCLUSION

10.1 INTRODUCTION

This thesis sought to examine the social acceptance of renewable energy by considering community, industry and government perceptions of residential solar energy technology and perceptions of policies to support its adoption in Australia. The research considered the ‘lived experiences’ of residential householders and their relationship with solar energy, industry members installing renewables energy and those in government and the public sector responsible for renewable energy policy delivery. Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy innovation’ was used as the framework for a multi-faceted approach to consider intersecting dimensions of social acceptance. This research focused particularly on financial incentives for the promotion of residential solar energy and considered the types of government policies that could sit alongside financial incentives to improve their effectiveness. The research investigated ways government policies could be changed to improve renewable energy outcomes. This is particularly relevant given that solar photovoltaic technology is now technically sound and cost efficient, with Vanderheiden (2011) recognising that ‘political rather than technical or technological challenges now pose the most difficult problems in the pursuit of a sustainable future’ (p609). The objectives of this research were to:

1. Examine community acceptance of residential solar energy and related policies, including community perceptions of justice and peer-to-peer interactions
2. Examine market acceptance of residential solar energy and the effectiveness of related policies to promote its adoption through consideration of Rogers’ Diffusion of Innovations Theory and intra-firm acceptance
3. Examine socio-political acceptance of renewable energy technologies, in particular residential solar energy, and associated policies, including those regulating industry and supporting the financial incentivisation of residential solar energy
4. Develop advice to government to support the increased adoption of renewable energy

The research-based Chapters in this thesis started with consideration of the perceptions of financial incentives to support residential solar energy (Chapter Three). The research then
reflected on the practical implications of financial incentives and the installation of solar systems in Western Australia (Chapters Four and Five). Next, community-level influences on the adoption process, including in terms of peer-to-peer interactions were considered (Chapters Five and Six), before moving on to discuss the 'linking up' of solar energy with the electricity regime via network operators (Chapters Six and Seven). Finally, the research considered wider public, industry and non-government support for the renewable energy policies that underpin the development of renewable energy in Australia (Chapters Eight and Nine). In this way, the research examined the social acceptance of renewable energy as influenced by financial incentives, social interactions and the institutions (including policies) that inform opportunities for acceptance. Consideration of stakeholder perceptions allowed development of a rich data set to identify unique insights into the way the promotion of residential solar energy is unfolding.

In the process of completing this thesis two rounds of mail-out surveys, with 657 completed responses, and sixty eight interviews were performed, and, importantly, Australia's relationship with renewable energy continued to evolve. This conclusion provides an opportunity to consider perceptions of financial incentives identified in these surveys and interviews, and the evolution of the renewable energy industry. The Conclusion is separated into three sections. The first section examines the theoretical findings in the research, and is broken down according to the three dimensions identified in Wustenhagen et al’s (2007) ‘triangle of social acceptance of renewable energy innovation’, with the element of ‘trust’ extracted from the community ‘corner’ of the triangle and elevated to its own dimension, as described in Chapter One. The summary of the respective dimensions is ordered based on their appearance in the thesis. This section ends with some limitations of the methods undertaken and further avenues of research. The second section summarises the advice to government included in Chapters in the thesis. In particular, this section seeks to highlight instances where different research topics, across different Chapters, arrived at similar policy conclusions. The final section ‘zooms out’ to consider solar energy adoption in the context of the rapidly changing electricity sector. This section does not seek to draw heavily from the findings within the thesis, but instead aims to consider the direction the electricity industry is moving towards and the way different stakeholders are framed in this process.
10.2 Findings

The findings of this research can be grouped according to Wustenhagen et al.’s (2007) ‘triangle of social acceptance’ dimensions of community, market, trust and socio-politics (Figure 10.1). In the case of this research, the community dimension examines the way peer-to-peer interactions can influence adoption behaviour, and perceptions of and interactions with equity in the subsidisation of solar energy. The market dimension reflects on the ways in which incentives influence adoption behaviour in Western Australia. The trust dimension considers the importance of industry regulation and also includes comments on the availability of reliable information to support adoption decision-making. Finally, the socio-political dimension draws conclusions on the imperfect aspects of Western Australian and Australian implementation of renewable energy policies.

Figure 10.1: The ‘triangle of social acceptance of renewable energy’ as developed by Wüstenhagen et al. (2007). Each dimension of social acceptance at each corner of the triangle is of equal importance. In the case of this research the element ‘trust’ included under ‘Community acceptance’ is elevated to its own dimension (see Chapter One).
10.2.1 **COMMUNITY DIMENSION**

Peer-to-peer interactions between residential householders were perceived as influencing adoption patterns, with evidence in Chapter Five of peer-to-peer interactions promoting adoption by a group of community members who did not seek alternative forms of information on solar. The continuing importance of peer-to-peer interactions in the distribution of solar is evident in that 74% of survey respondents identified that they were asked for information about solar energy by a friend or family member. This is consistent with Rogers’ Diffusion of Innovations Theory (2003), which suggests that there is reduced reliance on ‘expert’ opinions and increased reliance on peer-to-peer interactions as the adoption process continues. Chapter Six identified further peer-to-peer interactions. In the regional community of Narrogin the presence of signs on people’s front lawn as well as panels on their rooftops prompted discussion between neighbours about solar, which is likely to contribute to the ‘clustering’ of systems, as noted elsewhere in the literature (Balta-Ozkan et al., 2015, Bollinger and Gillingham, 2012, Graziano and Gillingham, 2015, Richter, 2013). The regional community of Carnarvon demonstrated strong peer-to-peer interactions around solar with the establishment of the informal solar community organisation, the ‘Fruitloops’. ‘Fruitloops’ members would install their own solar system and then help other community members to install systems. This contributed to not only increased numbers of community members choosing to install solar but also appeared to increase householders’ levels of understanding about the way solar technology works, with this regional community showing higher levels of satisfaction with their solar system compared with all other regions combined.

Peer-to-peer interactions, alongside the availability of subsidies, did have negative implications for equity. One example was highlighted in Chapter Six, where unusual circumstances in Carnarvon led to a moratorium placed on new systems. Since the majority of people installing a system were members of the ‘Fruitloops’, access to the electricity network was heavily weighted towards community members in the ‘Fruitloops’ social networks, which likely excluded some members of the community from adopting solar.

Chapter Three examined householders’ perceptions of equity in the availability of financial incentives in detail. The Chapter sought to determine whether householders prioritised the availability of financial incentives to promote the adoption of residential solar energy, or support for low income earners. While opinions varied between respondent categories, the
overall sample showed no particular support for subsidising solar or support for low income earners. Importantly, even for stakeholder groups prioritising support for low income earners, including those over the age of 60, those earning under $65,000 or those with only a primary or secondary education, support for low income earners never exceeded 50%. These results indicate that, in spite of the growing academic literature focusing on distributional justice issues in relation to financial incentives for the promotion of solar (Macintosh and Wilkinson, 2011, Nelson et al., 2011, Simshauser, 2016, Bell and Foster, 2012), specifically the transfer of wealth between lower income earners and those installing a solar system, householders themselves are not overly opposed to subsidisation and instead are concerned with procedural justice issues. While many studies exist examining the procedural justice concept in relation to large-scale and community-scale renewable energy projects (Wolsink, 2007b, Wolsink, 2007a, Gross, 2007, Ottinger et al., 2014, Zoellner et al., 2008, Eltham et al., 2008, Simcock, 2014, Van der Horst, 2007), this was the first to consider procedural justice from the perspective of householders and rooftop solar generation. It is worthwhile pointing out that even given the distributed nature of residential solar energy, survey respondents identified procedural justice issues somewhat similar to those experienced in large-scale developments. In particular, a lack of transparency around decision-making, a lack of consistency in the delivery of policies, and a lack of guarantee for the effectiveness of the technology are all common with large-scale generation concerns.

Chapter Five included consideration of the equity outcomes of the provision of financial incentives. In spite of early literature showing that Australian financial incentives promoted adoption by a middle-upper income group of householders (Macintosh and Wilkinson, 2011) and therefore acted as ‘middle class welfare’, this research suggested that the lowest 20% of homeowners in terms of socioeconomic status might have the highest rates of solar adoption, even after the discontinuation of financial incentives. This would confirm findings by Rogers (2003) that the availability of incentives can promote a lower income cohort to adopt a technology. The potential benefits of financially subsidising solar to lower income groups was evident in interview responses, with lower income respondents noting that they now had the financial freedom to be able to turn on air conditioners and heaters. The benefits of lower income groups being able to regulate temperatures in their home when external temperatures reach extremes extend to the tax-paying public, with reduced hospitalisation of vulnerable community members in extreme weather events (Howden-
Chapman and Chapman, 2012, Bambrick et al, 2011). In spite of these findings, it is noted that cross-subsidisation and regressive forms of taxation used to fund financial incentives for the promotion of solar should be limited wherever possible in the interest of reducing the prevalence of distributional injustices.

10.2.2 MARKET DIMENSION

The availability of financial incentives for the installation of solar systems was supported by the vast majority of survey respondents in Chapter Three, which included respondents who had installed systems and those who had not. The majority of survey respondents also accepted paying for financial subsidies, including in their electricity bills. Chapter Five found that survey respondents perceived financial incentives as effective in promoting the adoption of solar energy, consistent with the literature around solar adoption internationally (Haas et al., 1999, Chowdhury et al., 2014, Balcombe et al., 2014, Karakaya et al., 2015, Leepa and Unfried, 2013, Jager, 2006). However, this research also found that financial incentives promote the adoption of solar not only by reducing the capital cost of systems to an affordable level but by acting as a ‘cue-to-action’ to prompt people to decide to adopt solar. The availability of financial incentives also proved to be important in the decision-making for both regional communities interviewed in Chapter Six. In Carnarvon, the availability of generous incentives, alongside reductions in installation costs associated with bulk purchase of systems and self-installation, meant that systems were often very low cost or even free. Interview respondents in Narrogin also identified the importance of financial subsidies, with some saying that they did not think solar would be worth installing without financial incentives available. The adoption of solar by a less informed group of householders motivated by financial benefits is evidence that solar adoption may be moving along the Rogers Diffusion of Innovations curve (2003), with incentives bridging the ‘chasm’ between early adopters and early majority adopters identified by Moore (2014).

Chapter Five found evidence suggesting a relationship between prioritisation of access to incentives in decision-making, gathering potentially unreliable information from friends and family and lower levels of satisfaction with solar systems. This was consistent with Rogers’ (2003) assertion that financial incentives can result in consumers adopting a technology in order to access financial benefits as opposed to understanding the true benefits of the technology. Application of Rogers’ (2003) conclusions on the effects of incentives on the adoption process had not yet been applied to the adoption of solar systems. While the
financial incentives available promote initial adoption it might have the unintended consequences of having those who installed systems in the high-incentive period tell friends and family of the benefits of solar based on their own financial gains, which would result in unrealistic expectations of those installing a system without access to generous incentives. This was reflected in Chapter Five, with 89% of respondents who received the premium feed-in tariff satisfied with their system, compared with 71% who did not receive the feed-in tariff. Another possible reason for reduced householder satisfaction in solar energy is associated with the lack of government support for information for decision-making and industry regulation.

10.2.3 **TRUST (AND INFORMATION) DIMENSION**

Chapter Five identified that nearly half of all respondents believed that 'some information available regarding solar systems and subsidies was misleading', and only 40% of respondents were 'confident the solar system industry, its advertising and delivery of rebates were appropriately regulated'. Furthermore, some survey respondents in Chapter Three indicated they chose not to install a solar system because they perceived that industry could not be trusted. These perspectives were supported by external data and issues appear to have continued since the survey was undertaken (Chapter Four Addendum). Interview respondents in Chapter Six in particular highlighted significant concerns around the quality of solar systems installed in Narrogin, where solar installers do not remain in the community and so were not accountable for poor quality installations.

The level of information available to householders installing systems was identified as problematic in both Chapters Four and Five, with 89% of survey respondents indicating that 'more information is needed for people to understand the true costs and benefits of solar' and this was further evidenced with Chapter Six interview participants in Narrogin not knowing where to go to get advice on their system. Research presented in Chapter Seven indicated there was a perception from those working in network operator agencies that there was not enough information available to householders to support effective decision-making. Qualitative survey and interview responses indicated people didn't understand how buyback rates were calculated and what could be considered 'fair', and it seemed that many householders were not aware of the financial benefits of avoided electricity costs, instead assuming that credits on their electricity bills represented the only financial benefits of solar systems. The research in this thesis therefore supports other research which has
shown that members of the community do not have sufficient levels of energy literacy and are often not acutely aware of their energy decision-making, with evidence suggesting householders in Australia are unaware of where their systems were manufactured (Colmar Brunton, 2016) or whether they have accessed particular tariffs (Hobman and Frederiks, 2014).

10.2.4 SOCIOPOLITICAL DIMENSION

Chapters Seven, Eight and Nine focus on stakeholder perceptions of Australian Government policy and network operators. While the implementation of Australian Government policy and the functioning of network operators appear unrelated, there were key similarities between the findings in these chapters. In particular, findings indicated that: government intervention to support particular generation types/models can reduce efficient renewable energy investment; there are complex interactions between renewable energy policies and other government objectives, within and outside of the electricity regime; and, policy uncertainty acts as a barrier to renewable energy investment. This research therefore suggests that issues associated with renewable energy implementation first highlighted in the 1980's, including a lack of support from key stakeholders (including network operators), and a lack of consistent and effective policies, alongside regulatory barriers, continue to impede renewable energy adoption (March et al., 1982, March et al., 1981).

Chapters Seven and Eight included perceptions of instances of government intervention to promote a particular market outcome which resulted in inefficiencies within the electricity system. Chapter Seven discussed regulations established by government preventing the network operator from owning generation assets in order to reduce the likelihood of competition between two government-owned utilities. In practice, however, this regulation limits the potential for the network operator to install batteries to make best use of intermittent renewable generation, and therefore results in ‘push back’ on renewable energy generation investments. Chapter Eight included consideration of the Solar Credits Multiplier, providing evidence that the Multiplier inflated the number of renewable energy certificates in the Australian certificate market, ‘squeezing out’ more efficient, large-scale generation types. Furthermore, the Solar Credits Multiplier generated ‘phantom’ certificates that did not equate to actual renewable energy generation, and therefore ‘squeezed out’ legitimate opportunities for renewable energy generation and emissions reduction as well. Together these examples suggest that governments should have an awareness of the way
their policies will generate market barriers, failures and externalities that should be
dressed in effective policy development processes.

Chapters Seven and Eight also highlighted the complex interactions between government
policies and politics. Chapter Seven indicated that a government ‘vision’ for a decentralised
energy system and associated network operator acceptance of renewable energy would
likely see a reduction in the value of state-owned assets, changes to tariff structures and,
although not mentioned in the Chapter, would also see reduced employment in fossil fuel
sectors, all of which have financial and political implications for whichever government
promotes change. Similarly, Chapter Eight identified that governments no longer had a
bipartisan view towards the Renewable Energy Target, and that the future target value was
politically contested. That the Renewable Energy Target is perceived as increasing
electricity costs for industry, and therefore increasing the uncompetitiveness of Australian
trade, has negative implications for whichever party is supporting its implementation.
Conservative governments in particular, given their alignments with fossil fuel interest
groups and prioritisation of development of industry above environmental policies, could
endorse a reduction in the target value even if the Renewable Energy Target is achieving its
goals.

Finally, Chapters Seven, Eight and Nine all highlighted the potential for uncertainty to act as
a barrier to renewable energy investment. In Chapter Seven a lack of certainty in
government directions reduced the motivation for network operators to develop methods
for dealing with increased levels of renewable energy penetration. Chapter Eight indicated
perceptions that the continual reviewing of the Renewable Energy Target, with ten reviews
into the Renewable Energy Target policy over a five year period, created a level of
uncertainty that disincentivised industry investment in renewable energy. Chapter Nine
highlighted that review processes should clearly identify potential areas of policy change
during a review process, in order to prevent negative externalities associated with resource
investment in review processes that do not contribute to policy change.

The research presented in Chapter Eight was an update on work previously undertaken by
Kent and Mercer (2006), examining a previous review of the Mandatory Renewable Energy
Target. This enabled a longitudinal comparison to be made focusing on the way such
policies were reviewed. The research demonstrated that the Australian Government
maintains the status quo in the development of renewable energy policy and that renewable energy policy continues to be highly political, contested and influenced by other inter-related policy areas (in the most recent example, the carbon pricing scheme). These findings suggest that making wide-ranging changes to renewable energy policy to support a transition to a low carbon economy required under Australia’s Paris Agreement commitments (Australian Government, 2016) is unlikely to develop at the federal level. It is worth acknowledging that Chapter Seven has identified that state government ministerial oversight can be useful in promoting increased adoption of renewable energy. Indeed, state-based renewable energy schemes, particularly in left-wing Labor government states in Australia, are proving to be ambitious and successful (Pitt & Sherry, 2016). Given that electricity policy is driven at a state level in Australia perhaps the success of state-level renewable energy policies is unsurprising. Interactions between the Australian Government’s Renewable Energy Target and state-based schemes does, however, generate issues for the success of the Renewable Energy Target, with projects awarded funding under state-based schemes often not permitted to receive financial benefits, or be ‘counted’, under the Renewable Energy Target. This therefore increases the total capacity of renewable energy required to meet the target, with associated potential grid connection and overcapacity issues. Whether there is a decision to merge state-based schemes towards a more ambitious target, as was previously undertaken when the Mandatory Renewable Energy Target was expanded to the Renewable Energy Target, or dissolve the Renewable Energy Target and thereby reduce layers of regulatory oversight, remains to be seen.

10.2.5 LIMITATIONS
There are several limitations in the research investigating householder perceptions of residential solar energy. The most obvious is around the limited level of robustness in some findings. Importantly, some of the subscales used in this research had relatively low Cronbach’s coefficient alpha ratings. A modest pre-test of both surveys was performed that didn’t highlight significant issues, and given the novel questions posed by Chapter Three in particular, there were no existing survey template questions that could have been used to attempt higher levels of robustness. There were further limitations in the survey relating to perceptions of justice (Chapter Three) in that the survey was attempting to force respondents into a binary decision, i.e. support for low income earners or support for subsidies to promote higher adoption of renewable energy. It is possible that householders could have a more nuanced view, for instance that incentives should be available but
funding for these incentives should not be regressive. Furthermore, this survey did not seek to quantify the level of subsidy paid for by all householders, which likely influenced the results. The Western Australian feed-in tariff was paid for in large part using consolidated state revenue, so electricity tariffs did not increase in Western Australia to the same degree that they did in other states. Findings for the same survey could be very different where householders had a greater awareness of the level to which their tariffs increased to pay for solar incentives.

A final limitation of the research relates to the decision to survey and interview six specific postcode areas. While this decision was made in order to be able to compare and contrast experiences in metropolitan and regional communities, and between high and low socioeconomic and installation rate areas, the findings of Chapter Six identify that adoption experiences can vary widely between communities. Therefore, experiences in these areas might not be representative of either their class of community in terms of installation (high/low socioeconomic/installation metropolitan/regional), or even the experiences across the state of Western Australia. The research in Chapter Six identified a number of regionally-specific experiences, including the presence of a solar community organisation, solar champion or ‘fly-by-night’ solar operators. However, many more variations exist that might influence householder perceptions, such as a high incidence of solar cold-calling companies, particular political affiliations and their support for renewable energy, or the presence of a local larger-scale renewable energy project.

10.2.6 Future research
There are a number of future avenues of research suggested by the findings in this thesis. In particular, Chapter Four identified different perceptions of satisfaction between those who received Western Australia’s premium feed-in tariff and those that did not, and pointed to the potential for increased solar adoption by the ‘early majority’. It would be worthwhile surveying those householders who installed systems since the incentive-intensive period (i.e. after 2012) to see whether high satisfaction rates have persisted, whether lower income groups continue to install systems, and whether people are more likely to be receiving information from friends and family, and what this means for their solar satisfaction levels.

Chapters Three, Four and Six all identified issues with levels of trust in the solar industry and it would be worthwhile examining whether these issues persist in the future, and
whether particular policies are useful in reducing the prevalence of these issues. At the time the surveys were distributed many respondents would likely have had only one interaction with a solar supplier. Over the coming years, with solar panels and inverters reaching the end of their working life, and the increasing adoption of household scale battery technologies, householders will have increasing opportunities to engage with solar installers. The academic literature relating to perceptions of interactions with solar industry members remains limited, however evidence from this research suggests levels of trust may continue to decline, with implications for the ongoing adoption of residential solar energy.

Some participants in this research expressed the opinion that the relevance of the research was limited given that it did not include consideration of batteries as storage for solar generated electricity. However, it should be pointed out that every conclusion drawn from this research can be applied to the incentivisation of batteries. Ill-conceived incentive programs for storage systems are just as likely to result in cross-subsidisation of consumers; these incentive schemes may promote unsustainable growth of industry and potential corruption in infrastructure providers; consumers may be unaware of how to make best-use of their batteries; battery technology, installation and information may not be of the highest quality; batteries can be promoted at the regional level through champions and community groups; batteries will impact networks, both technically and in terms of cost-recovery potential; and in all likelihood changes to government policies will continue to lag behind developments to the economics and technical aspects of battery technologies.

10.3 Recommendations to Government

The thesis suggests that governments should look beyond financial subsidies when considering policy development for the promotion of renewable energy to consider all of the other influencing factors that are under their control. While the installation statistics support the tenet that financial incentives, as a blunt policy instrument, are effective in promoting the adoption of residential solar systems (Chapters Five and Six) there is a need to ensure that such policies represent good value-for-money. This research highlights that several, relatively simple and seemingly obvious, policies should sit alongside the development of financial incentives.
Governments should seek to make independent and coherent (i.e. jargon-free) information available to the general public (Chapters Four, Five and Six). Information can assist the general public with developing realistic expectations of the benefits of solar energy, and could result in more householders installing a residential system that is appropriately sized for their household conditions. This has the potential to increase consumer satisfaction and reduce the likelihood of excessive feed-in to the network. Information could also help to improve householders’ awareness of when their system is not functioning effectively, who to turn to if a system is not functioning effectively and make the best use of their system under their retail contracts (for instance by load shifting).

Incentivisation of solar systems needs to be supported by a more rigorous and transparent regulatory regime (Chapters Three, Four and Six). There are inherent issues with the current approvals process, in particular that the current clean energy advocacy agency, the Clean Energy Council, also certifies solar installers, and administers the installers’ ‘Code of Conduct’. While it is in the Council’s best interests to ensure a safe and reliable solar sector, it is also in the best interests of the solar industry members it represents to limit publicly available information on the evidence of inappropriate installations. Furthermore, there appears to be an ongoing issue with the installation of cheap ‘tier 3’ systems, which the Clean Energy Council is responding to at present (Chapter Four Addendum).

Governments should be mindful of the extent to which financial incentivisation of solar could result in direct or indirect cross-subsidisation between consumers (Chapters Three, Five, Six, Seven and Eight). Specifically, the funds used for incentives accessed by a small number of consumers are frequently paid for by all consumers (Nelson et al., 2011). Additionally, the reduction in payment of network tariffs by those installing a system may see those without solar systems experiencing tariff increases to improve the likelihood of network cost recovery (Simshauser, 2016). It should be noted that the majority of residential householders (80%) are supportive of the availability of subsidies, and a smaller majority of householders (68%) are also supportive of paying for subsidies in their electricity tariffs (Chapter Three). Furthermore, the presence of generous financial subsidies has been found to reduce levels of social inequality by promoting installation by the most disadvantaged householders (Chapter Five). Therefore, the presence of cross-subsidies alone should not discourage governments from considering incentive programs. Rather, governments should investigate options to reduce the likelihood or volume of these
cross-subsidies (Chapters Three, Five, Six and Seven). For example, incentives could be means tested, directed towards lower income groups, limited in scope, or funds for incentives could be funded from a non-regressive form of taxation (Chapter Five).

The most important finding regarding government promotion of renewable energy were multiple impressions that government lacked clarity in terms of ‘what to do’ with renewable energy. This was manifested in a sense that governments prioritised the ‘status quo’ in the development of renewable energy policy (Chapters Three, Four, Seven and Eight), that governments lacked a ‘vision’ of where the renewable energy industry was headed (Chapters Three, Seven and Eight), and coinciding with these that there was a lack of consistency in the way policies were implemented and a sense that policies implemented by government could not be relied upon (Chapters Three, Four, Seven and Eight). Together, these policy approaches result in a process of ‘disjointed incrementalism’ (Lindblom, 1979), where an approach to supporting renewables moves only in incremental steps, with not all of these moving forwards (Chapter Eight). While it might be expected that industry and government research participants would highlight issues with renewable energy policy development, residential stakeholders were just as likely to highlight concerns, emphasising a sense of procedural injustice in their perception of renewable energy policy delivery (Chapter Three). Residential householders proposed a number of potential policy approaches that would indicate higher levels of government support for renewables, including potential mandatory installation on new homes, greater diversification in technologies supported by government, and research and development required for promoting a decentralised electricity system (Chapter Four).

One particular focus in the thesis was on the use of review processes as a form of policy development (Chapters Eight and Nine). This research highlighted that ‘constant review is not reform’ (Chapter Eight), with submissions to the 2012 Renewable Energy Target review indicating that 77% of respondents thought legislation should be amended to increase the number of years between reviews and 60% indicating there was a need to maintain policy consistency and reviews damaged that potential. Following the 2012 review process the renewable energy industry, in particular the large-scale renewable energy industry, suffered from a lack of investment - the result of uncertainty surrounding the scheme with a new government in power (Chapter Eight Addendum). The small-scale solar industry also suffered, however, with frequent uncertainty around whether the ‘deeming’ feature, which
allows small-scale systems to receive 15 years of generation certificates upfront, would be amended or removed. The final research Chapter in the thesis proposed a consultation framework that could reduce review fatigue and uncertainty for industry surrounding unnecessary reviews. Review participants should be made aware of their influence on policy development coming out from the review process, and the extent of consultation required to meet objectives (Chapter Nine).

Finally, the research identified that governments should take a more active role in determining how residential solar should ‘link up’ to the existing electricity regime, in particular given the perception that network operators potentially restrict residential solar energy connections (Chapters Six and Seven), and in terms of its interaction with cost recovery of the electricity distribution network (Chapter Four and Seven). Governments can assist with promoting a smooth transition to a decentralised electricity network by engaging with all incumbent electricity regime participants to develop a ‘vision’ of what the system should look like, by directing network operators to invest in technology to support increased penetrations of distributed generation, and by amending regulations that restrict network operators from making the best use of residential solar energy (Chapter Seven). This might include that network operators be allowed to install and manage battery storage, to reduce reverse feed-in to transmission networks and for use during peak demand periods. Governments should also acknowledge that tariff realignment is required to allow networks to improve their cost recovery models (Chapters Four and Seven) in such a way that doesn’t result in cross-subsidisation between consumers and a potential electricity death spiral (Simshauser, 2014).

10.4 WHERE IS THE ELECTRICITY INDUSTRY GOING?

The twenty-first century is seeing a rapid transformation of the electricity regime. Where the electricity sector has historically been comprised of base-load, large-scale, centralised electricity generation, often under state control, the electricity industry in Australia is seeing a movement towards generation that is renewable, intermittent, and increasingly small-scale, distributed and community-owned. In response to this new fleet of generation capacity, network operators are increasingly coming to terms with changes to the use of their resources. There is a reduction in reliance on large-scale transmission assets and distribution assets are increasingly experiencing a two-way flow of electrons, with
implications for the technical boundaries of the network and for network cost recovery. Similarly, energy retailers must be increasingly nimble and develop ways to buy and sell electricity from generators of different sizes and at different positions in the network. Regulators must be able to respond to changes in sites and modes of electricity production and consumption, protecting the viability of the networks that electricity distribution relies upon whilst also maintaining signals to promote competition. Finally, all of this must be performed within a framework of rapidly changing consumer expectations.

Residential solar energy is the first step in this transition towards an increasingly 'democratised' electricity sector, which has the end-user engaged in far more complex interactions with electricity. End-users are no longer solely unconscious consumers of electricity, where the flick of a switch will create demand, but will generate electricity, store electricity, trade electricity, and even use electricity for transport. End-users will be able to assist networks with reducing peak demand, and therefore drive down costs, by using stored electricity to shift grid-based consumption to outside peak hours. End-users can also assist retailers with reducing their costs by providing a source of stored electricity when wholesale electricity costs are high. Associated with these potential benefits to network operators and retailers will be an increasingly complex raft of retailer contracts.

Such a 'democratisation' of the electricity sector will necessarily see end-users investing the capital in the next generation of electricity infrastructure, as opposed to generation, network and retail companies. The interactions described above will only be created after investment in a collection of technologies, including solar systems, batteries, Advanced Metering Infrastructure and even electric cars. This will inherently transfer the risk for cost recovery from industry participants to householders and other community members. A truth as yet unacknowledged by those touting the benefits of a decentralised electricity system is that the cost-effectiveness of this transition for end-users lies with their ability to negotiate an electricity contract in their favour. The increasingly complex nature of electricity generation and distribution, alongside a lack of energy literacy in the general public, means negotiation powers may be limited. There is evidence of this in this research, with residential householders making solar investment decisions based on rebates acting as a 'cue-to-action' before they run out, and based on peer-to-peer interactions as opposed to rational economic decision-making. Solar consumers appear to be easily convinced to purchase over-sized systems and appear to have limited understanding of how to fully
engage with solar systems to maximise their financial benefits. Solar consumers’ high expectations of financial benefits of solar systems have also been informed by government incentives promoting solar as a form of ‘free energy’, with governments unaware of (or not acknowledging) the need for tariff adjustments to ensure network operators remain viable.

It is evident that considerable work is required to support the increasing development of energy literacy in the general public. It is important that householders develop the skills, knowledge and vocabulary for assessment and decision-making around these technologies. Or, alternatively, models can be developed to assist householders with decision-making. One public servant mentioned that householders are not expected to have a comprehensive knowledge of health care (there are doctors, hospitals and health insurers for this), nor are they expected to have a comprehensive knowledge of the financial system (there are accountants, financial planners, and mortgage brokers for this), and hence perhaps there should also be energy advisors who can be trusted by householders to provide reliable information and advice. The question, then, is who can be trusted to act independently and reliably in providing information to community members? The ‘democratisation’ of the electricity industry is occurring within a highly contested framework of competing interests, many of which have been encouraged by successive governments promoting cost-efficiency and market competition between incumbent industry players. Additionally, each player is not necessarily driven by an altruistic desire to see an energy transition so much as an opportunity to access a ‘window’ for their own market growth or continue to fulfil their legislated function. While conducting this research a number of people in the solar installation business were interviewed. All were passionate about their businesses and the benefits of residential solar energy. They were excited about delivering a product that would meet the needs of those they were serving. Yet the firms that some of these people worked for were simultaneously providing inaccurate information that would lead to residential consumers purchasing over-sized systems. Similarly, the network operators interviewed all voiced an interest in renewable energy. All could see potential benefits to the network, as well as difficulties in increasing solar access. These network operators stated that they were tasked with being ‘generation agnostic’. Despite this, there was evidence that on a utility-wide scale these network operator agencies were restricting the connection of renewable and distributed generation. Therefore, there is a perception of competing interests, even within agencies, which could reduce the reliability of information provided to the public.
It is worth asking what the government’s role is in this energy sector transition, and at which level of government intervention should be undertaken. This thesis has highlighted a number of opportunities for government to improve solar energy policy. The research has suggested improved information for residential householders around solar, alongside a strengthening of regulations and audits for renewable generation systems and installation. In particular, this research has advocated for the development of a government-scale ‘vision’ of the energy sector, acknowledging changes to the roles of generators, retailers, network operators and regulators. These suggestions have been made on the basis of information and data provided by industry, government and community stakeholders. However, Australia, like so many countries, is currently in the grips of post-Global Financial Crisis strategies to reduce government debt, coinciding with a neoliberalisation of the economy, associated reductions in regulation and support for ‘small government’. It is evident that governments may be more invested in developing policies that are ‘simple’ to deliver, quick to roll out and carry favour with the voting public than in developing complex policies that could have greater economic efficiency, lower levels of cross-subsidisation and educational empowerment of the community, but with associated increased levels of planning, regulation, education delivery and opportunities for failure.

Nevertheless, it is precisely at this time that government intervention is required to direct the future energy transition. Without government intervention, and development of a ‘vision’ on how the future energy system should look, there is an increasing likelihood that ad hoc generation and network distribution investments will create market inefficiencies and push up prices; that industry incumbents will continue to ‘push back’ on renewable investments; and that consumers will develop a level of distrust for the ‘tools’ of an electricity sector transition, potentially culminating in a lost opportunity to move towards a more economically efficient, low carbon future. However, there are seeds of hope for a managed approach to the electricity sector transition. This research has shown that, in spite of the vast market systems, technical machines and regulatory and legislative frameworks that underpin the electricity sector, it is individual human beings who have the potential to instigate change. It is the champions in regional areas who manage to excite an entire community about the prospect of solar, or the lone voices in network operator agencies that guide a change in processes. It is the renewable energy advocates beating down doors and seeking Ministers’ ears, and it is those Ministers, with energy utility CEOs, heads of
regulators and the knowledge of the public service at their feet, who can drive a just, efficient and clean energy transition for us all.

10.5 References


HOBLMA, E. V. & FREDERIKS, E. R. 2014. Barriers to green electricity subscription in Australia:“Love the environment, love renewable energy... but why should I pay more?” Energy Research & Social Science, 3, 78-88.


SIMCOCK, N. 2014. Exploring how stakeholders in two community wind projects use a "those affected" principle to evaluate the fairness of each project's spatial boundary. Local Environment, 19, 241-258.


APPENDICES:

LIST OF APPENDICES:

Appendix 1: Survey used in Chapter Three: ‘RESEARCH INTO DOMESTIC SOLAR ELECTRICITY SYSTEM INSTALLATIONS IN WESTERN AUSTRALIA’

Appendix 2: Survey used in Chapters Four and Five: ‘RESEARCH INTO DOMESTIC SOLAR ELECTRICITY SYSTEM INSTALLATIONS IN WESTERN AUSTRALIA’

Appendix 3: Interview Participant Form used in Chapters Five, Six and Seven: ‘PARTICIPANT INFORMATION SHEET: RESEARCH INTO ATTITUDES ON DOMESTIC SOLAR IN WESTERN AUSTRALIA’

PARTICIPANT INFORMATION FORM

RESEARCH INTO DOMESTIC SOLAR ELECTRICITY SYSTEM INSTALLATIONS IN WESTERN AUSTRALIA

Dear Participant,

We write to you today regarding a study examining attitudes and opinions on the costs and benefits of domestic solar energy systems to the environment and society, undertaken as part of a PhD research project.

Participants for this research have been randomly selected from publicly available Landgate data. Completion of a short survey is required for this portion of the research. We request that the survey be completed by someone in the household involved in the payment of bills and purchase of appliances. The survey should take no longer than fifteen minutes to complete.

All electricity consumers pay for renewable energy systems through their electricity tariffs. However, some households get their money back through subsidies for solar electricity systems. The data obtained will provide information on whether consumers are willing to financially support renewable energy technologies, even if the financial benefits are not evenly distributed across society.

The next phase in the research process will include interviews. If you would be interested in speaking to the researcher by phone please tick the relevant section over page.

Participation in this survey is completely voluntary and you may cease involvement at any time. This survey is anonymous and no individual data will be revealed. Completion of the survey is taken as evidence of your consent to participate in this study. If you have any questions or concerns regarding this research, please don’t hesitate to contact the primary researcher Genevieve Simpson (genevieve.simpson@uwa.edu.au) or Assistant Professor Julian Clifton (julian.clifton@uwa.edu.au).

We thank you in advance for taking the time to complete the survey. Your involvement in this research is greatly appreciated.

As thanks for participating in this research, you can choose to enter a draw to win an iPad Mini.

Please return the completed survey by 6 December 2013.

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time.

In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at the University of Western Australia on (08) 6488 3703 or by emailing to hrea-research@uwa.edu.au.
PLEASE RETURN COMPLETED SURVEYS BY **6 December 2013**

USE THE PRE-PAID ENVELOPE SUPPLIED OR ALTERNATIVELY POST FREE OF CHARGE TO:

M004
University of Western Australia
Reply Paid 61050
Crawley WA 6009

**1 - PRIZE**

TO GO INTO THE DRAW TO WIN AN IPAD MINI, PLEASE INCLUDE THE FOLLOWING DETAILS:

Name: ________________________________  Phone: ________________________________

Postal Address:

_____________________________________________________________________________

E-mail:

_____________________________________________________________________________

**2 – FURTHER RESEARCH**

Please tick this box if you would be happy to discuss your experiences and opinions regarding renewable energy systems and subsidies.  

[ ] Phone number: ________________________________ Best time to call: _________ AM / PM

**3 – RESEARCH FINDINGS**

If you are interested in the outcomes of the research, please tick this box and a summary of the results will be forwarded to you via email.

[ ]

*Please note this information will be separated from the completed survey questionnaire*
SECTION 1: This section includes questions about your demographics.

1.1) What is your sex?
    Male [ ]
    Female [ ]

1.2) What is your age?
    0 – 29 [ ]
    30 – 39 [ ]
    40 – 49 [ ]
    50 – 59 [ ]
    60 + [ ]

1.3) What is your highest educational attainment?
    Primary or Secondary School [ ]
    Advanced Diploma (TAFE etc) [ ]
    Bachelor Degree [ ]
    Graduate Diploma or Graduate Certificate [ ]
    Postgraduate Degree [ ]

1.4) What is your total pre-tax annual combined household income?
    $0 - $40,000 [ ]
    $40,001-$65,000 [ ]
    $65,001-$90,000 [ ]
    $90,001-$120,000 [ ]
    $120,001+ [ ]

1.5) How many people usually live in your house?
    1 [ ]
    2 [ ]
    3 [ ]
    4 [ ]
    5 [ ]
    6 or more [ ]

1.6) Where have you seen solar systems on other properties? Choose ALL that apply.
    On my street [ ]
    In my close neighbourhood [ ]
    In my suburb / region [ ]
    In other suburbs / regions [ ]
    I have not seen/noticed any [ ]
SECTION 2:  This section relates to your attitudes and opinions regarding the costs and benefits of domestic solar energy systems.

Please indicate the extent to which you agree with the following statements.

2.1) More pressing infrastructure needs exist in regional areas than access to cheap, reliable electricity

2.2) Governments should support renewable energy in regional areas before metropolitan areas

2.3) Everyone should have equal access to rebates and the ability to install solar systems

2.4) Only wealthy people can afford to install solar systems in regional areas

2.5) More should be done to increase renewable energy, even if it increases electricity bills

2.6) Everyone benefits from renewable energy through lower emissions and reduced reliance on fossil fuels

2.7) Benefits of renewable energy outweigh increases in electricity costs

2.8) I believe the contribution renewable energy technologies make to reducing emissions is valuable

2.9) The environmental benefits of renewable energy have been overstated

2.10) It is better to pay for some solar systems in low-income housing than subsidise many systems for home owners

2.11) Low-income households are under financial stress so their electricity bills should not include any contribution to renewable energy

2.12) All electricity consumers should contribute equally to the costs of renewable electricity
2.13) Limiting costs of living for low-income households is more important than funding renewable energy

2.14) I would be more supportive of subsidies knowing that most solar installers are not wealthy

2.15) Everyone should make sacrifices now as we will all experience climate change and reduced access to fossil fuels

2.16) Funding should go to large, efficient renewable energy projects instead of household projects

2.17) I would prefer to subsidise solar systems in households than subsidise large companies

2.18) Government policies should reflect the interests of householders before industry

2.19) It is unfair that all electricity consumers subsidise the installation of household solar systems

2.20) People who install solar systems do so primarily for self-interested, economic reasons

2.21) I would only purchase a solar electricity system if it was subsidised by the government

2.22) Too much public money has been put into supporting household solar systems

2.23) Subsidies for solar systems should continue to be available so everyone can access them in future

2.24) Government should continue to support ALL renewable energy projects

PLEASE CONTINUE SURVEY OVER PAGE
SECTION 3: This section relates to your housing tenure and solar system experiences.

Please complete the following questions if you HAVE installed a solar system:

| 3.1) Which statement best reflects your relationship with your solar electricity system? Please choose ONE response. |
| I might not get back what I paid, but I am doing my bit for the environment and supporting the renewable energy industry. [ ] |
| I think it was a sound investment decision over the long term, with environmental and industry benefits immediately. [ ] |
| I installed a system to reduce my exposure to increasing electricity tariffs / fuel costs and take advantage of available rebates. [ ] |

| 3.2) What subsidies did you receive when installing your system? Choose ALL that apply. |
| Solar Homes and Communities Grant ($8,000) [ ] |
| Household Renewable Energy Scheme (WA rebate) [ ] |
| Premium Feed-in Tariff (40 cent or 20 cent kWh/unit on your electricity bill) [ ] |
| Solar Credits Multiplier / Renewable Energy Certificates (via installer or individually) [ ] |
| Remote Renewable Power Generation Program Grant (or similar) [ ] |
| Unsure, but a total value of approximately $________________________ [ ] |

Please complete the following question if you HAVE NOT installed a solar system:

| I would like to install a solar electricity system but I am not the home owner [ ] |
| I would like to install a solar electricity system but my home is not suitable for this kind of technology (too small, inappropriate orientation of roof, shading etc) [ ] |
| I would like to install a solar electricity system but I cannot afford it [ ] |
| I would install a solar electricity system if I was allowed to feed electricity into the grid [ ] |
| I looked into installing a solar electricity system but decided it was not for me [ ] |
| I am not thinking about installing a solar electricity system because I am moving soon [ ] |
| I am considering installing a solar electricity system at present [ ] |
| I have not considered installing a solar electricity system [ ] |
3.4) What is your current tenancy status for the house the survey was sent to?

Home owner / mortgage holder [ ] Go to Q 3.5
Renting / Other non-owner [ ] END

3.5) When did you purchase or build this property? ________(Year)

3.6) Approximately how old is this property? ________(Years)

3.7) Is this the FIRST property you have purchased?

No [ ] Go to Q 3.8
Yes [ ] END

3.8) What was the FIRST property you purchased?

House / Townhouse / Villa / Duplex / Terrace house [ ]
Unit / Apartment [ ]
Other kind of property [ ] ________(Kind)

3.9) When did you purchase your FIRST property? ________(Year)

3.10) Where did you purchase your FIRST property?

Australia [ ] ________(State)
Other Country [ ] ________(Country)

If you have any comments regarding the contents of this survey or issues relating to government support for renewable energy technologies in regional areas please include these below.

THANK YOU FOR COMPLETING THE SURVEY
Dear Participant,

We write to you today regarding a study examining motivations for installing domestic solar electricity (photovoltaic) systems, undertaken as part of a PhD research project.

Participants for this research have been selected based on the presence of a solar electricity installation on their rooftop, as determined using satellite imagery. Solar system installers or official databases have not been used to obtain personal data. We request that the attached survey be completed by the central decision-maker regarding the solar installation. If a previous owner, or your landlord, installed the system please complete only the specified sections of the survey. The survey should take no longer than fifteen minutes to complete.

The research is seeking to determine the importance of rebates and community engagement in solar installation decision-making. The data will be used to determine whether consumers continue to rely on rebates as motivation for installation of a system, or whether there are low enough installation costs and high enough levels of trust in solar systems to drive installations.

The next phase in the research process will include interviews. If you would be interested in speaking to the researcher by phone please tick the relevant section over page.

Participation in this survey is completely voluntary and you may cease involvement at any time. This survey is anonymous and no individual data will be revealed. Completion of the survey is taken as evidence of your consent to participate in this study. If you have any questions or concerns regarding this research, please don’t hesitate to contact the primary researcher Genevieve Simpson (genevieve.simpson@uwa.edu.au) or Assistant Professor Julian Clifton (julian.clifton@uwa.edu.au).

We thank you in advance for taking the time to complete the survey. Your involvement in this research is greatly appreciated.

As thanks for participating in this research, you can choose to enter a draw to win an iPad Mini.

Please return the completed survey by 6 December 2013.

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time.

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University of Western Australia
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Crawley WA 6009

1 - PRIZE

TO ENTER THE DRAW TO WIN AN IPAD MINI, PLEASE INCLUDE THE FOLLOWING DETAILS:

Name: _______________________________ Phone: _______________________________

Postal Address:

____________________________________________________________________________

E-mail:

____________________________________________________________________________

2 – FURTHER RESEARCH

Please tick this box if you would be happy to discuss your experiences and opinions regarding renewable energy systems and subsidies. [ ]

Phone number: __________________________ Best time to call: _______ AM / PM

3 – RESEARCH FINDINGS

If you are interested in the outcomes of the research, please tick this box and a summary of the results will be forwarded to you via email. [ ]

Please note this information will be separated from the completed survey questionnaire
SECTION ONE: ALL SURVEY RESPONDENTS TO COMPLETE

1.1) What is your sex?

Male [ ]
Female [ ]

1.2) What is your age?

0 – 29 [ ]
30 – 39 [ ]
40 – 49 [ ]
50 – 59 [ ]
60 + [ ]

1.3) What is your highest educational attainment?

Primary or Secondary School [ ]
Advanced Diploma (TAFE etc) [ ]
Bachelor Degree [ ]
Graduate Diploma or Graduate Certificate [ ]
Postgraduate Degree [ ]

1.4) What is your total pre-tax annual combined household income?

$0 - $40,000 [ ]
$40,001-$65,000 [ ]
$65,001-$90,000 [ ]
$90,001-$120,000 [ ]
$120,001+ [ ]

1.5) How many people usually live in your house?

1 [ ]
2 [ ]
3 [ ]
4 [ ]
5 [ ]
6 or more [ ]

1.6) Has your household invested in any of the following? Please choose ALL that apply.

Solar water heater/heat pump water heater [ ]
Hybrid or electric vehicle [ ]
Passive solar design retrofit of your home/invest in solar design of your new home [ ]
Replacement of existing light bulbs with LED/energy efficient lighting [ ]
Purchase of energy efficient/high energy star rating appliances [ ]
Purchase of carbon offsets or similar for ALL your household consumption [ ]
Please indicate the extent to which you agree with the following statements.

<table>
<thead>
<tr>
<th></th>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure/Don't know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7</td>
<td>I would only purchase a solar system if it was subsidised by the government</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.8</td>
<td>Not as many people will install systems now that rebates have reduced</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.9</td>
<td>Subsidies for solar systems should be available to help industry and consumers</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
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<tr>
<td>1.10</td>
<td>I would install a solar system even if it was more expensive than electricity from the grid</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
<tr>
<td>1.11</td>
<td>I vote for political parties that prioritise environmental as opposed to economic issues</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.12</td>
<td>Preparing for the reduced availability of finite fossil fuel resources is important</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.13</td>
<td>Man-made climate change is a real and serious phenomenon</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.14</td>
<td>If I purchased a new home I would install a solar system</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.15</td>
<td>I voluntarily recommend to others that they install a solar system</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.16</td>
<td>Educational assistance is needed to help people understand the real costs and benefits of solar</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.17</td>
<td>I am confident the solar system industry, its advertising and delivery of rebates are appropriately regulated</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.18</td>
<td>Other people have requested advice from me regarding solar systems</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>1.19</td>
<td>Are you the owner/occupier of the house?</td>
<td>Yes [ ]</td>
<td></td>
<td>Continue survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No, I am renting/other non-owner</td>
<td>[ ]</td>
<td></td>
<td>GO TO SECTION 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.20</td>
<td>Did you install the solar system at your house?</td>
<td>Yes [ ]</td>
<td></td>
<td>GO TO SECTION 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No [ ]</td>
<td></td>
<td></td>
<td>GO TO SECTION 3</td>
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</tr>
</tbody>
</table>
SECTION TWO: OWNER/OCCUPIERS THAT HAVE INSTALLED SYSTEMS TO COMPLETE

2.1) When was your current solar electricity system installed? _______ (Mon.) _______ (Year)

2.2) Is this the first system you have installed? Yes [ ] No, my first system was installed in _______ (Year)

2.3) Is your current solar system financed with the assistance of the following? Please choose ALL that apply.
- Interest-free or low-interest green (government) loans [ ]
- Loan accessed via energy retailer or system provider [ ]
- Packaged into your home loan or other personal loan [ ]

2.4) Which subsidies did you receive? Please choose ALL that apply.
- Solar Homes and Communities ($8,000) [ ]
- Household Renewable Energy Scheme (WA rebate) [ ]
- Premium Feed-in Tariff (40 cent or 20 cent kWh/unit on your electricity bill) [ ]
- Solar Credits Multiplier / Renewable Energy Certificates (via installer or individually) [ ]
- Remote Renewable Power Generation Program Grant (or similar) [ ]
- Unsure, but a total value of approximately $________________________ [ ]

2.5) What was the net installation cost of your current solar system (cost after deducting all claimed subsidies)? $________________________

2.6) Before you installed your domestic solar system on your property, where had you seen solar systems on other properties? Please choose ALL that apply.
- On my street [ ]
- In my close neighbourhood [ ]
- In my suburb / region [ ]
- In other suburbs / regions [ ]
- I had not seen/noticed any [ ]

2.7) Please RANK the following motivating factors for installing your solar electricity system from 1 (most important) to 6 (least important).
- Reducing greenhouse gas emissions [ ]
- Reducing exposure to increasing electricity tariffs / fuel costs [ ]
- Take advantage of the availability of rebates [ ]
- Be seen to be setting a good example in the community [ ]
- Increase the value of my property [ ]
- Experiment with new technology [ ]

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2.8) Please choose ONE statement that best describes your experience with obtaining information about your first solar electricity system. “I decided to install a system...”

“...after talking to someone I know who is in the energy or technical industry” [ ]
“...based on advice from a friend/neighbour/family member” [ ]
“...based on the recommendations of an installer” [ ]
“...after seeing some information in the media” [ ]
“...after I did a lot of research into solar systems to make sure it was the best decision for me” [ ]

2.9) What prompted you to move from considering to install to deciding to install your first system? Please choose ONE response.

Discussion with a door-to-door or telephone salesperson [ ]
Advertisement you saw on television/social media/paper [ ]
Discussion with friends/family/neighbour [ ]
Awareness that rebates were reducing [ ]
Awareness that system costs had reduced to an affordable level [ ]
Opportunity to bundle cost into my home loan or access another loan [ ]
Any other factors:

Please indicate the extent to which you agree with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure / Don’t know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.10) The time it took to pay off my system was more important than whether I received a rebate</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2.11) I installed my system in part to access ‘free money’ from the Government</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2.12) I installed my solar system for economic reasons, other benefits are a bonus</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2.13) My solar system is living up to my expectations</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2.14) I understood how my electricity bills would change after installing a solar system</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2.15) Changes to my bills after installing my system met or exceeded my expectations</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
2.16) Some information available regarding solar systems and subsidies was misleading

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure / Don't know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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<tr>
<td>[ ]</td>
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</tbody>
</table>

2.17) I installed my solar system primarily because it was a new technology I was interested in

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure / Don't know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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2.18) When I installed my system I knew that it might stop working and I would lose my investment

<table>
<thead>
<tr>
<th>Strongly agree</th>
<th>Agree</th>
<th>Unsure / Don't know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
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</table>

SECTION THREE: ALL OWNER/OCCUPIERS TO COMPLETE

3.1) When did you purchase or build your current property?

   [_________](Year)

3.2) Approximately how old is your current property?

   [_________] (Years)

3.3) Is this the FIRST property you have purchased?

   Yes [ ]   GO TO SECTION 4
   No  [ ]   CONTINUE

3.4) What was the FIRST property you purchased?

   House / Townhouse / Villa / Duplex / Terrace house [ ]
   Unit / Apartment [ ]
   Other kind of property [ ] [_________](Kind)

3.5) When did you purchase your FIRST property?

   [_________](Year)

3.6) Where did you purchase your FIRST property?

   Australia [ ] [_________](State)
   Other Country [ ] [_________](Country)

SECTION 4: If you have any comments regarding the contents of this survey or issues relating to government support for renewable energy technologies in regional areas please include these below.

THANK YOU FOR COMPLETING THE SURVEY
PARTICIPANT INFORMATION SHEET

RESEARCH INTO ATTITUDES ON DOMESTIC SOLAR IN WESTERN AUSTRALIA

The research being undertaken aims to assess the current status of domestic solar electricity systems and the perception of subsidies in Western Australia. This will be undertaken through conducting semi-structured interviews with government, industry and community members, and by having households complete a survey about their experiences and perceptions of solar. The data will be used as the basis for a PhD thesis to be submitted to the University of Western Australia.

This portion of the research will examine perceptions of domestic solar energy systems, subsidies associated with their installation and people or experiences that might influence these perceptions. This will be undertaken by interviewing community members, members of the renewable energy industry and people involved with policy.

This research questions why different geographic regions experience different rates of technology adoption, including solar adoption. The research findings may provide insight into ways policy can be developed to promote a more evenly distributed adoption of technology between and within communities.

The interview process which you, as the participant, have been asked to participate in is likely to cause low to insignificant levels of harm. In talking about your personal opinions and experiences you may experience feelings of guilt or distress. To the greatest extent possible the researcher will try to minimise these feelings, changing the topic of interview if the participant appears to be uncomfortable. At any point the participant can ask to change the line of questioning, or suspend the interview. The researcher apologises for any inconvenience associated with the time required for participants to contribute to this research.

Participation in this interview is voluntary and you, the participant, are free at any time to withdraw consent to further participation without prejudice in any way. The participant need give neither reason nor justification for such a decision. In such cases, the record of the participant is to be destroyed, unless otherwise agreed by the participant. Your participation in this study does not prejudice any right to compensation, which you may have under statute or common law.

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time. In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at the University of Western Australia on (08) 6488 3703 or by emailing to hreo-research@uwa.edu.au.

All research participants are entitled to retain a copy of this Participant Information Form.

If you have any questions or concerns regarding this research, please don't hesitate to contact the researcher, Genevieve Simpson, on 0404 89 2383 or by e-mail at genevieve.simpson@uwa.edu.au. Alternatively, the research supervisor at the University of Western Australia, Dr Julian Clifton, can be contacted at julian.clifton@uwa.edu.au should you wish to get in touch with him in relation to this request for participation or the research involved.
PARTICIPANT CONSENT FORM
RESEARCH INTO DOMESTIC SOLAR ATTITUDES IN WESTERN AUSTRALIA

Participant: ________________________________ (please print)

You, the participant are free at any time to withdraw consent to further participation without prejudice in any way. You need give neither reason nor justification for such a decision. In such cases, any record related to you will be destroyed.

Your participation in this study does not prejudice any right to compensation, which you may have under statute or common law.

I (the participant) have read the information provided and any questions I have asked have been answered to my satisfaction. I agree to participate in this activity, realising that I may withdraw at any time without reason and without prejudice.

I understand that all identifiable information that I provide is treated as strictly confidential and will not be released by the investigator in any form that may identify me. The only exception to this principle of confidentiality is if documents are required by law.

I have been advised as to what data is being collected, the purpose for collecting the data, and what will be done with the data upon completion of the research.

I agree that research data gathered for the study may be published provided my name or other identifying information is not used.

__________________________
Participant signature

__________________________
Date

Approval to conduct this research has been provided by the University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise any questions or issues with the researchers at any time.

If you have any questions or concerns regarding this research, please don’t hesitate to contact the researcher, Genevieve Simpson by e-mail at genevieve.simpson@uwa.edu.au. Alternatively, the Chief Investigator (supervisor), Assistant Professor Julian Clifton, can be contacted at the above address should you wish to get in touch with him in relation to this request for participation.

Any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at the University of Western Australia on (08) 6488 3703 or by emailing hreo-research@uwa.edu.au.

All research participants are entitled to retain a copy of the Participant Information Form.

Yours sincerely

Dr Julian Clifton

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Since it was established in 2001 the RET has been successful in increasing the proportion of renewable energy generation in Australia. However, the scheme currently suffers from a lack of policy certainty, resulting in a freeze on large-scale infrastructure investments. Key objections to the RET, including that reduced demand in Australia will result in ‘overshoot’ of the 41,000 GWh LRET value, and that the RET results in unnecessary costs to industry and householders do not acknowledge the value of the scheme to the environment and society, and are based on information asymmetry. In the absence of a carbon pricing mechanism the RET is Australia’s most important policy for reaching its international commitment of a 5% reduction on 2000 emissions by 2020.
Introduction

I am pleased to be able to provide this submission to the Australian Government regarding the evaluation of policy and governance mechanisms for Australia’s Renewable Energy Target (RET). I am a PhD candidate focusing on the interaction between public policy application and on-ground responses, and have previously researched Australia’s RET (Simpson and Clifton, 2014a & b – attachments 1 and 2).

My primary concern regarding the RET continues to be around the implications of policy uncertainty for the renewable energy industry. While the RET has historically received bipartisan support, recent political developments indicate that the current government’s level of commitment to the renewable energy industry and to the RET is low. Decisions made by the Coalition Government, including the decision to assign a review board placed within the Department of Prime Minister and Cabinet, as opposed to having the review undertaken by the independent Climate Change Authority (as is stipulated in legislation), the intentions to or successes in abolishing the Climate Commission, the Clean Energy Finance Corporation (CEFC), the Australian Renewable Energy Agency (ARENA) and the Climate Change Authority represent a lack of commitment to renewable energy and the environment.

Renewable energy is an important technology to assist Australia’s transition to a low carbon economy, and provides opportunities in employment, research and development and the empowerment of households’ to interact with energy infrastructure. I urge the government to maintain the existing 41,000 GWh target, in order to ensure the policy consistency the renewable energy industry requires to promote investment. This decision would reflect the interests and preferences of the vast majority of stakeholders involved with renewable energy. Based on an analysis of the previous RET review submissions, high energy consumption and fossil fuel based industry were the only stakeholders to recommend a reduction in the Large-scale Renewable Energy Target (LRET) value, or abolition of the scheme altogether (Simpson and Clifton, 2014b). The majority of these stakeholders recommended that the scheme should be disbanded given the carbon pricing mechanism would result in least-cost emissions abatement. In the absence of a carbon pricing mechanism there is no clear policy-based reason to abolish the RET, and indeed the RET is likely to be the key policy required to reach Australia’s international commitment to a 5% reduction on 2000 emissions by 2020. The likelihood of the Direct Action policy to meet emissions reduction targets is equivocal. The existing GWh target should be maintained as policy consistency is required to promote industry certainty necessary for reaching any proposed target, and in order to avoid international perceptions of sovereign risk in Australia.

This submission is structured around the questions provided in the RET Review preparation paper.

How has the RET performed against the objectives in the Renewable Energy (Electricity) Act 2000?

The RET has been successful in increasing the proportion of electricity generation sourced from renewable energy in Australia. The expanded RET from 2009, including the potential for hydropower projects to benefit from investment in plant efficiency to access financial benefits under the RET, has seen clear growth in generation from wind and solar power, with hydro reaching previously experienced levels of generation, in spite of reduced rainfall (figure 1).
With the exception of the use of waste coal mine gas, which is excluded from the 41,000 GWh LRET value, the RET encourages the development of ecologically sustainable renewable energy resources. Expansion of the scheme to low-emissions technologies, use of native forest waste wood generation and increasing the number of waste coal mine gas facilities with the ability to generate renewable energy certificates would be contrary to objective (c) of the Act. While these technologies may result in a reduction of emissions from the Australian electricity sector, the reduction may be less than if the scheme continued to favour renewable electricity generation technologies exclusively or would be more costly to industry.

Are there more efficient and effective approaches to achieving these objectives?
No, the Renewable Energy Target is a sound market-based mechanism that will see least-cost renewable technologies competing with fossil fuel generation in Australia’s National Electricity Market and Wholesale Electricity Market.

Previous submissions under the Climate Change Authority indicated that most stakeholders believe the RET is an appropriate scheme for promoting an increase in renewable energy capacity in Australia (Simpson & Clifton, 2014b). Those submissions that did not support the RET as a means of reducing Australia’s carbon emissions or transition to a lower-emissions economy generally did so on the basis that the carbon pricing mechanism would result in least-cost emissions abatement, and that the carbon pricing mechanism should be used to promote Australia to a low emission economy. This view was held by the Business Council of Australia, the Cement Industry Federation, the National Farmers Federation, Rio Tinto and the Chamber of Minerals and Energy. It is worth noting that all these stakeholders have since indicated support for the Coalition Government’s intention to abolish the ‘carbon tax’, and are therefore likely to have their primary interests aligned with least-cost production and industry growth, as opposed to support for reducing Australia’s greenhouse gas emissions, regardless of the structure of the scheme.
Do the objectives of the Act remain appropriate, in light of falling electricity demand and the Government’s target and policies for reducing greenhouse gas emissions?

The first point to make regarding this statement is the assertion that there is ‘falling demand’ for electricity in Australia. It is true that demand for electricity from centralised grids is falling over time; however this does not take into account consumption of on-site distributed electricity generation (domestic solar systems etc). A recent analysis has found that, based on current projections and including off-grid generation, the renewable market share will reach 22% by 2020 (figure 2), not significantly different from the policy goal of ‘at least 20% renewable energy’ included in the RET legislation (but omitted from the 2014 RET Review Terms of Reference). Logic would suggest that it would be important for RET calculations and projections to factor in the demand for electricity generation that is being met by the very renewable energy systems that are supported under the RET.

![Renewables market share](image)

Figure 2 – Parkinson, 2014a

With the Government’s intention to abolish the carbon pricing mechanism, as well as other agencies important for implementing policies, schemes and programs capable of reducing emissions (CEFC, ARENA, Million Solar Roofs scheme, reduced funding for CSIRO [Pears, 2014]) and Tuesday’s budget announcement that only half of the proposed budget for the Emissions Reduction Fund would be available in the first four years of its implementation, it is likely that the RET will be a key policy regarding Australia’s ability to deliver on its international commitment to reduce 2000 emissions by 5% by 2020.

Should the LRET be abolished, reduced or increased? If retained, what level should it be? What would the impact of such changes be?

The LRET should be retained, with its current 41,000 GWh target. Maintaining this target represents an ongoing commitment to industry for policy certainty, which is required to attract overseas investment in large-scale infrastructure. Furthermore, there should be an attempt to reach bilateral commitment between governments for maintenance of this target to 2020. In the absence of a carbon pricing mechanism the RET is the only market-based incentive available to promote lowest-emissions electricity generation.
Do small-scale renewable energy systems still require support through the SRES? If so, for what period will support be required for?

Small-scale renewable energy systems contribute to the legislated total target of 45,000 GWh of renewable generation by 2020. If small-scale systems are to be removed from the RET then the LRET should have its target expanded to 45,000 GWh by 2020 to make up for this shortfall.

There is some evidence to suggest that financial support is no longer required for small-scale domestic solar electricity systems. Scales of economies have increased and there is enough market competition to drive down prices. Additionally, there are schemes available which allow lower income households to take out loans for systems, so access to solar electricity systems is no longer restricted.

However, in the absence of an alternative scheme for displacement technologies, and noting that solar water heaters and air source heat pump water heaters have not experienced the same reduction in price, there are still benefits in having these systems included under the RET. This is particularly the case given there is still a solar water heater manufacturing industry in Australia, that will benefit from increased revenue and could act as a site of industrial research and development, if future revenue is assured (Solarexpress, 2014).

In the interest of creating a level playing field for all small-scale renewable and displacement systems all systems should be able to access funds through the Small-scale Renewable Energy Scheme (SRES). In particular, this means providing support to the incumbent, successful domestic solar industry and also opening the scheme to other technology types. The use of banding or multipliers, such as the Solar Credits Multiplier, should not be used as it creates an unsustainable industry base and can result in the creation of ‘phantom’ credits (Simpson and Clifton, 2014b).

Should the LRET and SRES schemes be recombined?

The LRET and SRES schemes should remain as separate schemes, with separate targets and separate administration.

The schemes were initially separated given the unexpected oversubscription to the Solar Credits Multiplier, which led to an oversupply of Renewable Energy Certificates (RECs) on the RET market. The oversupply reduced the value of RECs, and therefore reduced incentives for large-scale industry, stalling decisions to invest in renewable energy infrastructure. While the Solar Credits Multiplier has since been dismantled, the potential for the two sub-schemes to have negative interactions still exists.

The schemes work in inherently different ways. Planning for large-scale projects is over a much longer timeframe, allowing parties time to develop power purchase agreements and agreements on the trading of Large-scale Generation Certificates (LGCs). The fixed projection of demand for LGCs over time is critical in creating consistency and reliability in demand and therefore investment. Alternatively, the non-binding target under the SRES allows for fluctuations in the creation of small-scale certificates. While we may never see an over-generation of certificates as we did under the Solar Credits Multiplier, a reduction in generation of certificates could see the Small-scale Technology Certificate (STC) Clearing House utilised. As of 11 May 2014 there are 584,676 certificates in the STC Clearing House, from 2,658 deposits, representing over $23 million, much of which is to be delivered to domestic installation owners, as opposed to industry. The reverse could also be suggested – that by combining the schemes you could create a market for the STCs in the clearing house (when the value of certificates exceeds $40 per unit), however in doing so you would
also be introducing volatility to the LGC pricing structure and disadvantaging large-scale projects (with lower $/watt installed costs) in favour of accessing the clearing house.

While there may be administrative efficiencies in merging the schemes, the process would add unnecessary policy uncertainty surrounding the RET.

**What impact is the RET having on electricity markets and energy markets more broadly? How might this change over time?**

There is considerable speculation around the impact that the RET is having on electricity markets, energy markets and the ability for industry to remain competitive in Australia and internationally. The refrain from industry has been based around the cost of purchasing LGCs and STCs to meet their commitments (Hepworth, 2012). Additionally, Terms of Reference for this review indicate that the cost of the RET to Australian households should be considered. There is much speculation on how the cost of the RET will rise over time, given the apparently significant financial impact the RET is having, even at its current low percentage contribution to national electricity generation.

These arguments are generally misleading. There are several reasons for this:

- The use of renewable energy technologies, particularly wind, can reduce wholesale electricity prices through the Merit Order Effect — that is, as a result of the low cost of in-time generation due to low fuel inputs, renewable energy is the cheapest form of generation at some times of the day, out-competing higher-cost generation sources and their impact on the spot market price for electricity (Cudius, Forrest and MacGill, 2014). This reduction in the wholesale price of electricity is generally not taken into account when analysing the cost of the RET to consumers.

- The growth in electricity bills acknowledged by householders and industry is driven in largest part by an increase in network costs, not as a result of the RET (Climate Change Authority, 2012). The RET contributes to electricity price rises, alongside the carbon pricing mechanism, and in most states the cost of premium feed-in tariffs (which can be considerably expensive, as was experienced in Queensland [Ironsde, 2013]. The exact contribution of the RET to increasing electricity bills may be lower than the general public believes.

- The cost of the RET has, in recent years, been higher than you would expect over longer-term forecasts due to the impact of the Solar Credits Multiplier creating an over-supply of certificates in the market (figure 3). The number of certificates that industry was required to surrender in 2012 may have been equivalent to as much as 33% of all electricity demand from electricity networks (not including on-site consumption of electricity generated by distributed renewable energy systems – figure 4, own research from Clean Energy Regulator data). This means you would expect to see the cost of the scheme to industry decreasing in future years, all else being equal.

- Finally, modelling has suggested that changes to the GWh value of the LRET could see electricity costs increase by as much as $119 million, when taking into account increased costs associated with policy uncertainty (Nelson, Nelson, Ariyaratnam & Camroux, 2013).
Are the current exemption arrangements appropriate?
The creation of Partial Exemption Certificates (PECs) does not influence the total capacity of renewable energy in Australia; instead it shifts the burden of payment for surrendering certificates from all electricity consumers to those that are not exposed to international competition. Careful consideration should be given when selecting those businesses that are to receive PECs. Consideration should include the likely costs in businesses meeting their obligations under the RET in the absence of PECs, the ability for them to pay these contributions and how shifting the burden to other manufacturers is likely to impact on their productivity.

If PECs are to be made available these should be tradable, as electricity retailers currently have the ability to determine the value of the PECs, irrespective of wider market conditions.
How does the RET interact with other government policies that have, or will have, an impact on the operation of the RET, or that impact on renewable energy or energy markets more generally? What can be done to improve the efficiency and effectiveness of these interactions in delivering intended policy objectives?

The schemes that have the potential to interact with the RET are dwindling and are unlikely to have consequential interactions with the RET.

The Climate Change Authority’s 2012 Review examined a variety of initiatives that were likely to interact with, or had been interacting with, the RET (Climate Change Authority, 2012). Key to these were the CEFC and state-based support schemes for small-scale energy systems. There were numerous submissions that considered that those projects that were able to access CEFC funds should not be able to access funds under RET, as this would result in uncompetitive practices and ‘double dipping’ of government incentives. There were also those that considered all large-scale renewable energy systems should be able to access the RET, with CEFC designed to support emerging renewable energy technologies that may not yet be market-competitive. Given the Coalition Government’s commitment to axe the CEFC, consideration of the interaction between the CEFC and the RET appears redundant. However, if the senate is successful in being able to block the abolition of the CEFC I would provide support for the second suggestion – that technologies/firms be capable of receiving funds under both the CEFC and the RET. This will increase the likelihood that these technologies will be able to enter the renewable energy market, and inclusion of as many renewable energy projects under the RET as possible will increase the likelihood that Australia will meet the 41,000 GWh LRET.

State-based schemes for promoting the installation of small-scale systems, particularly domestic solar electricity systems, have been wound back across the nation and are therefore unlikely to interact with the scheme. The introduction of any program associated with the ‘Million Solar Roofs’ campaign would likely have interacted with uptake under the SRES, and may have promoted another ‘spike’ in sales, and therefore costs for industry to comply with the updated binding small-scale technology percentage, as experienced under the Solar Credits Multiplier. However, the ‘Million Solar Roofs’ program seems to have been scrapped from the 2014-15 budget (Pears, 2014) and it is therefore unlikely that any funds will be made available to householders and impact on the SRES.

The government’s commitment to also abolish ARENA will further reduce the likelihood of interactions between the RET and other schemes.

Should any other energy sources be included in the LRET? Should any non-renewable (but low emissions) energy sources be included?

Under the RET waste coal mine gas generators can create LGCs, although these are not included in the annual GWh targets. The decision to include existing waste coal mine gas under the RET is appropriate. These projects were initiated based on a New South Wales commitment that proponents would have access to a renewable energy certificate scheme (Simpson and Clifton, 2014b). Also, the complex company structure between coal mine owners, operators and generation firms mean that without LGCs cost recovery for waste coal mine gas generation may be unlikely.

If any non-renewable energy sources are to be included under the RET they should not be included under the 41,000 GWh LRET (i.e. they should be treated in the same was as existing waste coal mine gas facilities). This will increase the number of certificates industry is required to purchase under the scheme. There are significant disadvantages to the inclusion of waste coal mine gas operations under the RET, including that it increases costs to industry. Alternatively, low emission energy
sources could compete for funds under the Emissions Reduction Fund. If the RET is used to support low emission energy sources industry and domestic consumers will have to pay for this generation, if the Emissions Reduction Fund is used tax payers will have to pay for this generation. This will be a judgement call for the government.

Should any new small-scale generation technologies be eligible under the SRES?
Modelling should be undertaken to determine the impact of any new small-scale generation technology types being introduced to the SRES. As it stands, the preference for small-scale solar, wind and micro-hydro creates competitive advantages for these technology types and a market barrier for new market entrants. For this reason it would be equitable to allow all small-scale renewable electricity generation sources, with a minimum standard of quality and efficiency, access to the SRES. As it stands the number of STCs generated for small-scale hydro and wind are low enough that it does not represent significant financial ramifications for the scheme (380 wind systems and 15 hydro systems, compared to approximately 1.2 million solar systems [Clean Energy Regulator, 2014]).

Introduction of new technologies will result in an administrative cost, in that all technologies should be required to meet minimum technical thresholds and therefore must be assessed by some government or associated regulatory agency. Consideration of the maturity of new technology types, and manufacturers' ability to provide sufficient evidence to warrant a confident acceptance under the scheme by said government or regulatory agency, is therefore required.

The capacity of new technology types and their ability to feed-in to the grid should also be considered. Considering the network augmentation that may be required in certain parts of Australia to deal with considerable in-flow of electricity within the distribution network it may be worth ensuring that new technology types have a low capacity – similar or even lower than solar systems, or alternatively excess generation should be ‘grounded’, thereby minimising impacts on the local distribution network.

Should any new displacement technologies be eligible under the SRES?
Displacement technologies are more appropriately placed under an alternative scheme, given the RET’s legislated goal of increasing renewable electricity generation, as opposed to creating mechanisms to displace electricity consumption. However, in the absence of alternative displacement-specific support programs it may be appropriate to include other displacement technologies under the RET. There are considerable opportunities for ground-source heat pumps and associated combined heating and cooling systems to reduce demand for electricity in Australia. These technologies currently lack access to markets given the technology is not significantly developed, and scales of economy have not been reached in construction or installation. The lack of access to SRES funds further increases the market gap between these technologies and solar water heaters and air source heat pumps. The ramifications of expanding the scheme to new installations should be considered. In early stages of market growth uptake of these systems and generation of certificates is likely to be low and it is not likely there will be a significant impact on the STC market.

What should be the frequency of statutory reviews of the RET?
Statutory reviews of the RET should be undertaken only once every four years, although it may be deemed necessary to undertake an ‘administrative review’ more frequently, to try to increase the efficiency of the scheme in line with the development of other agencies and reporting mechanisms. For example, in future there may be an option to streamline industry reporting practices further with the National Greenhouse and Energy Reporting System. Any administrative review should not
include consideration of target values, technology types with access to the scheme, and other components which are instrumental to the success of the scheme and that may reduce investor confidence in relation to the scheme.

The 2012 Climate Change Authority review recommended increasing the number of years between reviews from two years to four years. This recommendation was accepted by the then Labor Government. Leading up to the 2013 election the Coalition party pledged to re-review the RET in 2014. Changes to legislation to increase the number of years between reviews were not implemented prior to the 2013 federal election. On entering government the Coalition maintained that they were required to re-review the RET in 2014, based on legislated requirements. Based on the Coalition government’s election commitment to re-review the RET, and given the Coalition Government has not acquiesced to all legislated requirements regarding the review (such as that the review should be undertaken by the Climate Change Authority) even if the Labor Government had been able to change legislation prior to the change in government it is more than likely that there would have been another review. This process merely demonstrates that the decision to review the RET is based on political motives, rather than what is stipulated in the legislation. The decision to continuously re-review the RET has policy implications which extend beyond the renewable energy industry in Australia, and is active in increasing the perception of Australia as a site of sovereign risk.

While it is hoped that the outcome of the 2014 Renewable Energy Target review will have similar findings to the 2012 Climate Change Authority Renewable Energy Target review, the decision to have an ‘independent’ board appointed to over-see the scheme, the decision to have ACIL Allen, a generally pro-fossil fuel consultancy firm (which previously provided modelling for the Climate Change Authority Review deemed to be inaccurate) undertake the modelling, the apparent disregard for considering the future likelihood of a carbon price in modelling scenarios and various other aspects of the review process indicate that the outcomes of the review may result in recommendations favouring a reduction to the current 41,000 GWh LRET (Morris, 2014; Parkinson, 2014b). In this case, a future government may choose to again re-review the RET outside of legislated periods, with the intention of expanding the scheme. By this time opportunities to access international investment in renewable energy may have passed, with Australia being deemed too risky as a site of investment.

What administrative and regulatory arrangements should be put in place to ensure that the reinstatement of native forest wood waste is consistent with the sustainable management of native forests?

Further consideration of the introduction of forest wood waste generation under the RET is required. Preserving our native forests is important for maintaining a resource which acts as a carbon ‘sink’. Where native forest has been approved for clearing there is no need to provide additional incentives for electricity generation; if it is economically feasible wood waste can already be used as a source of generation in some states, but it should be competitive with other fossil fuels.

If the judgment is made to continue with the decision to allow native forest wood waste generation under the RET there must be significant regulatory mechanisms in place to prevent the RET acting as a mechanism for developing a financial market for the destruction of native forests. This should include a clear definition of ‘wood waste’ as being products that are produced as off-cuts of wood being processed and should not represent clear-felling of all timber not labelled as ‘high value’. It should also be noted that stringent regulations have been developed in the past for the wood-chipping industry which have been deemed to be ineffective (Australian Government, 1999). Fines and other disincentives must therefore be developed to stand alongside any permission granted for
allowing forest wood waste under the RET, and stringent policing of the forestry industry is required. Combined, the administrative and regulatory burden surrounding this recommendation is likely to be costly, whilst still of limited potential to minimise adverse impacts on native bushland. For this reason native forest wood waste generation should not be allowed under the RET.

The volume of generation as a result of native forest wood waste generation may have an impact on the ability for other genuine renewable electricity generation projects to find a market for their certificates. Native forest wood waste generation should not be preferential to the development of more environmentally sustainable renewable energy technologies like wind, solar and geothermal.

Terms of Reference — Scope of the Review, includes considering: “The economic, environmental and social impacts of the RET scheme, in particular the impacts on electricity prices, energy markets, the renewable energy sector, the manufacturing sector and Australian households.”

As a final comment I would note that the first point in the RET review Terms of Reference (above) does not reflect the questions included in the RET Review preparation paper. There is little opportunity in the scope of the questions provided to discuss the broader environmental and social impacts of the RET, and the extent to which maintenance of the scheme in its existing format is required to maximise these benefits. The provision of rebates that have allowed domestic households to install small-scale renewable energy systems has increased householders’ ability to protect themselves from increasing tariffs, and given statistics show that lower-income areas are particularly supportive of renewable energy it is likely that funds have largely gone towards those most in-need of assistance (Green Energy Trading, 2014). Additionally, the availability of rebates has resulted in increased demand and coincident increases in scales of economies which have seen systems reduce in price to be cost-competitive with electricity from the grid, under a twenty-five year lifetime (Parkinson, 2011). This reduction in price-per-unit for domestic solar electricity systems, combined with competition between installers making a variety of price packaging options (loans etc) available, may mean a scheme like the ‘Million Roof Tops’ policy is no longer required. But there are more emerging generation and displacement technologies that could benefit from support under the RET, even if that benefit is as little as increasing the proportion of society aware of low-emissions alternatives.

Conclusion
I request the Government’s consideration of the above-stated issues with regard to the RET and hope that recommendations coming out of the review process reflect the interests of the Australian public, the renewable energy industry and Australia’s commitment to emissions reduction targets. Australia has made significant developments in expanding its renewable energy capacity, and these should not be stymied in order to appease special interest groups.

Sincerely,

Genevieve Simpson, B. Sc. (Hons)
PhD Candidate
School of Earth and Environment
University of Western Australia
Disclosure statement
The views and opinions included in this submission to the Australian Government’s Renewable Energy Target Review are solely those of the author and do not represent the policies and opinions of the University of Western Australia.

References:


References related to corporate support for repealing the carbon pricing mechanism:


