

Remote Renewable Energy in Australia: Barriers to Uptake and the Community Engagement Imperative

Ms Marteena McKenzie & Dr Michael Howes

Australian School of Environmental Studies
& the Urban Research Program,
Griffith University, Brisbane

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Abstract

The provision of safe and reliable energy is essential for the development of a modern economy and has been the prime goal of domestic energy policy. There are, however, many remote communities in Australia that lack access to a conventional electricity grid but are well placed to take advantage of viable alternatives. In these situations the deployment of renewable energy systems would not only solve the electricity supply problems but would also assist in achieving environmental policy goals by cutting net greenhouse gas emissions and moving communities closer to sustainable development. The utilisation of these alternatives also offers an interesting laboratory to test the theoretical framework of ecological modernisation that underpins environmental policies. Despite their many benefits, the uptake of renewable energy systems in remote communities often remains curiously low. This paper investigates the barriers to change by analysing some of the political, economic and social factors that have been at work. The results provide some useful findings, particularly with regards to the need for effective community engagement in successful policy implementation.

Introduction

A safe and reliable energy supply is seen as an essential service in most industrial societies and is usually given a reasonably high policy priority by the state. The delivery of this service is by varying combinations of public infrastructure, state utilities and private providers. In many remote Australian communities, however, the provision of energy poses something of a problem because they are often too distant to make connection to a conventional electricity grid viable. The traditional response has been to install diesel generators, but these are often expensive to run and maintain, require fuel to be hauled long distances (often under difficult conditions), and are noisy and highly polluting. One solution to this dilemma is to install renewable energy systems that utilise technology such as photovoltaic solar cells and/or wind generators. Such systems have been freely commercially available for many years but their uptake in remote regions of Australia has been surprisingly low. This paper will consider why this is the case. The first section offers a brief overview of the strategy and theoretical framework of this research. The eight barriers to change identified will then be dealt with in turn by summarising the relevant literature, outlining the empirical findings of this study, and testing the theoretical framework of ecological modernisation. Overall it is argued that most of the barriers to change are not technical, that community engagement is a key factor in successful policy implementation, and that the idea of ecological modernisation needs further development to be more suitable in an Australian context.

Background to the Research

An international literature review unearthed several barriers to uptake of renewable energy (RE) systems identified by previous studies. These were grouped into six broad categories: market factors; financial and economic factors; institutional factors; technical factors; social and cultural factors; and, community engagement factors. Semi-structured interviews with key Australian stakeholders were then undertaken to analyse and test these barriers. Attempts were made to ensure that interview respondents were selected from a diverse range of organisations. Although the number of interviews undertaken was relatively small, this objective was achieved. Respondents were drawn from a non-government organisation / RE advocacy group, an electricity retailer with operations in remote communities, government departments responsible for administering a remote RE rebate scheme and an Indigenous organisation specialising in remote RE planning and installation. Efforts were also made to select respondents whose position within the relative organisation was directly related to the planning or installation of RE installations in remote communities. These considerations ensured that interview respondents came from diverse organisations and were able to comment on the impediments to uptake in practical ways.

The identity of respondents has been protected by a pseudonym but their role in the RE sector is indicated in table 1 below.

Table 1: Respondents and their role in Renewable Energy (RE)

Pseudonym	Role and Organisation
Scott	Policy Officer, Not-For-Profit RE energy advocacy organisation
Worth	Manager, remote RE project involving an Indigenous science organisation
Best	Program manager for domestic RE subsidy program, government department
Hunt	Program manager for large-scale RE subsidy program, government department
Richards	Sales and marketing manager, government owned national electricity retailer
Golf	RE engineer, government owned national electricity retailer
Guest	Public projects manager, government owned national electricity retailer

Three interesting points emerged from these interviews. First, they gave a more in-depth understanding of the six barriers that had been identified by the international literature. Second, two new barriers emerged that had not been previously identified: malicious damage to RE systems, and the changing nature of remote communities. Third, the research indicated the limitations of ecological modernisation (the theoretical

framework that underpins environment and development policies) in its application to the Australian context.

Ecological modernisation (EM) is a broad school of thought that argues that although they have gone astray, the state, industry, and the market can all be made sustainable if they are restructured (Massa & Andersen 2000; Dryzek 1997). Fundamentally, it is assumed that environmental risks can be treated as challenges that arise from the inefficient use of resources and that economic growth can be de-linked from raw material use through better technology and improved decision making systems. It is argued that there are many 'win-win' scenarios where what is good for the environment will also be good for business because cutting waste should also cut costs (Buttel 2000; Mol & Spaargaren 2000). There are many versions of EM, ranging from the weak techno-centric view that focuses on the deployment of new technology, to the stronger calls for a more radical restructuring of market, state and community institutions to make them more democratic (Christoff 1996). The stronger versions overlap with ecological democracy and reflexive modernisation (Blowers 1997; Cohen 1997). There are, of course, many critics of this school of thought but it remains highly influential in the development of environmental policy, planning and management systems (Fisher & Freudenburg 2001; York & Rosa 2003).

The idea of EM and its applicability to the deployment of RE systems in Australia is explored as part of the analysis offered in this paper. Each of the barriers to change is dealt with in individual subsections below. In each of these subsections the relevant academic literature, interview data and application of EM theory is summarised.

Market Factors

For purpose of this analysis 'market' issues and 'financial and economic' issues surrounding RE uptake in Australia are separated into discrete categories. Market issues are grouped according to the distinctions identified in Painuly (2001), including a controlled energy sector, lack of competition, high transaction costs, perverse subsidies, non-consideration of externalities, taxes on RE, and trade barriers. These constitute market failures, imperfections and distortions. Market factors were identified in the literature review as significant barriers to a robust and sustained RE energy industry in Australia, an outcome that was also realised in the responses of most interviewees.

Non-accounting for externalities was a key concern for several respondents. Richards noted that ‘the true cost of energy in Australia is not realised... the externalities of diesel and petrol use are not included in market transactions’. Similarly, Scott recognised this as a problem mentioning that:

As long as we [Australians] don’t have carbon taxes, we’re not actually paying for emissions of CO₂ and all the subsidies that come with transporting diesel to remote communities to run generators... we’re not really seeing the true cost.

The issue of subsidies in Australia was a considerable concern for most respondents. Richards explained that ‘in some cases, the cost of transporting the diesel to remote locations is greater than the cost of the diesel itself. This is due to subsidy issues’. Scott asserted that ‘there’s a significant level of subsidies to the fossil fuel industry in general [that] do definitely skew the system’. Similarly, Worth commented on the distortion of diesel fuel prices in remote Indigenous communities, where subsidies resulted in the ‘cost of transporting it being higher than the cost of the diesel itself’. Overall, responses of interviewees tended to corroborate findings from literature regarding the significance of barriers to remote RE installations imposed by market failures and imperfections. Structural market barriers of this nature are difficult to overcome, and given that the Australian economy is heavily fossil fuel orientated, these issues are highly relevant to the Australian case study.

A core theme of EM is the de-linking or decoupling of materials from economic flows (Mol & Sonnenfeld 2000). This has implications when considering market barriers to remote RE uptake, with experiences in countries such as Germany, the Netherlands and Sweden showing that environmental reforms leading to total decline in resource use and emissions can coincide with economic growth (Mol & Sonnenfeld 2000). Case studies of this nature are useful when exploring government policy-making related to remote RE. As Gouldson and Murphy, (1997) argue, economic and environmental goals need not be mutually exclusive. The complexity and pervasiveness of market impediments to successful RE industries in remote communities conforms to EM’s explanation of the multifaceted causes of environmental degradation (Mol & Spaargaren 2000). Similarly, the actions required to overcome these issues are firmly dictated by EM’s insistence on broad reforms in ‘social practices, institutional designs and societal and policy discourses’ (Mol & Sonnenfeld 2000) to bring about socially and environmentally benign change.

EM recognises the potential for market distortions and failures to cause damage to the environment. It is argued, however, that some market mechanisms can still be employed to better capture environmental externalities in market transactions (Murphy & Gouldson 2000). This is highly relevant to the case of market barriers in the Australian RE industry and several suggestions have been made to overcome these issues. Most RE proponents argue that the federal government should withdraw subsidies and cross subsidies for connection to the grid and provide greater subsidies for renewables (Blakers & Diesendorf 1996; Reddy & Painuly 2004). Similarly, there is a case for government to internalise the externalities of fossil fuels in order to include their environmental, social and health costs in market transactions (Blakers & Diesendorf 1996; Dryzek 1995). There have been calls for an inquiry into fossil fuel subsidies in Australia, which would address the issues of perverse subsidies and provide a framework for tackling the increasing GHG emissions (Reidy 2003).

Far from representing a burden on the Australian economy, the development of a strong remote RE market could result in significant economic gain. The flow-on potentials of a strong remote RE industry in Australia include competitive advantage and export prospects for Australian systems, where issues of service delivery and extreme environmental conditions are paramount (Brandt & Svendsen 2006; Walker 2000). There is also opportunity for applying experiences and successes in remote areas to increasing RE uptake in urban areas (Green 2004). Economic factors may be overcome by identifying multiple income streams from RE projects, including credits from the MRET target or carbon credits (Sonneborn 2004). An issue closely related to market considerations are those of financial and economic obstacles.

Financial and Economic Factors

Financial and economic barriers include economic viability, relative market size, high cost and lack of access to capital, up-front capital costs for investors, credit access issues and the lack of financial institutions willing to fund renewables (Painuly 2001). Several respondents (from government, an energy retailer and an NGO) nominated financial and economic issues as *the* most significant barrier facing the RE industry in Australia. Guest argued ‘financial barriers to be *the number one* impediment to a large-scale RE energy industry in remote Australia’ (emphasis added). These concerns were echoed by Golf, who said ‘the relative costs of solar systems remain a big problem, and

institutional and financial barriers are complex and interrelated'. Impediments of this nature were also recognised by Scott, who argued that:

[RE] is still seen as a very expensive option and that's got many facets associated with it...one of those is economies of scale: the more you do it, the more you can make it cheaper and the more we can promote it.

For the managers of the government RE subsidy schemes that have recently been scrapped, these issues are obviously significant. Best explained that 'I don't think there will be much more funding for the renewable energy schemes... not for individual properties or houses or anything like that'. Hunt was more pointed in his evaluation of the problems facing the industry; 'the barriers are very simple. One word – Economics, that's the bottom line - Economics'. While the Indigenous organisation involved in this study is funded by several government agencies and did not cite financial obstacles as an overarching issue, educating funding providers on the cost-effectiveness of remote RE schemes has been a challenge. Worth commented that financiers 'were using the capital cost of the equipment as their comparison, instead of life cycle costs of energy supply' when making decisions on funding allocations.

The issue of economies of scale for RE technologies is central for several organisations in this study. The energy retailer is attempting to overcome these factors by investing heavily in both 'mainstream' remote RE applications like solar and wind, as well as funding geothermal power and alternative bio-power technologies such as sugar mill by-product and macadamia nut farm waste utilisation (Richards). The Indigenous organisation is strategic in its approach to economies of scales in RE technologies, techniques which are outlined further in this paper. The subsidy scheme manager pointed out that the numbers of remote installations has increased from around ten in 1995 to over 90 currently (Best), a trend that is contributing to relative costs and increased consumer confidence in the technologies.

As indicated by the background research and confirmed by interview responses, considerable impediments to a robust remote RE industry are financial and economic factors. All respondents nominated some factor relating to financial issues as a considerable barrier to their work or the expansion of the industry in general, indicating the overarching importance of this issue.

According to EM, financial and economic issues must be considered in concert with a multitude of other factors as causes for environmental degradation and barriers to amelioration. Moreover, the development of a strengthened remote RE industry may be viewed as a key strategy for achieving the goals of EM, where environmental protection is not considered an obstruction to a strong economy, but an opportunity for economic growth as demand for environmentally benign technologies increases (Weale 2005). EM also treats expenditures on better technologies as an investment, where outlays reap returns and are not simply considered costs (Murphy & Gouldson 2000). As such, stakeholders in the expanding remote RE industries are considered agents of change, and are perceived as conduits of ecological restructure and reform (Blowers 1997; Mol & Sonnenfeld 2000). EM provides a useful framework for recognising the obstacles presented by market and financial barriers to a robust remote RE industry. Applications of EM strategy for achieving sustainable development may also be usefully applied to build a strengthened RE industry in Australia.

Strategies for overcoming financial and economic issues are closely related to those proposed for addressing market barriers. There is a clear requirement for system pricing to be reduced (Reddy & Painuly 2004). If pricing structures were appropriately amended, many of the financial and economic impediments in the remote RE industry would be ameliorated. As prices fall, the key issue of prohibitive upfront capital outlays relating to remote RE would be overcome. In the meantime, there has been support for the strategy of 'bundling' small remote power systems together, so that financial issues regarding economy of scale can be overcome by mass-purchase of systems (Sonneborn 2004). Institutional issues are an important consideration in the obstacles to a robust RE industry and are closely related to financial and economic issues.

Institutional Factors

As has been mentioned previously, sorting the impediments to installation of RE systems in remote areas into clearly defined categories is difficult. Institutional factors include mechanisms to disseminate information, legal and regulatory frameworks, stability of the macro-economic environment, clashes of interests, relative research and development culture, existence of professional institutions and level of private sector participation (Painuly 2001, 79). In short, institutional considerations relate to the capacities of regulatory and bureaucratic arrangements to foster or impede remote RE

installations. As expected, respondents also nominated institutional matters identified in preliminary research as key concerns.

Problems surrounding government interest and support for remote RE were a recurring theme in the interviews. Richards noted that ‘government commitment tends to be characterised by half commitments and inconsistency’. Scott extended this line by arguing that ‘at a federal level there’s a total lack of government support for renewables in general’, pointing out:

...it’s not just the lack of actual on-the-ground programs that support renewables, but I think...in the language that comes out, an obvious lack of enthusiasm to support renewables and also a general support for anything that is not renewables’

There were suggestions of disparities in responses between varying levels of government to RE projects. Guest noted that:

Different levels of government have different drivers and different responses to remote solar projects. Local councils have had a piecemeal approach, where responses tend to be driven by individuals rather than policy.

Scott echoed this sentiment when mentioning that ‘there seems to be a bit more of a willingness on a state level to embrace renewables’. While division of responsibility for management and funding of conventional electricity generation is clearly defined between government tiers, there seems to be a degree of ambivalence and uncertainty surrounding the RE industry, leading to unclear policy directions between government departments. Best, manager of the government subsidy scheme noted:

The state government has a fairly good view of renewable energy and they would like it promoted, but they don’t have the available funds... [and] obviously the federal government doesn’t have that much funding to contribute either.

Concerns were also levelled at the degree of transparency and equity in government decision-making related to RE:

...with a centralised system [*like coal-fired or nuclear*], you’ve got one or two really big and really rich companies who have got a very strong lobbying position to approach the government. So there’s a complete imbalance of information that is going up to the government level (Scott)

Several respondents argued that the dispersed nature of remote power supply has implications for the quality and strength of lobbying potential. Without a strong and centralised lobbying voice, it is difficult for the needs and demands of this industry to be met (Scott). The interrelatedness of institutional and financial barriers was highlighted by several respondents, with Hunt arguing that ‘for the votes that a politician can expect to get from providing individuals with rebates, they would simply not be worth the expense’.

Government decision-making may be obstructive in other ways, especially in the Indigenous political sphere. The organisation involved in this project has ongoing concerns that ‘there’s discussion now about the viability or how remote communities, particularly remote Indigenous communities, should be resourced or *whether they should be resourced at all*’ (Worth) (emphasis added). Uncertainty and complex decision-making structures also presented problems. Worth noted that:

In our establishment, the whole policy environment wasn’t structured in a way that was helpful for us. There were numerous changes to operating procedures and policy within the support agencies like ATSIC and now FACS, and even in the Greenhouse office.

The Indigenous organisation has tackled institutional barriers in a strategic way. Previous research conducted by the organisation identified several key areas of opportunity relating to institutional barriers specific to the Central Australia, the Top End, the Kimberley and North Queensland. A key component of the ongoing project is to ‘build an integrated support network’ for RE systems in remote areas (Worth). Having recognised the lack of suitably qualified contractors of RE technologies in these regions, the organisation focused on establishing ‘a commercially viable, qualified contractor network’ (Worth). The organisation is attempting to achieve this by calling for expressions of interest for existing contractors to get their RE accreditation through a Recognition of Prior Learning (RPL) process. The aim is to develop quality and quantity in contractors available to install, service and maintain RE systems (Worth).

The Indigenous organisation is also attempting to address deficits in RE information availability in Australia and an information warehouse is being developed. Given the

large number of system installations the organisation has overseen, they have access to a great deal of data relating to component reliability, system design and contractor information. The information warehouse is designed to compile and store data that could be used as a reference and decision-making tool for the RE industry and consumers alike (Worth). It is hoped that this effort could help overcome technical and institutional factors identified as obstructions. These issues are complex and relate in various ways to all tiers of government and bureaucratic arrangements. These barriers have clear implications for the strategies proposed for achieving sustainable development through EM. Fundamental transformations in governance, involving a shift away from top-down approaches towards decentralised power and consensual governance is a key tenet of strong forms of EM (Christoff 1996; Mol & Sonnenfeld 2000). This is clearly related to the drive for bottom-up approaches to energy access, security and supply that is supported by proponents of remote access to renewables. The diversification and appropriate application of RE in remote communities is a convincing means of achieving these ends.

Altering the role of social movements and NGOs is also a consideration of strong EM that argues that social movements should be awarded greater power in public and private decision-making regarding ecological reform (Mol 2000; Mol & Sonnenfeld 2000). This has obvious resonance with the goals and comments made by the alternative energy advocacy organisation, which has a significant role in lobbying government decision-making on energy issues.

Several suggestions have been made to address the institutional barriers to an expanded RE industry in Australia (Mills 1997; Reddy & Painuly 2004). Despite growth in public concern over environmental issues, government decision making continues to favour economic growth at the expense of environmental outcomes. Better government decision-making and strong political will to bolster the RE industry is necessary (Beder 2000). Increasing the political strength of the RE industry would help attract financial support from government and investors, and increased funding for research, development and demonstration of RE systems is a necessary first step to achieve this (Blakers 2000; Blakers & Diesendorf 1996; Sanden 2005; Watt & Outhred 2001). This step, along with those government responsibilities discussed above, would help foster more 'RE friendly' institutional arrangements. A solid RE research, development and

deployment culture in Australia could have flow-on benefits in the form of research collaborations and educational opportunities (Wenham *et al.* 2001). Furthermore, as market penetration increased, the political power of RE proponents would develop in ‘institutional virtuous’ circles (Sanden 2005, 138).

Governments need to shift focus from a short-term strategy to a long-term perspective that incorporates socially and environmentally benign goals (Mills 1997). Learning from the experiences of governments with higher RE installation rates presents a promising start. Through innovative energy policy, the share of RE in Germany has more than doubled in the past decade (Wustenhagen & Bilharz 2006).

Government may also have a role in working with RE providers to develop a strategic industry plan (Blakers & Diesendorf 1996). Accredited and labelled green pricing incentive schemes, GHG reduction or RE targets, education, information, training and standards for buildings and equipment, emissions taxes, targets and training schemes and least cost planning for systems providers are all strategies that could be implemented (Watt & Outhred 2001). Strategies of government intervention should ‘set in motion a process of self-sustained growth...where cost reductions generate market growth which in turn generate cost reductions’ (Sanden 2005, 145). Any successful strategy employing these approaches will require a coordinated policy approach between Commonwealth, State and Local governments (Watt & Outhred 2001). The Environment Protection and Heritage Council, and the Intergovernmental Agreement on the Environment on which it was built, might offer useful models (Howes 2005, 55-7). Improved support from government is required for renewables in remote regions, particularly in Indigenous communities (Walker 2000).

Technical Factors

Given that remote RE systems are mainly located in arid and desert regions in Australia, there are inherent challenges for system designers to deal with extremes in climate and geography. Technical constraints in RE systems have restricted and slowed industry development in Australia. Technical issues can include a lack of standard codes and certification, lack of skilled personnel and training facilities, and unreliable or poorly designed systems (Painuly 2001, 79). Technical impediments identified in interviews

reflected these barriers classified in the literature review, with many respondents nominating technical issues as a central barrier to a significant RE industry in Australia.

Most agree that while systems have improved dramatically in the past decade, there are still technological improvements that could be made. Systems currently being installed are adequate, but 'it is human nature to push for better technologies...we can do better' (Golf). This is reiterated by Hunt, who stated 'I think the technologies are pretty good. Panel, battery and inverter are all really good'. Similarly, the Indigenous organisation has ceased development on system design and is now working towards refining problematic components (Worth).

Reliability and standardisation of equipment was a significant issue that impacted the success of RE systems in remote Indigenous communities. A preliminary market survey of RE systems in 2000 showed that 'only about two-thirds of the surveyed equipment was working. That's related to the systems being designed to a budget and being of insufficient capacity' (Worth). Standardisation of systems in these regions is also significant, where distances travelled for maintenance and repairs precludes contractors from having ready access to a variety of spare parts (Worth). The organisation has developed a set of strategies. Standardising construction and appearance, testing that components meet international performance standards, ensuring designs are robust, ensuring configurations and enclosures are vermin-proof, dust-proof and self-ventilated and factory-testing each system prior to installation in the community are all steps taken (Worth). Each system is equipped with a data monitor that records various parameters relating to system performance, including the amount of energy coming in from the solar panel, the load being used, how people are using the power, battery temperature and battery state-of-charge. These data are used to measure system performance and reliability and are fed back into a central database which contributes to the information warehouse discussed previously (Worth). For this organisation, addressing technical issues is a cyclical process. While system design has ceased, improvements in system components continue, facilitated by data fed back through the collection process described above (Worth).

Technical issues are an obvious consideration when examining the obstacles to a robust remote RE industry in Australia. While there have been significant improvements in the technologies available over the past decade there are several technical factors that

obstruct the continued development of this industry. There are clear links between discussions of technical barriers to broad distribution of RE systems in remote communities and EM. The theories of EM seek to analyse the changing role of science and technology: where they were once considered the root cause of environmental degradation, EM attempts to address their important role in ameliorating and averting damage (Gouldson & Murphy 1997; Mol & Sonnenfeld 2000; Mol & Spaargaren 2000). As such, considerations of advocates for remote RE are reduction of GHG emissions and environmental harm through the replacement of fossil-fuel intensive diesel generators with low emissions solar, wind or hybrid set-ups. This strategy is in line with strong EM and it provides a convincing basis from which to advocate for the expansion of this industry.

Some attempts at overcoming technical issues have been analysed in previous studies and continuing technological developments in the RE field are promising. There is a fundamental requirement for increased reliability in remote RE installations. The RE industry must produce reliable, user-friendly designs (Lowe & Lloyd 2001). This is especially pertinent in Indigenous communities, where high turnover in household occupancies affects the availability of people with system training (Lloyd 2001). Better design may be achieved by reducing the number of components in the system, increased standardisation of systems, and increased implementation of third-party accredited testing processes. These steps would also foster feedback loops to industry, which would assist in highlighting product deficiencies (Menges 2003; Sonneborn 2004; Walker 2000). Users and future-users of technology are often critical sources of technology innovation (Ornetzeder & Rohrer 2006). Similarly, regular maintenance of systems is paramount, and Jennings and Healey (2001, 332) suggest ‘as a minimum, six-monthly maintenance of the hybrid equipment for the first year or two should be a part of the contract with equipment installers’.

While the current approach of system designers is to encourage limits in demand to match the capacity of the technology, this strategy tends to lead to overloading. Presnell (2001, 355) notes that ‘matching system performance with user expectations is the ‘holy grail’ of the...industry’. There should be a shift towards responsive, flexible systems; an approach that would help reduce the need for diesel backup and system over-sizing (Walker 2000). Comprehensive life-cycle-analysis of competing power supply options could generate data useful for decision-making (Madlener & Stagl 2005).

Demand management should also be addressed through consumer education, increased use of high efficiency devices and examination of household energy use on the whole (Crawford & Treloar 2004; Walker 2000). There is also impetus for increasing flexibility in RE installations by improving the hybrid capacity of current sources (Lund & Munster 2006). Overall, it appears that the small market share of RE has less to do with technological performance and more to do with changes outside their development (McVeigh *et al*, 2000).

Social and Cultural Factors

Along with advances in science, engineering and technology, social considerations are central to expanding the renewable energy industry (Bradbrook 2002). Respondents identified and discussed issues uncovered in the literature review. These factors are somewhat difficult to define, but tend to include perceptions of product reliability and consumer or social acceptance of the product (Painuly 2001). In a broader sense, they tend also to include social and cultural *considerations* of system design, installation and maintenance such as cultural appropriateness of and acceptance of technologies and capacity of the community to maintain and service systems. These factors contribute strongly towards the long-term viability of a system in any community.

Consumer education and understanding were nominated as *the* critical impediment a respondent from the electricity retailer. Guest argued that ‘people’s understanding of energy in general is poor...with high levels of confusion between solar hot water and solar energy’. The education issue also surrounds demand-side management as most dwellings on remote properties tend not to be designed for energy efficiency, but are mainly constructed quickly and cheaply out of non-efficient materials like steel (Guest).

Consumer awareness is considered significant by Scott, who stated that ‘there is a much greater scope for remote applications in Australia. I think that there’s a greater awareness than ever before, but this is key to expanding the industry’. This awareness relates to ‘a lack of understanding of the benefits and awareness of the technology itself’ (Scott). Issues of this nature are also considered important by the government representatives who asserted that, despite progress in consumer awareness and confidence over the past ten years, ‘education and awareness building is a major factor

that needs to be overcome' (Best). Demand-side management and consumer education are also considered more 'cost-effective' than RE subsidy schemes (Hunt).

There was some evidence that issues concerning confidence in RE technologies are being overcome. Richards commented that the successes of RE in many remote communities has facilitated a growing confidence in these applications: the 'unproven' technologies are gaining widespread acceptance. There are additional positive flow-on effects of RE systems for communities in the Torres Strait, where people now enjoy reliable power supply and 'also use the wind turbines as navigational beacons in shipping' (Golf). Lack of confidence in technologies in Indigenous communities has been linked to poor performance of the systems and lack of training for operation and maintenance. Worth argues that these issues are extensive and the organisation is attempting to address them through improved training, support and user-friendly system design:

The social and cultural barriers, they aren't really barriers; they're just issues that we need to deal with when communicating with the outstations or homeland residents. The barrier would be in equipment that doesn't have a suitable interface with users, or in the lack of training that's provided.

The social and cultural appropriateness of RE technologies is a central concern for the Indigenous organisation, and their system design process is accordingly used as an opportunity for capacity building in communities. The process is educational, participatory, inclusive and reflexive. The aim of the community engagement process is to 'transfer information about the technology so that people can make an informed choice in the context of what they're trying to do' (Worth). This engagement strategy will be elaborated upon further. According to Worth, the issue of confidence in RE technology is *the* key impediment to the industry in Australia. He argued that:

The most significant barrier is confidence. It's a confidence issue that RE technology is robust and sustainable and appropriate. That confidence is in the minds of all the different players, the users of the technologies, the contractors that provide it and the people that actually fund it and supply it.

Given that the confidence issue is one concerning all key players in the industry, it is presumably a complex factor to overcome. Social and cultural considerations are clearly relevant to all respondents interviewed for this project. It is also evident that each

stakeholder had varying perceptions of what factors fall into this category, making a concerted attempt to tackle these issues difficult. This is significant because it is an issue that is paramount to the success of this industry and is difficult to both define and address. The imperative of social and cultural factors in the uptake of RE in remote communities is not well addressed by the theories of EM.

Given its Eurocentric origins, theories of EM have distinct cultural and structural bias. EM is an inherently corporatist (in that it tends to assume a close working relation between business, unions and the state) and pro-industrialist framework that has been criticised for not taking account of different social contexts in a meaningful way (Christoff 1996). In order to achieve sustainable development through EM, a corporatist, regulated and controlled state is an implied starting point. Curran (2001, 49) argues that EM ‘side-steps’ the polarisation of class, race and gender inherent in globalisation, and achieves ‘ecological sustainability policy success in advanced industrialised societies, but unequal penetration of such policy success across the developing countries’. Consequently, the centrality of social and cultural factors in determining the long-term success of the remote RE industry is not recognised by theories of EM.

This is especially pertinent in the unique Australian case study, where a considerable majority of the communities without grid electricity are Indigenous communities: fourth world people encapsulated within a first world nation. A key outcome of this research is the importance of cultural and social contexts in determining the success of remote RE projects. In terms of testing the validity of EM to explain and overcome environmental problems, the theory is clearly limited in this context. EM does not adequately account for these issues on its own and alternative strategies must be sought as a supplement to explain and tackle the apparent obstacles. A useful avenue for addressing the cultural and social issues identified by respondents is meaningful community engagement.

Community Engagement

Our research suggests that meaningful engagement with communities targeted by a development proposal is a significant step to ensuring its acceptance and long-term viability. Given that the significance of these processes has only recently emerged, they

have been employed with variable commitment and effectiveness. The community engagement imperative was identified in background research as a significant factor in addressing hurdles to the uptake and long-term success of RE projects in remote Australia. In the past, meaningful engagement techniques were not considered essential to the ongoing success of remote RE systems and have not been executed with best practice principles in mind. As expected, interview respondents in this project have addressed community engagement in planning, installing and maintaining RE systems in diverse ways.

The government-owned electricity retailer has clearly defined obligations to engage with the community on proposed energy projects. Although these expectations are made clear, there are myriad strategies to achieve these ends, which can produce variable outcomes. In the past, electrical engineers undertook community consultations and energy needs assessments and were also responsible for system design and installation (Golf). Given that technical specialists tended not to have training in the significance or techniques of community engagement, there are clear implications for the quality of these assessments and the long-term impacts on the 'host' communities.

More recently the energy retailer has acknowledged the importance of best practice community engagement strategies and has adopted new approaches to community needs assessment, installation and maintenance training. Recently the retailer employed the services of an external consultancy that specialises in community consultation (Richards). This has proved successful in that it has uncovered issues previously unexplored by the retailer and resulted in better outcomes for the community. The retailer was required to display complex electricity-related information in ways that were accessible and relevant to all members of the community, an issue that had not been considered by technicians undertaking community work in the past (Golf).

Accessibility of information in consultations can easily dictate who becomes involved in the process. In the case of this project, the needs of previously underrepresented community members including Indigenous people, women, children, aged people and cultural minorities were adequately addressed for the first time (Guest). The retailer also fosters community capacity building by holding open days on remote working properties that have had RE systems installed. Approximately six months after a project has been completed, the owners are encouraged to open their properties to neighbours

and interested parties so that the systems can be observed in operation and any issues encountered can be discussed (Richards). This is also a helpful way of building confidence and awareness in RE installations.

The participating Indigenous organisation has a strong dedication to positive community outcomes and sees itself as a community support service providing financial, social and cultural benefits through installation of appropriate RE systems in remote communities (Worth). As has been discussed previously, community engagement is central to all aspects of the organisations work, including energy needs assessment, system design, installation and training locals for maintenance. Community capacity building is also inherent in the organisations' goals and activities. Engagement strategies are also cyclical: they are continuously assessed and improved upon using follow-up studies and ongoing involvement with communities (Worth). The organisation provides some promising examples of best-practice methods for culturally appropriate consultation strategies with Indigenous communities in Australia that may be applied to other development projects.

The imperative of appropriate and adequate community consultation has emerged as a central consideration for the successful development of a robust remote RE industry in Australia. This is significant because best practice community consultation and engagement is a burgeoning field and there are few relevant guidelines available for access by stakeholders, and also because meaningful engagement techniques provide a convincing strategy for overcoming the complex issue of social and cultural barriers to the uptake and sustainability of RE. Community engagement in uptake of RE has been explored in other studies, and results indicate that 'renewable energy developments may well be beneficial...particularly if some sense of community ownership and involvement is maintained' (Hanley & Nevin 1999, 536).

Successful dissemination of RE technologies depends on 'mediations between design and use...social learning processes between various actors involved in the development, distribution of technologies' (Ornetzeder & Rohrer 2006, 141). A key challenge for policy-makers is to achieve appropriate, efficient and effective technology dissemination within allocated budgets (Dryzek 1995; Guerin 2001). As has been mentioned, EM does not deal well with the varying social and cultural contexts of achieving sustainable development, although the stronger variants do make some

general proposals for increased consultation and democratic decision-making. The strategies discussed above may be considered relevant to strong EM's strategy for achieving sustainability in that it represents a fundamental tool in achieving the consensual, 'bottom-up' form of governance that theorists propose (Mol & Sonnenfeld 2000). Community engagement is also a convincing method for fostering ownership and acceptance of systems and preventing malicious damage by individuals in communities.

Malicious Damage of Renewable Energy Systems

The key issues identified as barriers to installation of renewables in remote areas dealt with so far were all identified in some capacity through the literature review and existing research. However, there were several unexplored factors identified by interviewees that represent considerable impediments to remote RE systems in Australia. Malicious damage of new and existing RE systems was a problem encountered by several stakeholders in the industry. The electricity retailer has experienced several cases of vandalism of remote solar projects, particularly in the Torres Strait (Golf). Similar experiences in some remote RE projects were reported by the government department (Best). This contrasted with the Indigenous organisation that reported only one case of vandalism among the 80 installed systems in the five years it has been operating (Worth). Malicious damage of RE systems by individuals in the communities are a previously unexplored impediment to the sustained success of RE in Australia that was uncovered during the interview process.

Deliberate damage of RE systems by community members represents an obvious obstruction to the continued growth and success of the industry in remote communities. This factor is significant because it falls outside of the barriers uncovered by previous research and has detrimental social and financial consequences for the communities involved. Vandalism of power supply systems is an extraneous factor that needs to be accounted for by agencies responsible for RE installation, a factor that can add to the already obstructive installation and operation costs. It is interesting that despite similar numbers of remote RE systems installed, the government agency and energy retailers reported high incidents of vandalism, while the Indigenous organisation reported negligible occurrences. These outcomes may have links to community acceptance cultural appropriateness of installed energy systems and adequateness of community engagement techniques during planning and installation.

The relevance of malicious damage to the discussion of barriers to remote RE uptake also needs to be considered in the framework of EM. As with social and cultural contexts, EM makes little comment on ‘anti-social’ behaviour or the desire for community members to react negatively to strategies for sustainable development. What must be considered when discussing this issue is the relevance of these events within the broader public infrastructure context. Vandalism is a consideration in the provision of most public infrastructure including public telephones, transport, post boxes, streetlights and conventional electricity supply in both rural and urban settings (DCITA 2002, 4). Further study in this area could help rank the importance of intentional damage for the wider range of industry stakeholders.

The Changing Nature of Remote Communities

Another unexpected impediment that was uncovered by the interviews was impacts caused by the changing nature of remote communities. This trend has variously been discussed as the corporatisation, amalgamation or commercialisation of rural Australia and describes the movement of landholders to shift from small-scale holdings to larger, ‘corporatised’ arrangements. These situations occur when farming families combine resources and properties, or when external organisations buy out properties. Over the past 20 years, the number of farms in Australia has declined by a quarter. Farm size has subsequently increased, with physical property size increasing by around 23% in the same period of time (Productivity Commission 2005, 31). There has also been a shift towards more intensive agricultural practices, with the top 20% of broad-acre farms now accounting for 64% of output (Productivity Commission 2005, 31). Massive shifts such as these have obvious impacts on energy demand and staffing requirements.

Flow-on effects of corporatised rural properties include changes to the nature of employment. Large properties in remote regions are required to house employees on-site, and energy demands are affected by these population increases in remote locales. Energy demand may also be affected by workplace agreements between employers and employees over improved working/living conditions and industrial laws (such as occupational health and safety, or industrial hygiene regulations). It remains to be seen what impact the new Commonwealth industrial relations legislation will have on this factor (ACTU, 2006).

Several respondents have observed the corporatisation of regional properties. Hunt noted:

...where people used to have a TV, fridge, lights and things like that...their demand might have been somewhere around 10 or 12 Kwh per day. But with working properties, there were cool rooms, air-conditioning and all the types of things that you wouldn't even consider, [*resulting in*] demands of 30 or 40 Kwh. That's asking a lot from a solar systems and that's what drives the costs so high.

Richards expanded on this point, stating that :

There are stricter controls placed on workplace standards of employees ...in regions that are very hot there is demand for air-conditioning that has not been experienced before...this leads to renewables not performing to standards.

While employees of government departments such as QPWS may have expected basic accommodations while living in remote regions in the past, legislative directives now include requirements for permanent electricity generation, regardless of diurnal or seasonal variances. These requirements place unrealistic demands on small RE systems (Richards). One of EM's central proposals is the reduction of environmental impacts through the use of better technology (Christoff 1996). Smart design of buildings and electrical goods present promising avenues for reducing energy needs in this context.

Several interview respondents nominated the commercialisation of working properties in Australia as a key impediment to sustaining a robust RE industry in Australia. While this factor was not uncovered in preliminary research, it has important implications for the overall research question. If the corporatisation trend occurring in rural Australia continues, as the Productivity Commission speculates (2005), there are considerable consequences for the applicability of RE systems on remote working properties. With demand for power and sheer numbers of employees escalating concurrently, there are substantial impediments for the ability of RE systems to meet the energy demands of these properties. Furthermore, the RE systems required to meet such high demands would be of considerable capacity and therefore expense, compounding the problem further. These factors are significant and require the careful attention of RE system designers.

Conclusions

There is a clear need to provide safe and reliable energy supplies to remote Australian communities. The current strategy of installing diesel generators creates significant social and environmental problems. RE systems present a promising option for resolving this dilemma but their deployment has been hampered by a number of factors. This paper used the academic literature to identify several barriers, including: market; financial and economic; institutional; technical; and, social and cultural factors. Interviews were undertaken with key Australian stakeholders to provide a more in-depth analysis. During this process two new barriers were discovered that were classed as malicious damage and rural corporatisation. Overall it was found that effective community engagement was of prime importance in the deployment of RE systems and the implementation of broader energy policies. The research also provided an opportunity to test the applicability of theory of ecological modernisation to the Australian context. Key limitations became apparent that appear to have emerged from the corporatist European origins of the theory. This provides an opportunity for some further research that is currently being undertaken by the Urban Research Program Group on Ecological Modernisation and Sustainability at Griffith University.

Bibliography

- ACTU (Australian Council of Trade Unions). 2006. *Your Rights at Work: the facts* (online), Available: <http://www.rightsatwork.com.au/thefacts/> (05/05/2006).
- Beder, S. 2002. *Global Spin: the Corporate Assault on Environmentalism*, Green Books, Vermont.
- Buttel, F. 2000. 'Ecological modernization as social theory.' *Geoforum*. 31:57-65.
- Blakers, A. 2000. 'Solar and Wind Electricity in Australia', *Australian Journal of Environmental Management*, 7, 223-236.
- Blakers, A. & Diesendorf, M. 1996. 'A Scenario for the Expansion of Solar and Wind Generated Electricity in Australia', *Australian Journal of Environmental Management*, 3, 11-25.
- Blowers, A. 1997. 'Environmental Policy: Ecological Modernisation or the Risk Society?' *Urban Studies*. 34(5-6): 845-71.
- Bradbrook, A. 2002. 'Green Power Schemes: The Need for a Legislative Base', *Melbourne University Law Review*, 26, 15-31.
- Brandt, U. & Svendsen, G. 2006. 'Climate Change Negotiations and First-Mover Advantages: the Case of the Wind Turbine Industry', *Energy Policy*. 34 (10), 1175-1184.
- Crawford, R. & Treloar, G. 2004. 'Net Energy Analysis of Solar and Conventional Domestic Hot Water Systems in Melbourne, Australia', *Solar Energy*, 76, 159-163
- Christoff, P. 1996. 'Ecological Modernisation, Ecological Modernities.' *Environmental Politics*. 5(3), 476-500.
- Cohen, M. 1997. 'Risk Society and Ecological Modernisation.' *Futures*. 29(2): 105-19.

- Curran, G. 2001. 'The Third Way and Ecological Modernisation', *Contemporary Politics*, 7(1), 41-55.
- DCITA (Department of Communication, Technology and the Arts), 2002. *Telecommunications Action Plan for Remote Indigenous Communities* (online), Available http://www.dcita.gov.au/___data/assets/word_doc/7794/Telecommunications_Action_Plan_for_Remote_Indigenous_Communities.doc (05/05/2006)
- Dryzek, J. 1995. 'Democracy and Environmental Policy Instruments', in Eckersley, R. (ed) *Markets, the State and the Environment: Towards Integration*, Macmillan Education Australia, South Melbourne. 294-308.
- Dryzek, J. 1997. *The Politics of the Earth: Environmental Discourses*. Oxford University Press: Oxford.
- Fisher, D. & Freudenberg, 2001. 'Ecological Modernization and Its Critics: Assessing the Past and Looking Toward the Future.' *Society and Natural Resources*. 14: 701-709.
- Gouldson, A. & Murphy, J. 1997. 'Ecological Modernisation: Restructuring Industrial Economics'. In Jacobs, M. (ed.). *Greening the Millennium? The New Politics of the Environment*. Blackwell Publishers: Oxford. 74-86.
- Green, 2004. 'Recent Developments in Photovoltaics', *Solar Energy*, 76, 3-8.
- Guerin, T. 2001. 'Why Sustainable Innovations are Not Always Adopted', *Resources, Conservation and Recycling*, 34, 1-18.
- Hanley, N. & Nevin, C. 1999. 'Appraising Renewable Energy Developments in Remote Communities: the case of the North Assynt Estate, Scotland', *Energy Policy*, 27, 527-547.
- Howes, M. 2005. *Politics and the Environment: Risk and the role of government and industry*. Allen & Unwin: Sydney.
- Jennings, S. & Healey, J. 2001. 'Appropriate Renewable Hybrid Power Systems for the Remote Aboriginal Communities', *Renewable Energy*, 22, 327-333
- Lloyd, C. 2001. 'Renewable Energy Options for Hot Water Systems in Remote Areas', *Renewable Energy*, 22, 335-343.
- Lowe, D., & Lloyd, C. 2001. 'Renewable Energy Systems for Remote Areas in Australia', *Renewable Energy*, 32, 369-378.
- Lund, H. & Munster, E. 2006. 'Integrated Energy Systems and Local Energy Markets', *Energy Policy*, 34 (10), 1152-1160.
- Madlener, R. & Stagl, S. 2005. 'Sustainability-guided promotion of Renewable Electricity Generation', *Ecological Economics*, 53, 147-167.
- Massa, I. & M. Andersen. 2000. 'Special Issue Introduction: Ecological Modernization.' *Journal of Environmental Policy & Planning*. 2: 265-267.
- McVeigh, J., Burtraw, D., Darmstadter, J. & Palmer, K. 2000. 'Winner, Loser, or Innocent Victim? Has Renewable Energy Performed as Expected?', *Solar Energy*, 68 (3), 237-255.
- Menges, R. 2003. 'Supporting Renewable Energy on Liberalised Markets: Green Electricity Between Additionality and Consumer Sovereignty', *Energy Policy*, 31, 583-596.
- Mills, D. 1997. 'Sustainable Electricity: Local Solutions to Global Problems', *Pathways to Sustainability: Local Initiatives for Cities and Towns*, International Conference Proceedings, Newcastle, Australia
- Mol, A. 2000. 'The Environmental Movement in an era of Ecological Modernisation', *Geoforum*, 31, 45-56

- Mol, A. and G Spaargaren. 2000. 'Ecological Modernisation Theory in Debate: A Review.' *Environmental Politics*, 9(1), pp. 17-49.
- Mol, A. & Sonnenfeld, D. 2000. 'Ecological Modernisation Around the World: An Introduction', *Environmental Politics*, 9(1), 3-14.
- Murphy, J. & Gouldson, A. 2000. 'Environmental Policy and industrial innovation: integrating environment and economy through ecological modernisation', *Geoforum*, 31, 33-44.
- Ornetzeder, M. & Rohracher, H. 2006. 'User-led Innovations and Participation Processes: Lessons from Sustainable Energy Technologies', *Energy Policy*, 34 (2), 138-150.
- Painuly, J. 2001. 'Barriers to Renewable Energy Penetration; a framework for analysis', *Renewable Energy*, 24, 73-89.
- Presenell, K. 2001. 'Exporting Australia's Remote Area Power Supply Industry', *Renewable Energy*, 22, 353-360.
- Productivity Commission, 2005. *Trends in Australian Agriculture*, Research Paper, Canberra.
- Reddy, S. & Painuly, J. 2004. 'Diffusion of Renewable Energy Technologies: Barriers and Stakeholder Perspectives', *Renewable Energy*, 29, 1431-1447.
- Reidy, C. 2003. *Subsidies that encourage fossil fuel use in Australia*. Institute for Sustainable Futures Publication (online), Available http://www.isf.uts.edu.au/publications/CR_2003_paper.pdf (10/10/2005).
- Sanden, B. 2005. 'The Economic and Institutional Rationale of PV Subsidies', *Solar Energy*, 78, 137-146.
- Sonneborn, C. 2004. 'Renewable Energy and Market-Based Approaches to Greenhouse Gas Reduction-opportunity or obstacle?', *Energy Policy*, 32, 1799-1805.
- Walker, B. 2000, 'Integrating Renewable Energy Services in Remote Indigenous Communities of Australia: a national strategy', *Village Power*, 1-11.
- Watt, M. & Outhred, H. 2001. 'Australian and International Renewable Energy Policy Initiatives', *Renewable Energy*, 22, 241-245.
- Weale, A. 2005. 'The Politics of Ecological Modernization', in Dryzek, J. & Schlosberg, D. (eds.) *Debating the Earth: The Environmental Politics Reader (2nd ed)*. Oxford University Press, Oxford. 301-318.
- Wenham, S., Honsberg, C., Cotter, J., Largent, R., Aberle, A. & Green, M. 2001. 'Australian Educational and Research Opportunities Arising Through Rapid Growth in the Photovoltaic Industry', *Solar Energy Materials and Solar Cells*, 67, 647-654.
- Wustenhagen, R. & Bilharz, M. 2006. 'Green Energy market Development in Germany: Effective Public Policy and Emerging Customer Demand', *Energy Policy*, 34 (13), 1681-1696.
- York, R. & E. Rosa. 2003. 'Key Challenges to Ecological Modernization Theory.' *Organization & Environment*. 16(3): 273-288.