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Social acceptance of wind energy development and planning in rural communities of Australia: A consumer analysis

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ABSTRACT

Social acceptance is necessary for widespread adoption of new renewable energy technologies. A lack of social acceptance by local community residents is a barrier to increasing the renewable energy mix and targets in Australia. This study empirically evaluated predictor importance of key constructs of social acceptance, using responses from a sample of 226 survey respondents in Australia. Regression analysis suggest that 'Concerns with wind turbines' was the predictor most strongly correlated with Social Acceptance, followed by 'Annoyance with wind turbines', and then 'Consultation with stakeholders'. Implications of the study and recommendations for consideration by various interest groups (such as policy makers, and potential entrepreneurs) are discussed. This research contributes to theory building rather than theory testing of social acceptance of wind energy development.

1. Introduction

Renewable energy from wind technology has potential for addressing GHG emissions because Australia has some of the world's best wind resources (Verve Energy, 2013). Estimates for year 2020 suggests that wind energy is likely to provide up to five times as much power than, say, biomass (Hatfield-Dodds et al., 2007). Although wind energy has potential to strengthen the renewable energy mix for Australia, social acceptance of wind power development has become a contentious issue, with heightened concerns from local community residents and environmental activists (Lantz and Flowers, 2010; Bond, 2008; Bosley and Bosley, 1988; Dimitropoulosa and Kontoleonba, 2009). The United Nations report on sustainability which provides guidelines for sustainability does not provide an archetype for specific actions (Willums, 1998). Thus, addressing (environmental) sustainability through renewable energy development has become the subject of enquiry for several stakeholders.

Social acceptance is important for more widespread adoption and planning of new technologies (Sauter and Watson, 2007). Consumer acceptability on the other hand, often acts as an impediment towards renewable energy (Devine-Wright, 2005); this in fact can cause substantial planning impediments. Some analysts view social acceptance as the most significant threat to achieving government renewable energy targets (Strachan and Lal, 2004). Complications with social acceptance of wind power development and planning are particularly important for rural regions where governments are often faced with challenges in targeting community economic development and growth initiatives, which also tend to be prime locations for wind farms (Yiridoe et al., 2009).

The controversy surrounding social issues with regard to wind energy has certainly assumed significance on an international scale initiating several countries to impose mandatory regulations. Much of this controversy appears to emerge from an arbitrary and adhoc manner by which wind farms are established. These issues appear to go well beyond the immediate horizon of planning and provide significant challenges for the viability of wind energy development. As critical as this situation has become, a cursory understanding of what drives social acceptance of wind energy development will shed further light on this important area. Thus, in this exploratory study, we develop a conceptual model of key predictors or constructs of social acceptance of wind power development, and empirically test the model to evaluate predictor importance of the social acceptance elements. The applied research question addressed in this study relates to: what characteristics of wind energy are important predictors of social acceptance for wind energy development? Addressing this question will contribute to a better understanding of important issues associated with improving consumer confidence and acceptance of wind power technologies and wind energy development.

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It informs future research to consider public as well as consumer reactions towards social acceptance of wind energy. In this process this research also attempts to contribute to planning new insights towards the strong political will of integrating renewable energy as an important component to future energy systems (Enzensberger et al., 2002). This is important for wind energy socio-policy makers and entrepreneurs contemplating establishing wind energy. The following section provides an overview and importance of wind energy development in rural regions of Australia.

2. Theoretical background

Planning for wind energy development requires support and acceptance from various stakeholders. The fundamental issue with wind energy planning is social acceptance. Williams and Mills (1986) examined social acceptance in the context of a broad continuum, including the degree or strength of acceptance, and consideration of various social groups. Similarly, Wüstenhagen et al. (2007) identifies three dimensions of social acceptance, including socio-political acceptance, community acceptance, and market acceptance. According to Wüstenhagen et al. (2007), socio-political acceptance refers to broad-based support from policy makers and other key stakeholders. Socio-political acceptance deals with policies and technologies at the societal level that require favourable response. Community acceptance, on the other hand, involves residents and local authorities, and about decisions on renewable energy projects by local stakeholders (Wüstenhagen et al., 2007). In the view of Wüstenhagen et al. (2007), factors that influence community acceptance include community consultation and engagement, as well as equity, justice and fairness in the distribution of benefits and costs associated with renewable energy development. The authors refer to market acceptance as adoption of wind energy technology by consumers, investors, and the power generation industry.

In contrast to the dimensions of social acceptance and associated perspective by Wüstenhagen et al. (2007), which captures various groups of stakeholders and provides useful insights, a viewpoint by Sauter and Watson (2007) involves two concepts with potentially different meanings and approaches. According to Williams and Mills (1986), 'acceptance' relates to passive consent and active agreement or approval. This meaning of 'acceptance' suggests a wide continuum, both in terms of how social groups can be considered, and the extent to which acceptance is articulated.

To be socially acceptable requires positive attitudes and feelings towards an object or issue under consideration. Attitudes may be defined as 'a relatively enduring organisation of beliefs, feelings, and behavioural tendencies towards socially significant objects, groups, events or symbols' (Hogg and Vaughan, 2005, p. 150). Analysts such as Sauter and Watson (2007) notes that (social) acceptance can be expressed in various forms, including attitudes; behaviour; investment decisions and choices. There are several factors that impact public attitudes towards wind power development (Ellis et al., 2007). Factors that shape consumer and public attitudes include institutional factors such as equal participation in the planning process, along with other factors such as economic provisions, social impacts and political environment (Birnie et al., 1999; Khan, 2003; Devine-Wright, 2005; Wolsink, 2007). Feelings can be expressed in terms of sensitivity towards an object or entity. There are reports about negative concerns and emotional feelings about wind farms in Australia (Bond, 2008). Acceptance of technologies for generating green electricity, (e.g., wind, biogas, and solar) are often measured in terms of public attitudes towards such technologies (Sauter and Watson, 2007). In this study, 'acceptance' of wind turbines and wind farms is investigated using reported attitudes and feelings as proxies for (i.e., constructs of) social acceptance, consistent with the scholarly literature.

Several analysts report that social acceptance tends to be affected by several constraints and challenges (Bosley and Bosley, 1988; Thayer, 1988; Wolsink, 1987). For example, community engagement and local ownership, as well as concerns with and annoyance caused by wind turbines all influence social acceptance. These are discussed in more detail in the following sections.

2.1. Concerns and annoyance with wind energy

Several studies report a strong consumer preference for electricity produced using wind (and other renewable energy) systems (Carlman, 1982; Bond, 2008; Bosley and Bosley, 1988; Dimitropoulosa and Kontoleonba, 2009). In addition, some studies suggest that wind farms have little or no negative impacts on residential property values (Sterzinger et al., 2003), others have reported negative impacts on property values (Hoen, 2010). On the other hand, in terms of willingness to pay for residential property, the research findings are mixed especially in cases where wind farms are located in close proximity to such dwellings (Lloyd, 2011). Wind farms may also be perceived as aesthetically and visually not appealing, and evoke negative emotions among community residents (Gipe, 1995). Furthermore, other studies have reported quality of life concerns by individuals (Hoen, 2010). Several studies report annoyance with noise from wind turbines (Pedersen and Persson, 2004, 2007), sleep disturbance (Rideout et al., 2010), and visual interruption (Pedersen and Larsman, 2008). Similarly other empirical studies have reported annoyance caused by wind turbines, sleep disruption and psychological distress (Bakker et al., 2012). In response to the growing concerns and reported human health issues linked to wind turbines, some regulatory authorities are re-evaluating existing regulations and guidelines on setback distance specifically to address noise concerns (Pedersen and Halmstad, 2003).

A survey commissioned by the Australian Wind Energy (AWE) involving 1027 consumers find that 95% of respondents support wind farms, and 91% agreed it was important to establish wind farms in rural Australia to generate electricity (AWE, 2003). Although the general public tends to support electricity from wind technology, Bond (2008) found that about 2% of Australian respondents opposed wind energy development after the wind project construction (Bond, 2008), this raises fundamental consumer or public awareness and understanding of wind farms. Poor attitudes towards wind farm development have been reported in other studies (Firestone and Kempton, 2007; Eltham et al., 2008; Portman, 2009). In a recent study for Australia the majority of respondents report that wind farms not in close proximity to residential dwellings did not pose serious concerns (Bond, 2008). The proportion of respondents that 'do not worry' about various wind turbine externalities included 89% for visual intrusion, 81% for noise intrusion, 86% for effect on property values, 85% for radio interference, and 90% for sun/light flicker. However, 32% of the study participants report that the potential harmful impact of wind turbines on wildlife worried respondents 'somewhat' or 'a lot' (Bond, 2008).

Other studies for Australia also report that wind farms have negative effects on landscapes with high scenic quality, and a positive effect on landscapes with low scenic quality (Lothian, 2008). In addition, there are several reported individual cases of negative experiences and/or problems regarding gag orders, split communities, health related issues and turbine shadows (Lloyd, 2011). There are controversies about wind technology in the literature, with about 40% in favour of development of wind energy, while the Not-in-my-backyard (NIMBY) syndrome are not common views among Australians (Dalton et al., 2008), there are mixed reactions. In contrast to the above view, the 'Not-in-my-backyard' syndrome has also been reported to influence public attitudes towards wind power development in certain locations in Australia (Krohn and Damborg, 1999). In addition, segments of increasingly vocal groups mainly in rural settlements believe they have become 'collateral damage' in the siting of wind farms (Lloyd, 2011).

In several European countries, concerns and annoyance linked to wind turbines are elements of social acceptance which hamper renewable energy development (Wüstenhagen et al., 2007). Specific attributes of such concerns and annoyance from wind turbines include noise, and threats to flora, fauna and wildlife (Webb, 1994). Bird and bat mortality from collisions with wind turbines can be significant (Macintosh and Downie, 2006). In addition, civil construction for establishing turbines also results in threats to loss of wildlife habitats, introduction of new/invasive species, and climate change. A consequence of such negative attitudes and concerns can lead to negative emotions and feelings of anger and frustration and, ultimately, result in low confidence or acceptance of wind energy and energy development. There are also fears that considerable opposition can impede expansion and growth of the wind energy industry (Toke, 2005; Horbaty and Huber, 2010).

Of some concern is that the findings from these studies that do not support wind farm establishments appears to be strong and may not translate into acceptance of wind energy development.

2.2. Community engagement and consultation process

There are reported concerns that community consultation and engagement by prospective wind project developers in Australia have not been approached appropriately. For example, studies suggest that community residents are often not involved in the decision making process, including consultation during project proposal development, decisions about siting of wind turbines, and continued engagement for policy responsiveness and options (Hindmarsh and Matthews, 2008). The same study reported discontent about inadequate community engagement processes undertaken by developers, and lack of concern for affected communities to participate in the planning processes. In other cases, the public was not informed about the sites being considered for wind power projects (Bond, 2008). Another issue connected with community engagement and consultation is that, in some Australian states where project proponents engaged and consulted with local communities, some residents expressed concerns with environmental and health issues, but such concerns were essentially ignored or did not change the project implementation decisions (Bunting and Healy, 2004; Jenkins, 2001).

In summary, based on the literature reviewed above, there are several factors or characteristics that might be related to or influence social acceptance of wind farms and wind power development. In this study, we focused on those characteristics which are commonly stereotyped in the literature on social acceptance, or highlighted in previous and related studies. On the basis of this literature synthesis and the qualitative study, the authors propose that these factors may be broadly grouped or described as (i) consultation process; (ii) concerns with wind turbines; and (iii) annoyance with wind energy development.

3. Research methods

A multi-stage and multi-methods approach was used to investigate the research questions noted earlier. Application of an approach that integrates triangulation with mixed methods provides a more complete and broader understanding of the research issues being investigated (Veal, 2005). The general aim of an exploratory research is to obtain insights prior to the more rigorous investigation (Churchill and Iacobucci, 2005). Ethical issues required by the University's ethics committee were fulfilled i.e. informing participants about their involvement in the research, avoiding risk and harm to participants and other parties, allowing free choice by emphasising the participation was voluntary; ensuring privacy by not sharing the participant's responses and finally assuring participants of confidentially and anonymity.

3.1. Stage 1: qualitative research

In the first stage, which forms part of a larger research initiative, a qualitative study was conducted with stakeholders. The qualitative analysis allowed for linking paradigms of constructivism with interpretivism (Bryman, 2006). Qualitative research is useful where previous research in the topic area has limited understanding, inconclusive results (Morse and Richards, 2002; Golden-Biddle and Locke, 1997). As the research aims are designed to address an exploratory study, qualitative methods are the most favourable choice of research design to begin with. More specifically because qualitative research methods have been acknowledged as a process to better understand phenomena related to specific markets and/or market processes. Social acceptance is appropriately suited to a qualitative approach because of the need of studying a controversial topic area. Further, the focus on social acceptance for wind energy provides stakeholders a context of the specific actors and processes under study. Actively obtaining first-person accounts from individual stakeholders will provide greater understanding and evaluation of the phenomena taking place (Moisander and Valtonen, 2006). While qualitative research will also help to determine and understand participant's perceptions of the research context (Bullock et al., 1992), it will also attempt to advocate differentiation between perceptions of the various stakeholders. That is, the ability to distinguish between participants in a similar setting and "discover…their perceptions and the complexity of their interpretations" (Morse and Richards, 2002, p. 28). This would assist this research in bringing together the different views that upholds different stakeholders.

Similarly, qualitative research seeks the meaning and impetus that drives people's behaviour more in depth by drawing on their interpretations and perspectives on wind energy development issues (Woods, 2006). This is critical in taking into account the controversy that surrounds wind energy development. Not only will the literature form the basis of our questionnaire development but an insight of wider cultural or community expectations and influences that are relative to wind energy development will be considered (Woods, 2006).

This process was based on six unstructured interviews with various wind power project stakeholders: government representatives ($N=2$), wind project developers ($N=2$) and community residents ($N=2$). This process helped to provide insights and understanding (Malhotra et al., 2007) on various lines of questioning, and developing a structured survey questionnaire. The interviews were conducted using established guidelines in the literature; they were recorded, transcribed and inferences drawn using grounded theory principles (Glaser and Strauss, 1967). Interviews with the community residents informed other research components and the design of the questionnaire.

3.2. Stage II: structured survey research

The quantitative research and analysis component was linked to the paradigm of positivism, which postulates that all phenomena can be reduced to representative empirical indicators (Bryman, 2006). The three dimensions investigated are community residents' concerns with wind turbine externalities (i.e., concerns); (ii) consultation process prior to launching wind power projects (i.e., consultation process); and (iii) degree of annoyance caused by wind turbines (i.e., annoyance). In designing the structured questionnaire, a five-point Likert-scale (ranging from 1 = 'strongly disagree', to 5 = 'strongly agree') was used to measure concerns with wind turbines and community consultation process. Annoyance were measured on a five-point Likert scale ranging from 1 = 'never annoyed', to 5 = 'always annoyed' with or by various negative attributes of wind turbines. In addition, several questions were asked to elicit information on social and demographic characteristics of the participants, as well as questions about wind power project ownership. The survey questionnaire was pre-tested using a small sample of 20 respondents. Feedback from the pre-testing was used to revise and clarify several of the questions, before the final survey was administered.

Based on insights from the interviews, and the literature on social acceptance, key variables which capture social acceptance were investigated using attitudes metrics measured on a Likert-scale from '1' representing 'strongly negative', to '5' representing 'very positive'. Similarly, individual perceptions or feelings about wind turbines and wind technology for generating energy was measured on a five-point scale in terms of 1 = 'strongly opposed' to 5 = 'strongly favoured'. In each case, the variable measured a self-reported effect that wind turbines have on the respondent. Reported opinions on how respondents felt about wind turbines in their neighbourhood was measured on a Likert scale from 1 = 'strongly opposed' to 5 = 'strongly in favour'.

3.2.1. Sample selection and wind turbine sites

A sample for a study is taken out of a population and sampling frame. In this study the population and sampling frame element consists of current residents residing within a stipulate radius. A total of 15 wind farm locations (see Table 1 – List of Wind farms) that involved 149 post-codes were initially selected for this study. These 149 post-codes covered respondents living within a 20 km radius of particular wind farms. The list of wind farms was obtained after surveying several internet websites, such as Wind Power and Wind Farms in Australia (Clarke, 2011) and Wikipedia. All the wind farms considered in this study were located in rural regions of Australia, and had installed capacity of at least 70 MW. A total of 226 rural residents from the states of Victoria, Tasmania, South Australia, Western Australia and New South Wales completed the survey. The sample comprised of 36% males and 64% females. In terms of ownership, only 1% owned one or more turbines in the area. The survey was completed in October, 2013.

3.2.2. Statistical and regression analysis

Survey questionnaire reliability was assessed in terms of internal consistency of a set of selected scale items. In addition, a factor analysis method was applied to the variables assigned to each of the three dimensions of Social Acceptance constructs (Nunnally, 1967). Internal consistency for the three Social Acceptance constructs or elements was estimated using the Cronbach Alpha reliability coefficient, which ranges between 0 and 1. Nunnally (1967, p. 245) recommended a Cronbach $\alpha > 0.70$ for such exploratory research. For all three Social Acceptance constructs considered in this study, estimated Cronbach α statistics were above the Nunnally (1967) threshold: Consultation process $\alpha = 0.716$, Annoyance $\alpha = 0.962$, and Concerns $\alpha = 0.926$ (see Table 2).

Results of the factor reliability analysis suggest that the set of factors considered in the analysis satisfactorily capture key characteristics and components of social acceptance. In the data reduction technique using factor analysis, an absolute value statistic of 0.5 cut off loading was used to screen out weak indicator variables. In the initial screening, six variables failed to make this cut off, resulting in 22 variables used in the final analysis. A Principal Component Analysis method with Varimax rotation was used, with the rotation converging after four iterations. The total variance suggests that the three factors considered account for 63% of the variance by the 22 variables (Table 2). Among these, 12 variables were statistically associated with 'concerns with wind turbines'. Similarly, 5 variables were associated with annoyance with wind turbines while performing several activities. This factor is described as 'annoyance with wind turbines'. The third factor that loaded with 5 variables relates to the consultation process adopted for wind power development.

Factor scores from the factor analysis were calculated for each of the three social acceptance constructs, and the selected variables then used as independent variables in a step-wise regression analysis. Aggregated scores of Attitudes and Opinions about wind power projects were used to represent the dependent variable construct (Hair et al., 1998). A stepwise regression procedure was used to analyse the data due to the exploratory nature of the empirical research questions on interest. Stepwise regression is commonly used to find the most parsimonious set of predictors that adequately predict social acceptance (Tabachnick and Fidell, 1996). This approach is particularly relevant in this study as the model constructed is contributing to theory building rather than theory testing (Tabachnick and Fidell, 2001; Norusis, 1993). Apart from the theoretical and empirical literature guiding selection of variables, both Cohen and Cohen (1975) and Stevens (1996) noted that stepwise regression analysis is most appropriate in cases

Table 1
List of wind farms considered in this study.

Wind farm location and state	Installed capacity (MW)	Developer	Number of postcodes
Macarthur – Victoria	420	Macarthur Wind Farm Pty Ltd.	6
Woolnorth – Tasmania	140	Roaring 40s and Hydro Tasmania	1
Waubra – Victoria	192	Acciona Energy and ANZ Infrastructure	6
Waterloo – South Australia	111	Roaring 40s	8
Walkaway – Western Australia	90	Alinta	4
Snowtown – South Australia	99	Trust Power	4
Portland – Victoria	132	Pacific Hydro	2
Musselroe – Tasmania	168	Hydro Tasmania	1
Hallett – South Australia	298	AGL Energy	3
Emu Downs – Western Australia	80	Stanwell Corporation	5
Collgar – Western Australia	206	UBS International	9
Capital Wind Farm – Bungendore – New South Wales	140	Infigen Energy	2
Lake Bonney – Barmera South Australia	278	Infigen Energy	10
Mout Millar – South Australia	70	Transfield Services	3
Wattle Point – Edithburgh – South Australia	91	AGL Hydro	4

Table 2
Factor reliability and factor analysis.

Factors	Independent variables			Reliability statistic (Cronbach α)
	Concerns with wind turbines	Annoyance with wind turbine	Consultation process with wind project development	
Concerns analysis				
Visual intrusion of wind farms and turbines	0.804			
Potential harmful impact on wildlife	0.801			
Aesthetic impact of wind farms and turbines	0.786			
Extensive wind farm development makes a region less attractive	0.784			
Effect on property value	0.782			
Effect on sun light flicker	0.766			
Noise intrusions	0.766			
Health issues	0.752			
Unacceptable effect on birds	0.701			
Interference on radio	0.674			
Public consultations have consistently been ignored	0.644			
Effect of wind farm location in the neighbourhood	0.471			
Reliability statistic				α=0.926
Annoyance analysis				
Annoyed when performing an activity like, barbecues		0.942		
Annoyed when performing an activity like walking		0.909		
Annoyed when performing any other outdoor activity		0.904		
Annoyed when performing an activity like relaxing outdoors		0.895		
Annoyed when gardening		0.894		
Reliability statistic				α=0.962
Consultation analysis				
Opportunity to participate or contribute to the public consultation process			0.796	
Opportunity to present my views.			0.740	
Notified about consultation process for establishing wind farms			0.636	
Raise issues through submissions			0.602	
Overall planning process about implementing wind farms are clear and transparent			0.570	
Reliability statistic				α=0.716

Table 3
Total variance explained and correlations among variables.

Total variance explained Component	Rotation sums of squared loadings		
	Total	Per cent of variance (%)	Cumulative percentage (%)
1	6.879	31.268	31.268
2	4.509	20.495	51.763
3	2.441	11.097	62.859

Correlations among variables (N=226)

		Social acceptance	Concerns	Annoyance	Consultation
Pearson correlation	Social acceptance	1.000	−0.669	−0.164	0.175
	Concerns (1)	−0.669	1.000	0.000	0.000
	Annoyance (2)	−0.164	0.000	1.000	0.000
	Consultation (3)	0.175	0.000	0.000	1.000
Sig. level (1-tailed)	Social Acceptance	–	0.000	0.007	0.004
	Concerns (1)	0.000	–	0.500	0.500
	Annoyance (2)	0.007	0.500	–	0.500
	Consultation (3)	0.004	0.500	0.500	–

where the research objective focuses on finding constructs and measures that capture a dependent variable.

Table 3 (Model) illustrates the iterative process for entering/removing variables to the model at each stage. The initial analysis suggests that the variable capturing 'Concerns with wind turbines' was the predictor most strongly correlated with Social Acceptance, so it was included first in the step-wise regression. In the next step, 'Annoyance' with wind turbines was included, followed in stage 3 by 'Consultation' with stakeholders. Factor analyses using the varimax method helped to address multicollinearity (Hair et al., 1998). All three predictors considered were significantly correlated with Social Acceptance. Model Variance Inflation Factor (VIF) values are below 10 and the tolerance statistics substantially above 0.2 as proposed by Field (2000). Table 4 shows which variable were excluded at each step and what their β weights would be if they were entered in the next step. During the first step 1, Annoyance and Consultative were excluded, while in the second step, only Annoyance was included. If consultative process was entered with Social Acceptance,

Table 4
Model summary and analysis of variance (ANOVA).

Model summary	R	R^2	Adjusted R^2	Standard error of the estimate
	0.710	0.505	0.498	0.739

Analysis of variance (ANOVA)	Sum of squares	*df*	Mean square	*F*	Sig.
Regression	123.586	3	41.195	75.395	0.000[a]
Residual	121.299	222	0.546		
Total	244.885	225			

[a] Predictors: (Constant), REGR factor score 3 for analysis 24, REGR factor score 2 for analysis 24, REGR factor score 1 for analysis 24.

Table 5
Summary of regression results.

Model component	Unstandardised Coefficients		Standardized coefficients	*t*-Value	Sig. level	Correlations			Collinearity statistics	
	β	Std. error	β			Zero-order	Partial	Part	Tolerance	VIF
Constant	3.150	0.049		64.073	0.000					
Concerns	−0.698	0.049	−0.669	−14.155	0.000	−0.669	−0.689	−0.0669	1.000	1.000
Annoyance	−0.171	0.049	−0.164	−3.479	0.001	−0.164	−0.227	−0.164	1.000	1.000
Consultation	0.183	0.049	0.175	3.705	0.000	0.175	0.241	0.175	1.000	1.000

its standardized regression coefficient would be $\beta=0.184$, significant at $p=0.000$.

4. Results and discussion

During the interviews, community residents raised several concerns about wind farms located in their neighbourhoods. For instance, one study participant stated that 'yes we support renewable technology, but how is the government going to address several concerns such as impact on the environmental, fluctuations in land usage and health?' On the other hand, project developers and government representatives were positive about wind energy development outcomes. The rural community residents interviewed were very vocal about the concerns with wind farms in their regions; a lack of transparency about future projects, and poor local councils' consultations with the community prior to wind turbine development.

In addition, they affirmed that attitudes and how they felt can be detrimental for social acceptance. One rural community resident stated that 'social acceptance is crucial for the smooth functioning and support for wind farms. The media should provoke positive messages to favour wind energy, right now the media is biased towards these issues. Definitely this imposes negative feelings towards wind farm operations'. The other rural community resident stated that 'I would not accept wind farm development if I didn't feel right or have a good attitude about wind farms'.

Other survey results project that generating electricity using solar was ranked higher compared with wind. About 73% of respondents rated solar energy as number 1 in preference ranking over several other forms of energy. Wind energy was rated as the most preferred by 6% of respondents. The high preference rating of solar relative to wind and other energy alternatives may be because of existing government incentive programs and funding offered for solar power development, which is currently higher that for wind energy.

4.1. Predictors of social acceptance

The stepwise regression model summary statistics including R^2 and the associated change in R^2 at each stage of the step-wise regression analysis are reported in Table 4 (Model Summary statistics). 'Concerns' scores were $r=0.746$ and $R^2=0.557$, and explained 55% of the variation in Social Acceptance. By comparison, 'Annoyance' scores were $r=0.770$ and $R^2=0.594$. The R^2 values suggest that 59% of the variance in Social Acceptance in this sample can be explained by respondents' concerns and annoyance with wind turbines. The model $\Delta R^2=0.037$, and implies that adding a measure of Annoyance to the model explains an extra 3.7% of the variance at stage 2. The change in R^2 was significant, $F(1, 223)=20.2$, $p=0.000$.

Similarly, when 'consultation' was added to the equation in model 3, multiple r increases to 0.792, and 62.7% of the explanatory power of social acceptance was accounted for by these three variables, considered together. In addition, adding 'Consultation' to the model contributed an extra 3.4% of the change in R^2, which was significant at $F(1, 222)=20.2$, $p=0.000$.

An ANOVA technique was used to determine model F values for the regression equation associated with each model or step. All stepwise regression models/equations were significant at 1 per cent levels (Table 4 – Summary of ANOVA results). The coefficients of all the independent variables entered at each step in the stepwise regression models, and the associated test statistics are reported in Table 5 (Regression model results). In model 1, for example, social acceptance is the dependent variable and there is only one predictor variable – Concerns. In model 2 there were two predictors, Concerns and Annoyance, while in model 3, all three predictors, Concerns, Annoyance and Consultation were entered in the model. The results indicate that t-statistics were significant for each of these variables. The models suggests that all three constructs are strong (i.e., significant) predictors of Social Acceptance.

In model 3, the regression coefficients also highlight the relationship between social acceptance and each predictor. The coefficient for 'Concern' was −0.680, Annoyance = −0.175 and Consultation process = 0.168. The positive relationship between Consultation process and Social Acceptance suggests that improvements in stakeholder consultations increase Social Acceptance. On the other hand, as expected, increasing concerns with wind turbines, and annoyance with wind turbine externalities reduces Social Acceptance of wind power development. Overall, the magnitude of the regression coefficients suggest that 'concerns' makes a larger contribution to the prediction model, followed by 'annoyance' and by consultation process.

5. Social and policy implications

Qualitative responses to open-ended survey questions clearly indicated that local councils have observed that development of wind farms have prompted social conflicts and rural community disengagement. Respondents strongly supported the local and regional economic development benefits of wind farms through employment and indirect spin-offs from wind power development. Similarly there were also discussions around this high burden of concerns regarding planning for wind farms intensive operations that will need to be solved more so from a social perspective.

The survey results also indicate that nearly 27% of respondents did not consider wind turbines as environmentally-friendly. Thus, public education about the environmental benefits of generating electricity using wind technology compared with fossil sources of electricity can increase consumer awareness, thereby helping to increase consumer confidence and social acceptance (Mckenzie and Howes, 2006). The findings also support other studies which reported that lack of community acceptance is an impediment to development of wind power projects (Lantz and Flowers, 2010). Community consultation is important for success of development and planning for renewable energy in rural regions of Australia. McKenzie et al. (2006), for example, notes that Community engagement is critical for addressing obstacles to wind power project uptake, and ensuring project acceptance over the long-term. Although, Hindmarsh (2010) reports inadequate community involvement in wind power development (in Australia), other studies suggest that local community ownership and involvement is beneficial for renewable energy development (Hanley and Nevin, 1999).

The strength of policy implementation does not involve simply adding a (new) policy but implementing transformational changes (Chatterton, 2002). Previous studies have suggested that social acceptance is a necessary condition for more widespread adoption of innovative technologies (Sauter and Watson, 2007; Kaldellis, 2005; Wüstenhagen et al., 2007). Transformational changes required for strengthening social acceptance of wind power projects need to involve co-operation at the societal level and at the project level, and will have to involve various groups of stakeholders such as policy makers, local authorities, community residents and individuals, and environmental activists.

The regression analysis suggests that about 62% of the variation in Social Acceptance was explained by Concerns with wind turbines, Annoyance by wind turbines, and Stakeholder consultation process. Thirty eight per cent remains unexplained, and this could be due to many reasons. Orr (2003) proposes that decisions about wind energy development are dependent on individuals in society, and requires the whole social system to act, evolve and advance. Community acceptance supports Woodhouse's (2006) views that suggests the importance of getting rural and regional communities in broader policy debates that actually identify the value of cooperation and partnerships, particularly if such partnerships can be foster a consultative process among several levels of government, rural businesses/industries and local communities.

Carlman (1984) states that the issues with social acceptance are often presented in ways that are not always apparent. For example, wind power growth and development issues linked to social acceptance tend to be seen as 'residual questions' and/or referred to as 'non-technical' factors (Wustenhagen, 2003 Carlman, 1982) and, therefore, likely not to be considered in the local planning process, however, this research proves a point that this requires to be considered.

Only 15% of the respondents agreed that they had the opportunity to participate or contribute in wind energy development and planning. Due to the passive nature of Australia's social system, a regional study found that the planning system does not sufficiently consider contribution from individuals and communities, particularly in terms of critical infrastructure legislation (Hall et al., 2012). About 235 agreed that the views of the local residents for public consultation have consistently been ignored. It is recognised that communities benefits in terms of being involved right from the inception of the project development, design stages, impact assessment, access to information from research labs and other technical data from scientists, engineers and social scientists to make an informed decision (Tognato and Spoehr, 2012). Gross (2007) advocates that justice theory is central to the well-being of society, and procedural justice should be used as community consultation approach to improve community consultation, since involvement and participation can improve acceptance for wind turbines.

Distributive justice refers to equitable distribution of outcomes (Kuehn, 2000). In general, fairness and justice is linked to various social issues such as civil rights and human rights. Fairness and justice, and equity in distribution of project benefits and costs are also critical to social acceptance. Gross's (2007) has outlined a community fairness framework that can be applied to community consultation to increase social acceptance of the outcome. About 23% of respondents agreed that the processes lacked transparency, and only 20% were given the opportunity to present their views. It is also essential that the local government and developers recognise that consultation is a two way communication process, and includes those that conjecture dialogues, as well as enhance information sharing, mutual understanding and agreement, collective action that stipulates social and individual outcomes (Figueroa et al., 2002). Gross (2007, p. 27) notes that development decisions that are unfair can 'damage a community's social well-being'. Effective communication strategies in the early stages of the wind project development with relevant stakeholders are critical to avoid misinformation, and can provide insights about local issues (Lantz and Flowers, 2010). Mechanisms such as stakeholder consultation and distributive justice can help improve wind farm acceptance.

The findings on the general relationship between social acceptance and the three determinants of considered in this study are consistent with a priori expectations. For example, as expected, improving stakeholder consultation process increases social acceptance. In contrast, higher concerns with turbine externalities and annoyance by wind turbines lowers social acceptance of wind power development. An important contribution of this study relates to the quantitative findings from the predicted empirical regression model. The estimated equation of social acceptance of wind power system is summarised as

$$\text{Social Acceptance Predicted} = 3.354 – (0.746 \times \text{Concerns}) – (0.192 \times \text{Annoyance}) + (0.184 \times \text{Consultation}).$$

The regression analysis suggests that about 62% of the variation in Social Acceptance among the sample of rural community studied was explained by Concerns with wind turbines, Annoyance by wind turbines, and Stakeholder consultation process. Magnitudes of the regression coefficients suggest that concerns with wind turbines had a greater effect on Social acceptance than Annoyance and Stakeholder Consultation. The empirical findings also support conclusions from early literature on the effect of concerns and annoyance caused by wind power projects (Carlman, 1982; Wolsink and Van De Wardt, 1989; Thayer and Freeman, 1987; Bosley and Bosley, 1988), these also interfere with the planning process. Results also provide additional rationale behind community's rejection of wind farms due to concerns about (potential) changes in landscape, visual aesthetics, and annoyance linked to turbine noise (Hall et al., 2012).

There are various benefits to rural regions of Australia from improving social acceptance of wind energy. For example, rural regions of Australia currently face complex issues linked to changes in population growth, with some areas experiencing high population growth, while other areas are faced with declining population growth (Hicks and Ison, 2011). During the past few decades, such regions have witnessed increasing emigration of young adults in search of jobs, education and other attractions in cities (Hanson and Bell, 2007). Wind power development offers opportunities for rural economic development and growth (Mackenzie, 2006). Wind energy development can help expand labour mobility in rural areas, and contribute to creating employment opportunities in rural regions where wind farms are located (Bergmann et al., 2008).

A *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) report on rural Australia (Hatfield-Dodds et al., 2007) noted that rural businesses and communities can be best served by more ambitious medium term emissions reduction targets. Other important issues identified in the report include policies to facilitate GHG emissions trading, improving agricultural competitiveness, mobilising investment and activity, and a collaborative and consultative approach to policy development involving rural businesses and communities. Hatfield-Dodds et al., 2007 notes that although wind power development tend to use up some land, the land use for turbine installations tend to have little, if any, impacts on agricultural lands for grazing and crop production since most wind turbines tend to be established on less productive agricultural lands. On the other hand, landowners may benefit from land leased or rented from turbine installations. In some regions, wind farm developers are not only required to cover the cost of fencing to protect installations, but are also required to provide direct (and indirect) infrastructure developments and maintenance, such as access roads and power grid interconnection infrastructure. The current Australian framework appears to be having strengths as well as weaknesses. The question of whether this approach will sustain development of wind farms would need to be based on a careful consideration of what socio-policy response could be most effective in terms of dealing with concerns, annoyance and the consultative process to improve social acceptance of wind development in Australia.

6. Conclusions

Supporting growth in the development and planning of wind farms in rural regions of Australia can help in action against human induced climate change, decrease greenhouse gas emissions and job creation. This exploratory study demonstrated that social acceptance of wind power projects can be better understood by quantifying its significant determinants, including concern about wind turbine externalities, annoyance caused by wind turbines and improving stakeholder consultations. The findings on the general relationship between social acceptance and the three determinants considered in this study are consistent with a priori expectations. It was found that 'Concerns with wind turbines' was the predictor most strongly correlated with Social Acceptance, in a step-wise regression analysis. In the next step, 'Annoyance' with wind turbines was included, followed in stage 3 by 'Consultation' with stakeholders. The research identifies explicit issues and reflection about social acceptance through the lens of consumer analysis and reports how this can be linked to broader theoretical areas within the field. The paper recommends that policy efforts that tout specific rural wind energy development and planning should receive greater emphasis based on these findings. In conclusion this research adopts the view that investing in consumer confidence is beneficial for social acceptance which is a necessary condition for the widespread adoption of new renewable technologies.

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