Generating Guidance on Public Preferences for the Location of Wind Turbine Farms in the Eastern Cape

Jessica Hosking, Mario du Preez, Gary Sharp

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Abstract

There is general consensus that South Africa should be generating more power, *inter alia*, through harnessing renewable energy, such as wind, but not with respect to the location of such generating projects. This paper describes a wind farm project proposed for development in the Kouga Local Municipality, reports local resident's preferences on its nature and applies choice modelling to analyse these preferences. Two respondent groups were surveyed, distinguished by socio economic status. Respondents were presented two different onshore wind energy development scenarios and a *status quo* option. The scenarios differed by the combination of four elements: the distance of the wind turbines from residential areas, the clustering of the turbines (job creation for the poor respondent group), the number of turbines and a subsidy allocated to each household.

The paper finds that both respondent groups support South Africa's wind energy developments, but there were concerns about the impact of the wind farm on the environment and tourism. The affluent respondent group were found to be more sensitive to the distance between the wind turbines and residential areas, while the poorer group were found to be most influenced by changes to the prospects for employment created by such renewable energy projects.

Keywords: Choice experiments, renewable energy, wind turbines, local residents preferences, socio-economic status

1. Introduction

South Africa is the largest emitter of greenhouse gasses in Africa (Department of Minerals and Energy, 2003) mainly because the majority of electricity in South Africa is produced from coal. In order for South Africa to reduce its carbon emissions and comply with the UN Framework Convention on Climate Change and the Kyoto Protocol, Eskom (its leading electricity supplier) will be required to diversify its energy mix (SAinfo Reporter, 2008). This quest to comply has led to a drive to increase the percentage of energy produced by renewable and sustainable sources. The most prominent of these sources is wind energy. There are wind farms currently being developed in South Africa in both the Western Cape and Eastern Cape.

The reason wind is favoured as a source for the generation of electrical energy is because wind resources are easily harnessed through the use of mature wind turbine technology (Edkins , Marquard & Winkler, 2010). By the end of 2010 wind energy projects in South Africa had an installed capacity of 10MW (WWEA, 2011). The goal of the South African government is to generate approximately 10,000 GW of electricity through renewable energies by 2013 (Edkins et. al. 2010). To meet this target the installation capacity of wind power needs to increase dramatically. The introduction of a Renewable Energy Feed-In Tariff (REFIT) in 2009 incentivised independent power producers, such as Red Cap investments, to propose different renewable power projects throughout South Africa. Several of these proposals have caused concern particularly for coastal communities. The majority of these concerns are environmental and location related.

This concern is because wind turbines may (Binopoulos & Haviaropoulos, 2010):

- reduce the naturalness of the areas in which they are located
- increase road development in natural areas (so they may be erected and serviced)
- detract from the visual appeal of an area
- increase industrial noise in the area they are erected
- negatively impact on fauna and flora, e.g., discourage bird migration into the area
- reduce other development opportunities, e.g. flight paths for airports.

The negative externalities of wind energy are of greatest concern to the communities in the vicinity of the wind farms. On the other hand, these communities may derive benefits from the wind farm in the form of employment creation and increased tourism to the area.

The various advantages and environmental impacts that arise from the construction of a wind farm can be viewed in terms of trade-offs. The trade-offs may be worth it in some cases and not in others. In order to evaluate the public opinion toward wind energy one would need to know the scale of the various costs and benefits involved and how the public makes trade-offs between these costs and benefits. Through the use of the choice experiment variant of the choice modelling technique the public opinion on the different aspects of wind energy developments in the Kouga Local Municipality are measured. This includes:

- Identifying the aspects of new wind energy developments that are most important to the Kouga Local Municipality resident.
- Estimating the public preferences for different wind energy scenarios
- Comparing two different socio economic group's preferences for wind energy options

2. Wind energy in the Kouga municipality

The province of the Eastern Cape currently has applications for the building of wind turbine farms with the capacity to generate approximately 900 MW of electricity, but there has been resistance to the erection of the turbines at certain locations. The majority of the resistance comes from residents and businesses in the area that have interests in recreational resources and the environment around them. Although many of the residents and businesses support the drive for cleaner energy they are less resistant to the construction of wind farms when the wind turbines do not dominate the surrounding area.

In the Kouga Local Municipality a company called Red Cap Investments has proposed the development of a 121 wind turbine farm. The generating capacity of this wind farm will be approximately 300MW, enough to power approximately 54 200 households with electricity[1] (EIA). The wind farm will span over three locations; the "Eastern Cluster" that will be located near Aston Bay and Paradise Beach, the "Central Cluster" that will be located near St. Francis Bay and the "Western Cluster" that will be located near Oyster Bay (Red Cap Investments Pty (Ltd), 2011).

The areas that will be most affected by the wind farm development include Paradise Beach, Oyster Bay, Umzamozethu, St. Francis Bay, Port St. Francis, Sea Vista, Kwanomzamo and to a lesser extent Humansdorp, Jeffrey's Bay and Aston Bay.

3. The methodology

The wind farm development in the Kouga Local Municipality may have an impact on the visual attractiveness of the land (landscape character), abundance of bird life, employment and in some cases property values in the area (St Francis Bay Residents Association, 2010). These costs are often unaccounted for in standard environmental impact assessments (EIA) but are important to incorporate in order to provide a comprehensive assessment of the environmental impacts of a proposed wind farm and to assess the determinants of local community resistance to its development (Dimitropoulos & Kontoleon, 2008).

The perceptions of the residents in the locality of the wind farm toward the impacts and benefits are most likely influenced by social factors and general beliefs held in the community (Alvarez-Farizo & Hanley, 2002). The evaluation of the impacts will therefore depend on both the social factors and the environmental and technical factors. The problem is how does one quantify certain impacts such as the visual disamenty of a wind farm? The answer lies in a technique

[1] An average household uses ± 1.1 MWh per month (Eskom, 2011) or 12.12 MWh per annum (In one year the Red Capp investments wind energy development will generate approximately 657 000 MWh (300MW x 24 x 0.25 x 365), which can supply approximately 54 200 households with electricity each month.

known as choice experiments (or conjoint analysis) which is a stated preference technique that employs the use of questionnaires with hypothetical choice scenarios to determine the values of the environmental impacts that are based on perception. In this paper a choice experiment technique is applied to evaluate the public preference toward the proposed wind energy development in the Kouga Local Municipality and to determine which aspects of the wind farm development are perceived as undesirable to the residents.

3.1 Choice experiments

Choice experiments are based on two fundamental theories. The first theory is that of Lancaster (1966) which states that a *good* is made up of several parts (attributes) and that the enjoyment (utility) one derives from the usage or consumption of the *good* is determined by the attributes of the *good* and not from the consumption of the *good* as a whole (Lancaster, 1966). The second theory is random utility theory which proposes that not all utility derived from a *good* is observable to the analyst (Hensher, Rose & Greene, 2005). The combination of the two theories allows one to decompose utility of any *good* into two parts, an observable and an unobservable part:

$$U_i = V_i + \varepsilon_i \quad (3.1)$$

Where U_i represents the overall utility of a specific choice alternative *i*, V_i represents the observable utility component and ε_i represents the unobservable or stochastic utility component (Hensher et. al., 2005).

We can define the observable utility component in a linear form:

$$V_i = \beta_{0i} + \beta_{1i} f(X_{1i}) + \beta_{2i} f(X_{2i}) + \beta_{3i}(X_{3i}) + \cdots + \beta_{ni}(X_{ni}) \quad (3.2)$$

Where β_{1i} is the parameter associated with X_1 and alternative *i* and β_{0i} is the alternative specific constant associated with the i^{th} alternative (Hensher et. al, 2005).

In order to model individuals choices with only the available or observed data an analyst has to determine the probabilities associated with each alternative (choice) presented to the individual. If the individual faces *j* alternatives (where $j = 1,\ldots, J$) then using the individual decision maker's rule the individual will evaluate each alternative $U_1, U_2, \ldots, U_j, \ldots, U_J$ and select the option that yields the greatest utility. The analyst would assume that the probability of the individual selecting alternative *i* is equal to the probability that the utility of alternative *i* is greater than or equal to the utility of alternative *j* after comparing all alternatives in the choice set of $j=1,\ldots,i,\ldots,J$ alternatives (Hensher et. al., 2005):

$$Prob_i = Prob(U_i > U_j)\ \forall\, j \in j = 1, \ldots, J; i \neq j \quad (3.3)$$

This is the same as:

$$Prob_i = Prob[(V_i + \varepsilon_i) \geq (V_j + \varepsilon_j) \forall\, j \in j = 1, \ldots, J; i \neq j] \quad (3.4)$$

Rearranged to separate the unobserved components from the observed components:

$$Prob_i = Prob[(\varepsilon_i - \varepsilon_j) \leq (V_i - V_j) \forall\, j \in j = 1, \ldots, J; i \neq j \quad (3.5)$$

Assume that the unobserved components are independent and identically distributed with a Gumbel distribution. This would allow for the analyst to use the multi nomial logit (MNL) model to determine the probability of choosing alternative *i* over alternative *j* (Hanley, Mourato & Wright, 2001):

$$Prob(U_i > U_j) = \frac{e^{(\mu V_i)}}{\sum_{j=1}^{J} e^{(\mu V_j)}}\ \forall i \neq j \quad (3.6)$$

In equation 3.6, μ is a scale parameter that confounds the direct determination of the β parameters. This equation states that the probability of an individual selecting alternative *i* over alternative *j* in the set of *J* alternatives is equal to the ratio of the exponent of the observed utility of *i* to the sum of the exponent of all the observed utility indices for all *J* alternatives (Bergmann, Hanley & Wright, 2006).

The trade-offs between the attributes that a respondent makes can be determined by the estimated coefficients of the attributes from 3.2. A monetary attribute (usually a price or subsidy) combined with another attribute would permit an estimate of willingness-to-pay (receive) of respondents for changes in the attribute levels to be calculated. This can be determined as shown (Ek, 2002):

$$implicit\ price = -\left(\frac{\beta\ attribute}{\beta\ monetary\ attribute}\right) \qquad (3.7)$$

Because the scale parameter μ is present in both the β coefficients of the attributes and the monetary attribute the ratio of the two coefficients removes the confounding parameter. This equation allows for the determination of the public preferences for changes in the attribute levels in terms of economic values.

4. Compiling the questionnaire

An essential part of choice experiment is creating an effective survey tool that can provide relevant information about the respondents and their preferences. The questionnaire is constructed in four phases. Firstly the researcher creates a description of all possible characteristics that define the *good* to be analysed. Then a focus group is convened to ensure that only the relevant characteristics of the *good* are incorporated into the questionnaire. The third phase is a pilot study which is used to test the understanding and ease of the survey as well as identifying the appropriate bounds and levels for the cost attribute (Bateman and Willis, 1999). The last phase involves finalizing the main questionnaire and administering the survey.

As this study was conducted in South Africa, a developing country, it is important to note that there are distinct differences between this study and similar studies conducted in industrialised nations. This is because South Africa has significant inequalities in income distribution (Rosset, Patel & Courville, 2006). In South Africa the wealthy and poor communities are not only distinct in terms of income but also in terms of living environment, education and employment. It was therefore necessary to create two separate surveys to accommodate the differences in socio-economic status. The two groups are referred to as “affluent” and “underprivileged”. The affluent group was defined as the respondents with formal residents in the areas of St. Francis Bay, Port St. Francis, Paradise Beach, Jeffrey’s Bay, Humansdorp and Oyster Bay. The underprivileged group was defined as the respondents who reside in the informal areas (townships) of Kwanomzamo, Sea Vista, Tokyo Sexwale, Ocean View and Umzamowethu.

From focus groups with each group the main concerns or attributes of the wind farm were defined. Four main attributes were defined for each group. The attributes and levels incorporated into the questionnaire are given in Table 1. The size of the wind farm in terms of number of turbines and proximity of the turbines to residential areas in kilometres were attributes that were incorporated into both questionnaires. The levels of these two attributes were the same for both questionnaires. The spacing between turbines was identified as important to the affluent group because of its effect on bird and bat mortality. This attribute was qualitative in nature and was effects coded for the choice experiment. The underprivileged group were more concerned about the employment possibilities from the wind farm development than the affluent group. Therefore an attribute for job creation was incorporated into the underprivileged questionnaire instead of the clustering attribute. A subsidy attribute was included in both questionnaires. A subsidy was chosen over a price for renewable energy for two reasons. Firstly, it was assumed that wind farm developments impose negative presence costs on the residents in the surrounding areas. Secondly, the residents surrounding the wind farm development are likely to have municipal property rights that would be infringed upon were the wind farm to be built in proximity to their residence (Dimitropoulos & Kontoleon, 2008). The subsidy values were different for each respondent group this is because the same scale of benefits could not be applied to the two different income groups. The subsidy values for the affluent group were based on electricity consumption and the subsidy for the underprivileged group was based on the free basic electricity prices (South African Government Information, 2011).

Table 1. Selected attributes and attribute levels.

Survey Group	Attribute	Levels
Affluent	Size of wind farm	10, 20, 53 turbines
	Clustering of turbines	Close together, moderately close together & widely spread apart
	Proximity to residential areas	0.5km , 2km , 6km
	Subsidy per household	R100 , R250, R550
Underprivileged	Size of wind farm	10, 20, 53 turbines
	Job Creation	5 , 20, 40
	Proximity to residential areas	0.5km , 2km , 6km
	Subsidy per household	R3.25 , R13, R19.5

Once the attributes and the levels were defined, a main effects only, orthogonal and balanced design for the experiment was created in SPSS (version 12.01). As there were four attributes each with a corresponding three levels, a total of $3^4 = 81$ possible treatment combinations of attribute levels exist. A fractional factorial design was used to reduce this number to 27 treatment combinations. These combinations were then randomly paired into 108 choice sets (Hensher et. al., 2005). These sets then blocked into 27 unique versions, each containing four choice tasks. A status quo option was then added to each choice task.

The survey comprised four sections. The first two sections and the last section in the questionnaire were concerned with obtaining knowledge about the respondents understanding of wind energy and socio-economic information relating to each respondent. The third section contained the choice experiment. Four pages were shown to the respondents each page contained two choice cards. Each attribute on the choice cards was represented by a picture. The respondents were asked to choose between option A, B and C where option C was the *status quo*. A stratified sampling method was used to identify respondents for the questionnaire from different locations in the Kouga Municipality.

5. Sample Description

The affluent survey consisted of 244 usable or partially usable surveys. The underprivileged survey consisted of 270 usable surveys. A total of 26 surveys from the affluent survey were unusable and were removed from the data set. The average gross household income for the underprivileged sample was determined to be R30800.89. Therefore the average household in the poorer areas in the Kouga Local municipality is receiving approximately R2600 of income each month. A household in the affluent sample receives a gross income of approximately R 281 676.24 per annum and therefore the average monthly income is approximately R23 500. Table 2 shows the distribution of age, income and education of the two sample groups. The majority of the affluent group were older, better educated individuals with a better understanding of wind energy technology than the underprivileged sample.

Table 2. Sample characteristics for affluent and underprivileged respondent groups

Age			Income (annum)			Education		
	Affluent	**Poor**		**Affluent**	**Poor**		**Affluent**	**Poor**
Up to 30	17.5%	38.4%	Up to R15 000	-	17%	Primary	1%	23%
Up to 40	20.5%	29%	Up to R50 000	19%	42%	Secondary	10%	48.5%
Up to 50	19%	19.6%	Up to R200 000	22%	19%	Matriculation	45%	22.5%
51-80	43%	13%	Up to R750 000	24%	-	Tertiary	44%	6%

6. Results

The data was inputted into the econometric software NLOGIT (version 10). The data matrix was in the form (Bergmann et. al., 2006):
Option A:

$$V_a = \beta_{0a} + \beta_1 X_{size} + \beta_2 X_{cluster/job} + \beta_3 X_{distance} + \beta_4 X_{subsidy} \quad (6.1)$$

Option B:

$$V_b = \beta_{0b} + \beta_1 X_{size} + \beta_2 X_{cluster/job} + \beta_3 X_{distance} + \beta_4 X_{subsidy} \quad (6.2)$$

Status Quo Option:

$$V_{SQ} = \beta_1 X_{size} + \beta_2 X_{cluster/job} + \beta_3 X_{distance} + \beta_4 X_{subsidy} \quad (6.3)$$

Where V is the observed utility and β_0 is the alternative specific constants for options a and b. Effects coding was used for the affluent group attribute "cluster". This means that one level of this attribute was not included as an identified variable. The level omitted was the status quo.

The results of the affluent and underprivileged group of respondents are shown in Table 3 The influence of each attribute on the choice probabilities can be determined by the signs of the coefficients (Krueger, 2007). From the affluent results in Table 3 it can be seen that the sign of the coefficient for size is negative indicating that the respondent's utility decreases as the size of the wind farm increases, that is they would require a greater subsidy the bigger the wind farm. The coefficients of cluster1, cluster2 and cluster 3 are all positive and statistically significant (as can be seen from the p-value at a 5% level of significance). As expected the distance attribute is positive and significant suggesting that greater utility is derived, the larger the distance between the wind farm developments and residential areas. The subsidy value is positive indicating that respondents prefer larger as opposed to smaller subsidy values per household.

Table 3. Discrete Choice results for both groups

Model	Descriptor	Coefficient	Implicit price	Std. error	p-value
Affluent	Size	-0.002	3.85	0.003	0.419
	Cluster1	7.539***		0.654	0.000
	Cluster2	7.862***		0.671	0.000
	Cluster3	7.898***		0.664	0.000
	Distance	0.251***	-450.74	0.022	0.000
	Subsidy	0.001**		0.001	0.032
	ASCa	0.086			0.241
	ASCb	0.075			0.346
	Log-likelihood	-829.181			
	No. of observations	976			
	Pseudo R^2	0.35			
Underprivileged	Size	0.003	-0.11	0.003	0.188
	Jobs	0.040***	-1.31	0.003	0.000
	Distance	-0.072**	2.36	0.021	0.002
	Subsidy	0.031***		0.007	0.000
	ASCa	9.012***		2.394	0.001
	ASCb	9.124***		2.398	0.001
	Log-likelihood	-863.777			
	No. of observations	1080			
	Pseudo R^2	0.58			

In the underprivileged group the results were distinctly different. The size attribute was insignificant at the 5% level however the coefficient of this attribute was positive suggesting that the underprivileged group preferred larger wind farms to smaller wind farms. The job attribute was both significant and positive indicating that the respondent's utility improves when a larger number of long-term jobs are created. The distance attribute was negative. This indicates that the respondents would prefer the wind farm to be located closer to residential areas rather than far away.

6.1 Implicit Prices

The implicit prices for the attributes indicate the importance of the various attributes to each respondent group. The implicit prices are simply the trade-off between the attributes and the monetary attribute. These values can be used to determine the public preferences for the attributes of the wind energy developments in the Kouga Local Municipality and the importance or ranking of one attribute over another.

6.1.1 Affluent respondent group

The affluent households are willing to accept (WTA) a subsidy of R3.85 per month for changes in the size of the wind farm. This implies that affluent households prefer the size of the wind farm to be small rather than large. The statistical significance of the attribute indicates that size is not a significantly important attribute to this group, however the result does identify that the affluent households are concerned about the aesthetics of the wind farm and not the generation capacity of the developments. The coefficients of the clustering attribute are interesting in that the values for each level and the associated standard errors are remarkably similar. This indicates that there is no single clustering arrangement that is preferred over another but the positive coefficients indicate that the respondents derive higher utility from the development of wind farms than the current situation of no wind farms (Krueger, 2007). No implicit prices were calculated for this attribute as none of the levels were preferred. The affluent respondents are willing to accept a reduction in the subsidy of approximately R450.74 per month to have the wind farm located 1km from the residential areas in the Kouga local Municipality. This value is large, indicating that the respondents prefer to have the wind farm located at greater distances from their place of residence.

6.1.2 Underprivileged respondent group

The results from the underprivileged sample indicate that households in this group would be willing to accept a reduction in the subsidy of R0.11 per month if the wind farm is to be developed. Furthermore the households would also be WTA a reduction of R2.36 per month to have the wind farm located 1 kilometre from the residences in the Kouga Municipality. The implicit price associated with the job attribute indicates that the households would be willing to accept a subsidy reduction of R1.31 per month to have the wind farm developed in the area with the associated increases in employment. From the results it can be seen that the underprivileged group are strongly in favour of wind farm development in the Kouga Local Municipality so much so that they are willing to receive large reductions in the subsidy per household in order to increase the size of the wind farm, to create more jobs and to locate the wind farm closer to the residential areas.

6.2 Heterogeneous preferences and alternative wind farm scenarios

One of the benefits of using choice experiment methodology is that the estimated coefficients of the attributes in a choice experiment may be combined in such a way as to predict the economic value of alternative scenarios. Therefore the coefficients of the models may be used to predict welfare changes associated with different wind energy scenarios in the Kouga Local municipality. In order to derive these welfare measures a change in utility is calculated:

$$Welfare\ change = -\left(\frac{1}{\beta_{price}}\right)(U_i^1 - U_i^2) \quad (6.4)$$

Where U_i is the conditional indirect utility associated with alternative *i*. The base case is compared to the alternative wind energy scenario. Three different energy scenarios where considered for both groups:

1. A large wind farm (53 turbines), 500m from residential areas and widely spaced apart (40 jobs created)
2. Small wind farm (10 turbines), 6km from residential areas and close together (10 jobs created)
3. A large wind farm (53 turbines), 2 km from residential areas and close together (10 jobs created)

Equation 6.4 is used to generate the results for the welfare changes for each wind energy scenario. The values derived can be interpreted as the subsidy that households in each respondent group in the Kouga Local Municipality are willing to accept each month to have the wind farm located in their area of residence rather than the current situation of no wind energy (Bergmann et. al., 2006). Table 5 shows the changes in welfare for three different wind energy scenarios. As can be seen the affluent households would be willing to receive the largest reduction in compensation for the second scenario. This is because the affluent households value the distance attribute the most, therefore the scenario with the largest distance between residential areas and the smallest wind farm is the preferred choice. Interestingly the opposite is the case for the underprivileged households. These households would be willing to accept the greatest reduction in compensation for a larger wind farm located close to the residential areas with a large increase in employment opportunities (scenario 1).

Table 5. Welfare changes for different wind energy scenarios

	Scenario 1	Scenario 2	Scenario 3
Affluent	-R 1 096.50	-R 2 204.00	-R 1 114.00
Underprivileged	-R 91.97	-R 19.96	-R 88.51

As two different questionnaires were presented to the two socio-economic groups a direct comparison between the implicit prices could not be made. However an assessment of the resulting marginal values associated with changes in the attribute levels can provide a reasonable comparison between the two groups. From Table 6 it can be seen that affluent households are willing to accept R20 per month for an increase in size of the wind farm from 10 to 20 turbines however the underprivileged households are prepared to reduce the subsidy amount by approximately R1.08 per month to increase the size of the wind farm from 10 to 20 turbines. The most significant result from this table is the high value associated with a change in distance from 2 to 6 kilometres away from residential areas for the affluent sample. This indicates that the affluent households are willing to accept a reduction in subsidy (or alternatively are willing to pay) approximately R1802.00 per month to have the wind farm located further than 2 kilometres away from the residential areas.

Table 6. Changes in the attribute levels

		Affluent	Underprivileged
Size	10 turbines to 20 turbines	R 20.00	-R 1.08
	20 turbines to 53 turbines	R 66.00	-R 3.56
Jobs	10 to 20 jobs	-	-R 13.09
	20 to 40 jobs	-	-R 26.19
Distance	0.5 km to 2 km away	-R 676.10	-R 3.55
	2km to 6 km away	-R 1 802.94	-R 9.46

An interesting result shown in Table 6 is that the underprivileged households were prepared to accept reductions in the subsidy amounts for each attribute. This suggests that the underprivileged households are strongly in favour of the wind farm development in the Kouga Local municipality.

7. Conclusions

Wind energy is a mature technology with understood risks and realisable benefits. However this technology may not only provide benefits to a community through increased job creation and a reduction in air pollution but may also impose external costs by impacting the look of the landscape, the abundance of birds and the naturalness of the area. These external costs may vary in magnitude and impact depending on the case. In this paper the public preferences for the location and environmental attributes associated with wind energy developments in the Kouga Local Municipality were addressed. The perception of the effects of wind farm size, distance from residential areas, employment opportunities and spacing between the turbines were jointly evaluated in welfare-consistent terms. This was done by applying a choice experiment method.

South Africa is in the initial stages of adopting wind energy technology as a form of electricity generation. The social costs and benefits created by such a development will be different in South Africa compared to other developed countries due to the fact that there are significant income inequalities among the citizens. The concerns and preferences of all socio economic groups need be incorporated into the study to get a holistic idea of the impacts of such a development would have on all of the residents located nearest to the development. It is for this reason that two different socio economic groups were included in the study: an affluent group and an underprivileged group. The affluent group possessed formal residences in areas such as St. Francis Bay and Humansdorp. The underprivileged group were from informal residents in areas (townships) such as Kwanomzamo and Sea Vista. The affluent sample group received larger incomes, were older, better educated and well informed about wind energy.

The results indicate that despite some social costs arising from the development of a wind farm in the Kouga Local Municipality, particularly for the affluent households, the residents are positive and supportive toward wind energy developments. The affluent respondent group were mostly concerned about the distance between the residential areas and the wind farm developments. The respondents were willing to accept a reduction in subsidy (willing to pay) R225.37 per month to locate the wind farm 0.5km away from residential areas. The affluent households would be willing to accept a reduction in subsidy (or be willing to pay) approximately R2704.44 per month to have the wind farm located 6km away from residential areas. In the results this respondent group did not indicate that wind farm size was an important attribute influencing their preference for wind energy developments, however the results indicated that this group preferred smaller wind farms and preferred that the wind farm be developed in the Kouga Municipality over the status quo (that no wind farm would be built).

The underprivileged households derived utility from increases in job creation and from increasing the size of the wind farms. The households in the underprivileged group would be willing to accept a reduction in subsidy of approximately R52.37 per month to have the wind farm located in the Kouga Local Municipality with the associated 40 new employment opportunities created. This respondent group differed from the affluent respondent group in that they associated higher utility from reducing the distance between the wind farm and residential areas. This result suggests that this respondent group were not concerned about the change in landscape character and perceived that the larger the wind farm and the closer it is to residential areas, the greater the derived benefits would be.

The results from this study are significant in that two respondent group’s stated preferences toward wind energy development in the Kouga Local Municipality were starkly different. Overall the affluent households were most concerned about the aesthetics of the wind farm development and the disruption to the landscape surrounding their residences whereas the underprivileged respondents believed that the wind farm development would result in an increase in welfare for the population.

References

Alvarez-Farizo, B. & Hanley, N (2002) USING conjoint analysis to quantify public preferences over the environmental impacts of wind farms. An example from Spain. *Energy Policy* 30:107-116.

Bergmann, A., Hanley, N. & Wright, R. (2006). Valuing the attributes of renewable energy investments. *Energy Policy* 34:1004-1014

Binopoulos & Haviaropoulos. (2010). Environmental Impacts of Wind Farms: Myth and Reality. Centre for Renewable Energy Sources (CRES). [Online] Available at:< www.cres.gr/kape/.../CRESTRANSWINDENVIRONMENT.doc> [Accessed 24 June 2011]

Dimitropoulos, A. & Kontoleon, A. (2008) Assessing the Determinants of Local Acceptability of Wind Farm Investment: A Choice Experiment in the Greek Aegean Islands. Cambridge Department of Land Economy Discussion Paper Series, Number 35.2008.

Edkins, M., Marquard, A. & Winkler, H. (2010). *South Africa's renewable energy policy roadmaps.* United Nations Environment Programme Research Project. UCT. Cape Town

Ek, K. (2002). *Valuing the environmental impacts of wind power: a choice experiment approach*. Licentiate Thesis, Luella University of Technology, Sweden. [Online] Available at: <http://epubl.luth.se/1402-1757/2002/40/index-en.html> [Accessed 22 February 2011]

Eskom (2011) Fact Sheet. {online} Available at: < http://www.eskom.co.za/c/25/facts-figures/> [Accessed 14 October 2011]

Hanley, N., Mourato, S. & Wright, R. (2001) Valuing the environmental and employment impacts of renewable energy investment in Scotland. Scotecon, Stirling.

Hensher, D. A., Rose, J. M. & Greene, W. H. (2005) *Applied Choice Analysis: A primer,* Cambridge, UK, Cambridge University Press

Krueger, A. (2007). *Valuing Public Preferences for offshore wind power: A choice experiment approach*. Ph.D. University of Delaware.

Department of Minerals and Energy, 2003. *White Paper on the Renewable Energy Policy of the Republic of South Africa.* South Africa. Government Gazette. Vol. 466, No. 26169.

Lancaster , K. (1966). A new approach to consumer theory. Journal of Political Economy 74, 132-157.

Red Cap Investments (2011). Environmental Impact Assessment for a Wind Farm in the Kouga Local Municipality. Revised Draft Environmental Impact Report. [Online] Available at: <http://projects.gibb.co.za/en-za/projects/kougawindfarmfinaleir/kougafinaleir.aspx> [Accessed: 20 June 2011]

Rosset, P. Patel, R. & Courville, M. (2006). *Promised Land: competing visions of agrarian reform*. Land Research Action Network. Food First Books. 63

SAinfo Reporter (2008). SA's Energy Suppy. [online] Available at: *http://www.southafrica.info/business/economy/infrastructure/energy.htm* [Accessed 22 February 2011]

South African Government Information (2011). Government Services. [Online] Available at: <http://www.info.gov.za/faq/services.htm#municipal> [Accessed: 5 July 2011]

St Francis Bay Residents Association. (2010). The proposed Kouga Wind Farm. [Online] Available at: <http://www.sfbresidents.org/news/2010/Windfarm-Feb.html> [Accessed: 20 June 2011]

WWEA. (2011). *World Wind Energy Report 2010*. Germany: World Wind Energy Association