VALUING THE ATTRIBUTES OF RENEWABLE ENERGY INVESTMENTS IN SCOTLAND

by Nick Hanley and Ariel Bergmann,
University of Glasgow and
Robert Wright, University of Stirling

1 Introduction

Scotland has recently started down a new path in how it provides electricity to its people and industry (ROS, 2002 and Finnie, 2002). The Scottish Executive has set two challenging targets for use of renewable power sources in the next 20 years:

- by 2010, 18% of electricity consumed should come from renewable generation,
- by 2020, that portion should rise to 40%.

Currently only 10% of the electric energy produced in Scotland comes from renewable sources such as wind energy, hydro and waste-to-energy plants. The benefits and costs that will accrue to Scotland from this new commitment are both environmental and economic.

The major political and legal reasons for promoting renewable energy are external to Scotland. The United Kingdom has accepted a legally binding target of reducing emissions of a bundle of greenhouse gases (GHGs) by 12.5% below 1990 emission levels by 2008-2012, as its share of the European Union negotiated target of an 8% reduction in GHGs under the Kyoto Protocol. The Energy White Paper "Our energy future – creating a low carbon economy", published in February 2003 by the British Government, sets an even greater ambition by declaring that the nation should pursue a path of reducing CO_2 emissions by some 60% of current levels by 2060. Currently, the UK Renewables Obligation - a requirement on power supply companies to meet certain minimum fractions of total supply from renewables - has set a target of 15.4% by 2015-16 (The Herald, 2/12/2003).

The economic reasons for Scotland developing renewables are multifaceted. The first reason is that renewable energy projects by their very nature should be highly sustainable. There is minimal or no resource depletion due to the use of renewables technologies, as compared to gas, oil and coal based energy. Renewable energy projects, as with traditional fossil fuel projects, tend to be capital intensive, so the opportunity to develop and manufacture renewable energy equipment for domestic use and international export exists. There is the potential to transfer some of the workforce and job skills learned in the North Sea oil industry to this new industry as the offshore oil industry declines. England and Wales will have a more difficult time building sufficient renewables projects to provide adequate non-fossil fuel energy that their populations will need to meet domestic targets (OXERA, 2002). Scotland, on the other hand, has some of the greatest development potential in all of Europe, and therefore may have sufficient excess supplies to trade south of the border. Finally, rural areas of Scotland, with some of the greatest needs for economic development, will be the location of almost all land-based renewable energy projects (Hassan, 2001). These rural communities may well reap benefits from these long-term projects.

A fundamental restructuring of the power industry will need to be undertaken to achieve these renewable targets. Since the inception of the age of electricity in the 1880's in Scotland, as in the rest of the world, the power industry has been organized with a centralized hierarchical technological and management structure. Ever-larger generating facilities based on fossil fuels and nuclear power, and a unified transmission network to distribute the electricity over hundreds of miles was the model of development. The nature of land based renewable energy projects makes this development style technically impossible at this time. Current scale economies dictate that projects like wind farms and biomass generation plants be 3-5% the size of a traditional 1200 MW coal-fired plant. Even the largest wind farms being planned today are only 20% of this size. Also, because of the intermittency problems of renewable sources, greater quantities (measured by megawatt capacity) of generating assets are needed because of the lower average usage of this capacity. Renewable energy projects normally require large amounts of space to capture the energy in wind, water or solar radiation in sufficient quantity to be commercially viable. Dozens of communities in Scotland will therefore likely be impacted by renewable energy projects that will need to be constructed to meet the Scottish Executive's clean energy goals.

An additional issue that makes promotion of renewables important to the Scottish Executive during the next 20 years is the age of existing power generating assets in Scotland. Excluding hydroelectric assets, most of the power generating plants in Scotland will have to be replaced during the next 25 years. Traditional power plants have a 5-10 year planning horizon to come on-line and a determination needs to be made if renewable energy technologies can fill the void left by the closure of these old assets. The current profile of power production in Scotland is heavily weighted to generation from the nuclear power stations and coal-fired power plants:

Nuclear	44.9%
Coal	32.8%
Gas and Oil	12.2%
Hydro*	8.9%
Other**	1.2%

* Figures for hydro include the net electricity generated by pumped storage

** Includes landfill gas and wind power

Source: Key Scottish Environmental Statistics, 2002 (Scottish Executive)

This profile is facing dramatic reorientation during the next 20 years with the planned closure of all Scottish nuclear power plants; Chapelcross in 2005-2010, Hunterston B in 2011 and Torness in 2023. (NIA, 2003) A similar timeline exists for the closure of Scotland's two major coal-fired power plants; Cockenzie, a 1,200 MW plant, is anticipated to close in 2010 and Longannet, a 2,304 MW plant, will close in the 2020-2025 period (although the economic life of both these plants may be extended by a switch from coal to biomass[1] for the primary fuel source). The only major power facility in Scotland that is not anticipated to close in the next 25 years is the Peterhead gas-fired power station south of Aberdeen (Coastal Forum, 2002). The Peterhead facility faces its own economic problems. United Kingdom natural gas reserves in the North Sea are being drawn down faster than new discoveries are being made, and will be commercially unreliable in the next 5-7 years. Foreign imports from Norway will then become the main source for Scotland's natural gas generated electricity.

[1] The change to biomass energy crops is motivated by the financial rewards arising from government programs to promote renewables.

The primary policy instrument being utilized by the Scottish Executive to motivate development of renewable energy sources is the Renewables Obligation (Scotland) (ROS). The ROS has combined a demand-push legal requirement for renewable power usage with a supply-pull financial incentive program to reward private industry for constructing and investing in new renewable energy generation projects. The ROS compels licensed electricity suppliers to source specific quantities of eligible renewable energy for sale to all customers (residential, commercial and industrial), or face financial penalties for the shortfall. Existing large scale hydroelectric is ineligible, as this technology is deemed mature and economically competitive with traditional sources of power. Moderate and micro hydroelectric is eligible if certain modernization requirements are met. The original minimum portion of sales, by quantity, was set at 3% for 2002-3, rose to 4.3% for 2003-4, and will rise annually to 15.4% in 2015-2016. During the 18 months since the ROS was implemented in April 2002, a significant increase in renewable generation projects have applied for or are moving toward application and planning consent. 1500 MW of capacity have sought consent and another 2500 MW of capacity are near requesting consent. (BWEA, 2003)

The financial incentives for private investment in renewable power facilities are created by the use of the Renewable Obligation Certificates (ROCs). Electricity suppliers use these certificates as evidence that the required percentage of sales is matched with eligible green power production. The ROCs are traded separately from the actual electricity being generated and had a market price of £45-£50 per megawatt during the first year of the ROS. This money is earned by the renewable power generating company and represents revenue above the value of the electricity being sold to the power market. Renewable power generators earned £63 to £75 per megawatt of production during the 2002-3 period as compared to £17 to £25 per megawatt paid for fossil fuel powered production.

2 Introduction to choice experiments

Renewable energy investments in Scotland are thus expected to grow rapidly in the near future. These investments will produce a series of potential impacts on the environment, on the price of electricity, and on employment. Environmental impacts will include landscape effects, effects on wildlife, and changes in air pollution (for example, waste to energy plants emit air pollution). Exactly what environmental impacts occur, what happens to electricity prices through changes in cost, and any changes in employment, will depend on the exact mix of renewable investments (eg the balance between on- and off-shore wind farms; the extent of hydro developments). Taken together, environmental effects, price effects and employment effects can be thought of as the attributes of a renewable energy strategy. Knowing something about the relative economic values of these attributes is important if we wish a renewables strategy to (i) take some account of public preferences and (ii) take some account of economic efficiency (benefit-cost) concerns. Choice Experiments are an economic valuation method which enables this kind of information to be produced.

2.1 The characteristics theory of value and random utility theory

There are two fundamental building blocks that the foundations of choice experiments are based upon. The first is Lancaster's assertion that the utility derived from a good comes from the characteristics of the good, not from consumption of the good itself. This theory is sometimes called the Characteristics Theory of Value. Goods normally possess more than one characteristic and these characteristics (or attributes) will be shared with many other goods (Lancaster, 1966). The value of a good is then given by the sum of the value of its characteristics.

Random Utility Theory (RUT) is the second building block of choice experiments. RUT says that utility derived by individuals from their choices is not directly observable, but an indirect determination of preferences is possible. Elicitation of preferences by experiments that are consistent with, or at least do not violate, the modern theory of consumer preferences can be used to explain a portion of consumer utility (McFadden, 1973 and Manski, 1977). The utility function for a representative consumer can be decomposed into systemic and stochastic parts:

$$U_{an} = V_{an} + e_{an} \qquad (1)$$

Where U_{an} is the latent, unobservable utility held by consumer n for choice alternative *a*, V_{an} is the systemic, or observable portion of utility that consumer *n* has for choice alternative *a*, and e_{an} is the random or unobservable portion of the utility that consumer *n* has for choice alternative *a*. Because of the random, or stochastic, nature of the RUT, a researcher cannot perfectly predict the utility that any specific individual will receive from a specific choice and therefore not perfectly predict the preferences of that individual. Research is instead focussed on a probability function, defined over the alternatives which an individual faces, assuming that the individual will try to maximize their utility (Bennett &Blamey, 2001, Louviere, 2000). This probability is expressed as:

$$P(a|C_n) = P[(V_{an} + e_{an}) > (V_{jn} + e_{jn}),\ \forall a \neq j, \qquad (2)$$

for all j options in choice set C_n; *a* and *n* are as previously described. This expression states the probability of consumer *n* choosing option *a*, from choice set C_n is equal to the probability of the systemic and stochastic components of option *a* for individual *n* are greater than the systemic and stochastic components of option *j* for individual *n* in the choice set C_n. In order to compare and calculate the probability of choosing option *a* over option *j*, the equation can be rewritten as:

$$P(a|C_n) = P[(V_{an}-V_{jn}) > (e_{jn} - e_{an})],\quad \forall a \neq j. \qquad (3)$$

This equation states the probability of individual *n* choosing option *a* over option *j* is the probability of the difference between the systemic components being greater than the difference between the stochastic components of options *a* and *j*.

To empirically estimate (3), and thus to estimate the observable parameters of the utility function, assumptions are made about the random component of the RUT model. A typical assumption is that these stochastic components are independently and identically distributed (IID) with a Gumbel or Weibull distribution. This leads to the use of multinomial logit (MNL) models to determine the probabilities of choosing *a* over *j* options (Hanley, Mourato and Wright, 2001). The MNL model is used to estimate the probability of choosing one alternative over any other using the relative attribute levels and socio-economic characteristics of the respondents. It can be stated in terms of a conditional logit model:

$$P(U_{an} > U_{jn}) = \frac{\exp(\mu V_a)}{\Sigma_j \exp(\mu V_j)},\quad \forall a \neq j \qquad (4)$$

Here, μ is a scale parameter, inversely related to the standard deviation of the error term and not separately identifiable from the estimated coefficients in a single data set. The implications of this are that the estimated β 's cannot be directly interpreted as to their contribution to utility, since they are confounded with the scale parameter. When using the MNL model choices must satisfy the Independence from Irrelevant Alternatives (IIA) property, which means that the addition or subtraction of any option from the choice set will not affect relative probability of individual *n* choosing any other option. This is required as a result of the IID function (Louviere, 2000). Modelling constants known as alternative specific constants (ASCs) need to be included in the MNL model. The model needs one less ASC than there are options within each choice set. The ASC accounts for variations in choices that are not explained by the attributes or socio-economic variables (Ben-Akiva and Lerman, 1985).

The estimated coefficients of the attributes are linear parameters, and therefore can be used to estimate the tradeoffs between the attributes that respondents would be willing to make. The price attribute can be used in conjunction with the other attributes to determine the willingness to pay of respondents for gains or losses of attribute levels. This monetary value is called the "implicit price" or part-worth of the attribute:

Part-worth = -(B non-market attribute / B monetary attribute) *(5)*

The results are not limited to just monetary valuations. From a public policy perspective determining the marginal rate of substitution, or trade-off value, of non-market socially important attributes, can be important, such as the trade off between jobs and environmental quality. Indeed, all attribute exchanges can be quantified in such a manner. In fact, this is the principle process of interpreting the coefficients that are derived in the MNL model. The scaling problem noted above is resolved when one attribute coefficient is dividing by another, as in the part-worth equation.

3 Implementing a choice experiment

To meet Scottish Executive targets, hundreds of renewable energy projects of all sizes and types of technology have been proposed. These range from large wind farms and new hydro-electric schemes that have significant impacts on the countryside and local communities, to small changes like the addition of solar panels to rooftops and district heating plans with impacts that may only be felt by the immediate residents. This paper's objective is to estimate the value of positive and negative impacts arising from the kind of renewable energy projects that will be developed over the coming years. By identifying and understanding the value that Scots put on environmental impacts, job effects and price effects, it is hoped that the best mix of appropriate technologies can be promoted.

Attributes that the public connects to renewable energy projects are very easy to identify by just opening any newspaper in Scotland on almost any day. Weekly pronouncements are made by one group or another over the need to promote renewables projects for the benefits that will accrue to all or part of the country. Just as often, pronouncements are made over the potential harm that will occur to all or part of the country if renewables are allowed to expand without proper consideration for environmental amenities and quality of life.

Some of the most common positive attributes that are reported in the newspapers are the creation of jobs and tax revenue streams for Highland and Island communities, the potential transformation of oil industry workers into ocean and tidal energy jobs, relief from imported energy sources and prices, development of export industries from specialization in renewables, and doing Scotland's share to battle global climate change. Some common negative attributes that are mentioned in newspapers are the degradation of landscape (scenic vistas) from windmill projects and the harm to avian populations from the turbine blades, changes to fish and wildlife from creating more hydro reservoirs, the potential increase in electric prices to pay for the more expensive production technologies, and disruption of communities from the construction activities associated with the projects. The Scottish government has also declared that two major reasons for its support of renewable energy projects are the creation of new jobs in the Highlands and Islands area and the general commercial opportunities that come with the development of a new industrial sector to meet this world-wide expanding industry (Scottish Executive, 2002b).

3.1 Designing the choice experiment

In any choice experiment, attributes must be chosen which meet a number of requirements. These are that they are:

- relevant to the problem being analysed
- credible/realistic
- capable of being understood by the sample population, and
- of applicability to policy analysis.

Identifying the set of attributes and the levels these take is a key phase in choice experiment design. To this effect, focus groups were conducted with members from the general public (Dewar, 2003). The objective set to each group was to identify the 'characteristics' of 'green' electric energy production that were regarded as 'good' or 'bad'. One focus group (consisting of eight members) was organized in New Lanark, a restored mill village. The other focus group had twelve members and was urban in its nature. It drew from staff (secretaries and porters) at the University of Glasgow as well as non-students invited from the neighbourhood surrounding the university.

The facilitator had each group identify all the types of renewable power technologies that they could, and then discuss the good or bad characteristics of each type of energy project. Technologies that were identified were: windmills, hydro schemes (run of river and reservoir), tidal and wave power, solar (photovoltaic and hot water panels) geothermal, various types of biomass or waste combustion like burning municipal solid waste, wood burning, animal and organic waste, natural gas from landfills, and fermentation of organics. After identification of the attributes of each technology, the groups were requested to separate into smaller sections of two or three persons, and rank these attributes by importance to them. After that exercise, individuals were asked to indicate their personal choices for which characteristics were most important or of concern to them. Three characteristics that dominated all others were revealed by the focus groups. One was that renewable energy projects have a low environmental impact, and should reduce how we change or pollute the environment. Another was that the projects be aesthetically pleasing. This characteristic was a little more contentious because some group members felt that both windmills and reservoirs are pleasing to observe, while other members felt that large man-made structures took away from nature's scenic beauty. The final dominant characteristic was that wildlife should not be harmed any further than it already has and that projects that improved wildlife should be supported. Other less significant characteristics mentioned by individuals or groups were the creation of jobs, the effect on electricity prices, the abundance and sustainability of the resources, more localized control and responsibility for the project, the smaller scale of projects that could be implemented, and ability to maintain the projects.

Five key attributes were then identified from examining the focus groups, government announcements and statements, and the literature. The attributes that were identified as being of most relevance for the Choice Experiment were:

- Impacts and changes to the landscape,
- Impacts and changes to wildlife,
- Impacts and changes to pollution levels, in particular, air pollution,
- Creation of long-term employment opportunities, and
- Potential increases in electric prices to pay for renewable sources.

Once these attributes were determined, a questionnaire was constructed that presented the context of renewable energy development in Scotland. The national commitment by the United Kingdom to reduce production of global climate gases was explained. Survey participants were told that the survey was not concerned with any specific type of renewables technology, but with the impacts that could result from development of any renewable energy resource. The five attributes noted above were described, with examples being given to clarify each type of impact. Attachment of quantitative and qualitative examples to specific words or measurement standards was avoided. The questionnaire and the covering letter sent with it are included in the Appendices.

Four choice sets were then presented and the survey participant was requested to indicate their preference. Each choice set contained three options. Plans A and B were possible renewable energy projects, each with different attribute levels. A third option of choosing neither was given. This 'neither' option, commonly called the opt-out option, stated that there would be no increase in renewable energy, alternative programs would be implemented to avoid climate change, and that North Sea natural gas usage would be expanded to provide for future electricity generation. Figure One gives an example choice set. The final page of the questionnaire was concerned with collecting standard socio-economic information about the participant. Information was requested about location of household, number of children, employment in the energy sector, membership in a conservation group, age, household income, education attainment, and amount of last electric bill.

SPSS (VERSION 10.0) was used to create choice profiles, which were then combined to make up the choice sets used in the experiment. The combination of attributes and their respective levels was created using the orthogonal design procedure. Table One shows these attributes and levels as used in the final design. Given the 5 attributes and 17 associate levels, 24 representative plans were identified. 20 different choice sets were designed and used in the questionnaire. Combined plans were alternated in the order in which they appeared as a choice set and the order of the individual plans were alternated first or second within the choice set. This was done to avoid any bias from the ordering of choices or test exhaustion of the respondent. The latter was not of major concern given only four choice sets were included in each survey.

Table 1 Attributes and attribute levels

Attribute	*Description*	*Levels*
Landscape Impact	The visual impact of a project is dependent on a combination of both the size and location.	None, Low Moderate, High
Wildlife Impact	Change in habitat can influence the amount and diversity of species living around a project.	Slight Improvement, No impact, Slight Harm
Air Pollution	Many types of renewable energy projects create no additional air pollution, but some projects do burn non-fossil fuels. These projects produce a very small amount of pollution when compared to electricity generated from coal or natural gas.	None, Slight increase
Jobs	All renewable energy projects will create new local long-term employment to operate and maintain the projects. Temporary employment increases during the construction phase are not being considered.	1-3, 8-12, 20-25
Price	Annual increase in household electric bill resulting from expansion of renewable energy projects. An average household pays £270 a year (£68 per quarter) for electricity	£0, £7, £16, £29, £45
Alternate specific constants		
ASC-A	Takes value of 1 for Plan A, 0 otherwise. Acts to represent variations that cannot be explained by the attributes or socio-economic variables.	
ASC-B	Takes value of 1 for Plan B, 0 otherwise. Acts to represent variations that cannot be explained by the attributes or socio-economic variables.	

Because of budgetary concerns, the design was selected to estimate principal effects only. No secondary cross-effects can be determined from the choice design being used. The sample size requirements grow too rapidly when cross-effects are to be studied.

The questionnaire and accompanying cover letter were than submitted to a small pre-test with regard to their clarity and usefulness of the information contained. Four academics at the University of Glasgow and five persons in the general public who work in the Glasgow area were asked to read the material, take the choice experiment as if they had received it in the mail, then critique the process. Feedback from this process lead to a revised and shortened version of the cover letter, clarification of some terminology and changes in how the socio-economic information was requested in the questionnaire. All persons expressed overall satisfaction in the questionnaire, information provided and understanding of the choice experiment and its objectives.

3.2 Sample selection

The sampling frame for this project was the Scottish general public. Our sample population was thus randomly selected from the list of registered voters in eight council districts of Scotland. The districts are Aberdeenshire, The Highlands and Islands, The Western Isles, Edinburgh, Glasgow, Stirling, The Borders, and Dumfries and Galloway. Approximately 250 names were from Glasgow and Edinburgh, 80 from Aberdeenshire, and 30-45 names from each of the other districts.

Some 547 names were selected and mailed survey packages with a cover letter during the first week of September 2003. As an incentive to participate a £20 prize draw was offered. Three weeks later a follow-up postcard was mailed to encourage the completion and return of the survey. By October, 219 households had returned surveys, a 43% response rate after undeliverables are considered. 211 surveys were received in time to be part of the sample set. 8 surveys were returned too late to be included. 287 households did not respond.

4 Data analysis

To model the information collected from the questionnaire, each choice set has three lines of code that combines the attribute levels, ASC's and socio-economic variables (Bennett and Blamey, 2001). The data matrix appeared in the form:

Figure 1 Example choice set

	option example *Plan A*	*Plan B*	*Neither*
LANDSCAPE visual impact caused by location and/or size	HIGH	NONE	No increase in renewable energy
WILDLIFE health of habitat	SLIGHT HARM	SLIGHT HARM	
AIR POLLUTION	NONE	NONE	Alternative climate change programs used
EMPLOYMENT new jobs in local community	8-12 JOBS	1-3 JOBS	
PRICE OF ELECTRICITY additional rates per year	£16 per year	£7 per year	North Sea gas fired power stations instead
YOUR CHOICE: (please tick one only)	A	B	I would not want either A or B

Alternative Plan A: $V_a = ASC_a + \beta_{attributes}X + \beta_{soci\text{-}econ}Y$

Alternative Plan B: $V_b = ASC_b + \beta_{attributes}X + \beta_{soci\text{-}econ}Y$

No Renewables Option: $V_n = \beta_{attributes}X + \beta_{soci\text{-}econ}Y$
(The neither/opt-out plan)

where V is the conditional indirect utility, $ASC_{a,b}$ are the alternative specific constants for each choice plan, $\beta_{attributes}$ is a vector of coefficients associated with the attributes X and levels, and $\beta_{socio\text{-}econ}$ is a vector of coefficients associated with the socio-economics descriptors Y of the respondents.

NLOGIT 3.0/LIMDEP 8.0 econometric software was used to estimate the MNL model. When using the effect coding method for data in MNL estimation, a situation similar to the dummy variable trap can be created. To avoid this problem, one level of each qualitative attribute (landscape, wildlife, air pollution) had to be omitted. The attributes levels chosen for exclusion were the ones hypothesised to have the most negative effect on environmental amenities. Therefore, the estimated coefficients for each of the remaining levels indicate the value respondents placed on the change from the lowest valued (omitted) level to the level of greater utility. The omitted levels were: High Landscape Impact, Slight Wildlife Harm, and Slight Increase in Air Pollution.

4.1 Descriptive statistics

Any mail survey has the risk of self-selection bias. Comparing the socio-economic information collected on the 211 respondents used in the choice experiment, against the statistical profile of the Scottish population is one test for such a bias: the null hypothesis that the experiment population is equal to the national population must be rejected for bias to be suspected. In our sample, respondent's income and location of residence are different from the national distribution at 10% level. Our sample is lower income than the national average and more rural. These two descriptors are indeed correlated

Table 2 Descriptive statistics of respondents

Variable					*Description (percentages unless otherwise noted)*
AGE	<25	25 – 40	41 – 54	55 – 65	65>
Sample	5	27	27	17	24
Scotland	10	23	20	20	27
INCOME		<£16,000	£16,000 - £36,000	£36,001>	
Sample	mean £22,412	33	34	20	(12% did not respond)
Scotland	mean £26,988				
LOCATION		Urban	Towns	Village/Countryside	
Sample		42	16	41	(2% did not respond)
Scotland		70	30		
EDUCATION ATTAINMENT		University	College	School	
Sample		30	23	44	
2% did not respond)					
CHILDREN (living at home or away)				Yes - 69	No - 29
(2% did not respond)					
EMPLOYED IN ENERGY SECTOR				Yes - 9	No – 89
(3% did not respond)					
MEMBERSHIP IN CONSERVATION GROUP				Yes - 8	No – 84
(8% did not respond)					

(Not all categories will sum to 100% do to rounding and/or omitted answers.)
All data on Scotland comes from the 2001-2002 Family Resources Survey, Scottish Executive.

as a result of a higher response rate was demonstrated by rural Scots to the survey (greater than 55%) and income in rural Scotland is lower than the country average.

4.2 Model estimation and results

Results for all 211 respondents from the MNL model are shown in Table 3. The "simple" model shows results when only the choice experiment attributes are included in the regression. All attribute coefficients have the expected signs. The signs of all but the price attribute are positive, as consumer preference theory predicts, as these attributes are coded to show an increase in environmental quality which should lead to increased utility. Price is negative and therefore also in accord with standard economic theory. All of the environmental attributes are significant determinants of utility at some level: changes in air pollution, landscape effects and wildlife effects. However, employment creation is not a significant attribute.

Many socio-economic variables were collected, estimated and then rejected for inclusion in the "expanded" model for failing to demonstrate statistical significance. The student t-test and log likelihood tests were used in this determination. The rejected descriptive variables were: does respondent have children, employment in the energy sector, membership in a conservation group,

Table 3 Multi-nomial model results

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Model Descriptor	Model: Expanded model w/ covariates Coefficient	Implicit Price(£) (95% confidence interval)	(std. error)	Simple Model: Attributes only Coefficient	Implicit Price(£) (95% confidence interval)	(std. error)
Moderate Landscape	0.29	5.58 (0.28 – 11.44)	(2.99)	0.20	4.07 (-1.79 – 9.93)	(2.99)
Low Landscape	0.15	2.82 (-4.16 – 9.79)	(3.56)	0.16	3.21 (-3.77 – 10.19)	(3.56)
None Landscape	0.42*	8.10* (4.30 – 11.90)	(1.94)	0.39*	7.88* (4.08 – 11.68)	(1.94)
None Wildlife	0.22**	4.24** (-0.03 – 8.51)	(2.18)	0.27*	5.51* (1.24 – 9.78)	(2.18)
Improved Wildlife	0.63*	11.98* (8.30 – 15.66)	(1.88)	0.50*	10.11* (6.43 – 13.79)	(1.88)
None Air pollution	0.74*	14.13* (10.45 – 17.81)	(1.88)	0.71*	14.40* (10.72 – 18.08)	(1.88)
Employment	0.02	0.32 (-0.11 – 0.66)	(0.22)	0.01	0.23 (-0.20 – 0.66)	(0.22)
Price	-.05*	(0.0065)		-0.05*	(0.0058)	
ASCA	2.80*			2.96*		
ASCB	2.73*			2.80*		
IncomeA	-0.01					
IncomeB2	-0.01					
Higher EducationA	0.99*					
Higher EducationB2	0.85*					
Under age 40-A	1.06**					
Under age 40-B	0.88***					
Log-likelihood	-434			-509		
No. of observations	739			836		
Psuedo-R^2	.31			.29		

*significant at 1% level **significant at 5% level ***significant at 10% level

amount of last electric bill, age by five categories, and education by 3 categories. The covariates used in the "expanded" model show either statistical significance or economic theory states they should have been significant. Education and age of respondent are the former, while income is the later case. See Table 4.
A likelihood ratio test determines that the two models, in MNL coefficient form, are different at the 1% level of statistical significance. But the implicit prices derived from the two models are not statistically different. Simple visual examination of this is confirmed by the large overlap of the confidence intervals (95% level) of implicit prices of both models. The adjusted McFadden Pseudo-R^2 is also improved with the addition of the covariates. Louviere (2000) states that a McFadden statistic, in the 0.20 to 0.30 range, is comparable to an ordinary least squares (OLS) adjusted-R^2 of 0.70 to 0.90 in range. The same five attributes are significant in both models. Therefore the expanded model with covariates is deemed the superior model, and implicit prices from this are used in the following discussion.

Implicit prices are interpreted as the willingness-to-pay an increase in electricity charges per annum per household, for a change in any of the attributes. They reveal the following:

Landscape Impact
Households are WTP £8.10 to decrease high impact landscape changes to having no landscape impact.

Wildlife Impact
WTP of £4.24 to change a slight increase in harm to wildlife from renewable projects to a level that has no harm. However, households would be WTP £11.98 per annum to change a slight increase in harm to wildlife from renewable projects to a level that wildlife is improved from the current level.

Air Pollution Impact
Households are WTP £14.13 to have renewable energy projects that have no increase in air pollution, compared to a programme which results in a slight increase in pollution.

One very interesting finding is that employment effects are not statistically significant determinants of choices or of utility: respondents did not seem to care about employment effects to a significant degree. Looking closer at landscape impacts, moderate and low landscape impacts were not statistically significant compared with a high impact. Respondents thus only seem WTP to reduce high landscape impacts, but not low or moderate impacts.

An internal validation question was asked in the questionnaire to test for consistency of these results. Respondents were asked to indicate which single attribute was most important to them. The ordering of the attributes by votes from respondents was: air pollution, wildlife, electricity price, landscape, and employment. This gives support to and shows consistency with the preferences results shown in Table 3. Also, there is inferred consistency of the indirect utility measurement of individuals as the implicit prices are in the same rank order. Consistency with preference theory is also demonstrated by the estimated willingness-to-pay increasing with increased improvement of the qualitative attributes (for instance, with regard to wildlife effects).

Table 4 Covariate socio-economic characteristics used in model

Characteristic	*Description*
Income	Gross household income. Mid-point value used from 16 categories of income level, ranging from, £10,000 to £80,000, by £5,000 brackets.
Education Attainment	1 if higher education attained (university or college), 0 otherwise
Age	1 if respondent 40 years of age or younger, 0 otherwise

One important factor that may determine one's attitudes to renewable energy projects is where one lives, in particular whether one lives in the countryside or not. A way of testing this in our survey is to examine whether there is a statistical difference between rural and urban estimated MNL coefficients and implicit prices. To do this, the sample was partitioned according to place of residence as disclosed on the questionnaire. The sample population was thus segregated into two groups, those located in villages or the countryside, and those who reside in towns and cities. Separate MNL models were then run for each group (Table 5). A log-likelihood ratio test rejected the null hypothesis that the segregated subsets were equal at the 5% level. Moderate landscape impacts now register as significant in the rural model, as do jobs. Jobs remain insignificant in the urban sample, but this is perhaps unsurprising given most peoples' likely expectations about *where* jobs would be created. Note that the McFadden Psuedo-R2 for the rural subset has increased to 0.34 from the 0.29 level of the complete sample set.

Another reason why attitudes towards renewable energy investments might vary across people is their income: either because environmental concern is a "luxury", or because rising energy prices hit poorer households disproportionately hard. To test this hypothesis, the sample was split by annual household income level into two sub-samples: low income (£16,000 or less per year), and higher income (greater than £16,000 per year). The log-likelihood ratio test failed to reject the null hypothesis that the two subsets were equivalent to the complete sample set: there are no significant differences in preferences therefore between these two income groups.

Table 5 Implicit prices of attributes comparing rural, urban and all respondents

	Model – Attributes Only (standard error and 95% confidence intervals)					
Descriptor		*Full Sample Set Implicit Price(£)*		*Rural Subset Implicit Price(£)*		*Urban Subset Implicit Price(£)*
Moderate Landscape	4.07	(2.99) (-1.79 – 9.93)	12.15**	(6.3) (-0.196 – 24.5)	0.50	(3.31) (-5.99 – 6.98)
Low Landscape	3.21	(3.56) (-3.77 – 10.19)	-5.68	(7.09) (-19.58 – 8.20)	7.15	(4.03) (-0.74 – 15.04)
None Landscape	7.88*	(1.94) (4.08 – 11.68)	5.32	(3.32) (-1.18 - -11.83)	8.73*	(2.41) (4.01 – 13.45)
None Wildlife	5.51*	(2.18) (1.24 – 9.78)	6.18	(3.71) (-1.08 – 13.45)	4.43	(2.69) (-0.83 – 9.70)
Improved Wildlife	10.11*	(1.88) (6.43 – 13.79)	15.23*	(3.16) (9.04 – 21.49)	7.62*	(2.42) (2.87 – 12.36)
None Air pollution	14.40*	(1.88) (10.72 – 18.08)	19.08*	(3.73) (11.77 – 26.39)	11.77*	(2.08) (7.70 – 15.85)
Employment	0.23	(0.22) (-0.20 – 0.66)	1.08*	(0.44) (0.20 – 1.95)	-0.19	(0.26) (-0.69 – 0.32)
Log-likelihood	-509		-200		-290	
No. of observations	836		349		475	
Psuedo-R^2	.29		0.34		0.27	

*significant at 1% level**significant at 5% level

5 Conclusions

This section is divided into two main sections. The first will be conclusions drawn from the results of the full model with covariates. The second will the conclusions drawn from the comparison of the rural and urban sub-samples.

We found a substantial sensitivity to the creation of projects that will have a *high* impact on landscapes. Local planning authorities and the Scottish Executive should give extra attention to the issuance of permits for these types of projects. Conversely, there seems to be no sensitivity, or at least no positive mean willingness-to-pay, to reduce landscape impacts if the projects are designed to have moderate or low levels of landscape effects.

Wildlife is highly valued by the public and avoiding impacts on wildlife comes out as being as important as avoiding impacts on landscape. The implicit price to maintain a neutral impact on wildlife is 75% of the price households would pay to reduce landscape impacts from high to none. Any project that creates the potential to harm wildlife thus needs to have large offsetting benefits. The question of wildlife impacts and renewable energy investments should be a priority of the Scottish Executive to answer. The converse of this is the growing of coppiced willow as biomass for use in energy production is expected to create greater bio-diversity on farmland. Our results show that such *increases* in wildlife attract a high economic value. We have not included benefits related to the carbon sequestration function of biomass growth, but this might be an important part of the overall case for promoting biomass generation.

Conversely, avoiding air pollution from renewable energy investments was highly valued by our respondents. This would add to the case *against* burning biomass for power.

Finally, investing in renewable energy might well result, at least over the short to medium term, in an increase in electricity prices. Our results show that, unsurprisingly, increases in prices reduce consumer utility, since the coefficient on price in all of our models is negative and significant. However, we do not find that income groups differ in their preferences towards renewable energy. However, this study did not have a sufficiently large sample to test for those households near the 'energy poverty' level. This is an issue for further research.

Turning to spatial issues, there are important differences between urban and rural responses in this choice experiment. There is some evidence that accepting negative environmental impacts from the development of projects (eg landscape impacts) is more acceptable to the rural population: the rural sample show no willingness-to-pay for reducing landscape impacts from high to none. Conversely, rural people value wildlife benefits and reductions in air pollution more highly than their urban cousins (the latter may be due to a perception that biomass combustion was more likely in rural areas, i.e. close to the supply of such material). Finally, we found that employment creation is a statistically and economically significant attribute to the rural sample, but not to the urban sample. Rural respondents would be willing to pay an additional £1.08 per year from each household for each additional full time job created by the renewable projects. Employment seems to be the only real benefit captured by the rural areas that are living in closest proximity to the environmental costs of renewable projects.

6 References

Ben-Akiva, M.E. and Lerman, S. (1985): *Discrete Choice analysis: theory and application travel demand*, Cambridge, Mass: MIT Press.

Bennett, J. and Blamey, R., ed. (2001): *The Choice Modelling Approach to Environmental Valuation*, Cheltenham, UK: Edward Elgar

BWEA British Wind Energy Association (2003) Available from :<http://www.bwea.com/index.html> [Accessed 1 December 2003]

Coastal Forum (2002) Available from :<http://216.239.59.104/search?q=cache:xW-70higSd8J:www.scotland.gov.uk/environment/coastalforum/powerpaper.pdf+cockenzie+planned+closure&hl=en&ie=UTF-8> [Accesses 1 December 2003]

Dewar, M. (2003) *Report for the University of Glasgow Renewable Energy Synopsis of Focus Group Responses*. New Lanark: Focus Ecosse. Private commissioned focus group research.

Energy White Paper “Our energy future – creating a low carbon economy”, February 2003.London, HMSO.

Friends of the Earth (2003) Available from :<http://www.foe-scotland.org.uk/press/pr20030803.html> [Access 1 December 2003]

Hassan, Gerald and Partners, Ltd. (2001) Scotland’s Renewables Resources 2001, Volumes 1 and 2. Research commissioned by Scottish Executive. Document No. 2850/GR/03

Hanley, N., S. Mourato and R. Wright (2001) ‘Choice Modelling Approaches: a superior alternative for environmental valuation?’, Journal of Economic Surveys, July, 2001,15,3,pp.435-462.

The Herald, 2/12/2003

Lancaster, K. (1966) ‘Anew Approach to Consumer Theory’, *Journal of Political Economy*, 74, 132-157.

Louviere, J.J., D. Hensher and J. Swait (2000): *Stated Choice Methods: Analysis and Application*, Cambridge: University Press.

Manski, C. (1977) ‘The Structure of Random Utility Models’, *Theory and Decision*, 8, 229-254.

McFadden, D. (1974) ‘Conditional Logit Analysis of Qualitative Choice Behaviour’, in P. Zarembka (ed.) *Frontiers in Econometrics*, New York: Academic Press.

NIANuclear Industry Association (2003) Available from: <http://www.niauk.org/article_33.shtml> [Accessed 1 December 2003]

OXERA (2002) *A Report to the DTI and the DTLR: Regional Renewable Energy Assessments.* Oxera Environmental, Oxford, UK.

ROS *The Renewables Obligation (Scotland) Order 2002. Scottish Statutory Instrument 2002 No. 163*. Edinburgh, HMSO.

Finnie, R. (2003) Scottish Executive News Release:SEEN408/2003/25/03/2003. Available from: http://www.scotland.gov.uk/pages/news/2003/03/SEEN408.aspx

Scottish Executive (2002a) *Key Scottish Environmental Statistics, 2002.* A Scottish Executive National Statistics Publication, Edinburgh.

Scottish Executive (2002b) *Securing a Renewable Future: Scotland’s Renewable Energy*
HMSO, Edinburgh.

What is scotecon.net?

scotecon is the Scottish Economic Policy Network. It is a network of economists based in Scotland's universities which aims to stimulate academic research on the Scottish economy, particularly in those areas of interest and concern to the Scottish Parliament.

The network concentrates on increasing the quality and quantity of evidence-based research to inform policy and debate in areas such as education, enterprise, the environment, exclusion, health, rural affairs, training and transport.

The Universities of Stirling and Strathclyde are the physical location of **scotecon**; however, it has a strong virtual presence through our web-site www.scotecon.net which is being developed as a major focus for intelligence on the Scottish economy.

The Scottish Higher Education Funding Council (SHEFC) funds the network under its Research Development Grant Scheme.

The co-directors are Professor Brian Ashcroft of the University of Strathclyde (brian.ashcroft@scotecon.net) and Professor David Bell of the University of Stirling (david.bell@scotecon.net).

Contact details

info@scotecon.net
brian.ashcroft@scotecon.net
david.bell@scotecon.net

scotecon
University of Stirling
Stirling
FK9 4LA
T 01786 467484

scotecon
University of Strathclyde
Glasgow
G4 0LN
T 0141 548 3968

Appendices

Nick Hanley
Professor of Environmental Economics

Dear

The University of Glasgow is conducting research on renewable energy development in Scotland. Your household has been selected to participate in a survey that seeks people's opinions on the impacts that may result from new renewable energy projects. This research is being funded by the Scottish Economics Policy Network with a goal of promoting academic research on issues that are of special interest to the Scottish Parliament. This chance for your opinion to be heard as the this research will be published and made available to the public, conservation groups, government, industry, and anyone concerned for Scotland's future.

The Scottish Executive has committed itself to expanding the use of renewable energy resources, the primary reasons being environmental (concerns about climate change) and economic (creating new jobs and exports opportunities). The type of renewable energy projects we are talking about are more than just wind farms (on-shore and off-shore), but also include hydroelectric schemes, power plants that burn wood, farm waste and household refuse, solar panels on houses, facilities that extract natural gas from land fills, and shoreline power plants that use wave and tidal energy.

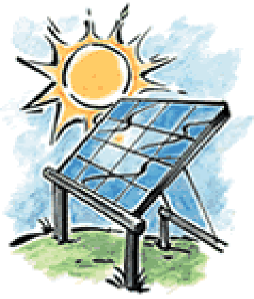
Your household is one of 500 thought-out Scotland, chose randomly from the electoral registrar. By completing and returning this survey you have the chance to voice your opinion about the future of renewable energy7 development in Scotland. You may be assured of complete anonymity and confidentiality of all information given to us, none of which will be passed on to anyone else.

As a sign of appreciation, 1 out of every 100 surveys that are returned will be randomly chosen to receive a £20 prize; replies must be received by 30 September 2003. If you have any questions about this survey please contact my self, or Ariel Bergmann (Ph.D. research student) at 0141 330 3385, email: scotlandresearch@yahoo.co.uk. Thank you for your help.

Yours sincerely,

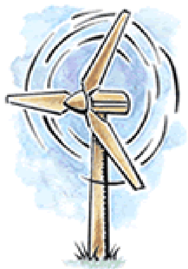
Professor Nick Hanley

DEPARTMENT OF ECONOMCS
Adam Smith Building, Glasgow G12 8RT
Telephone: 0141-330 4671 *or* 1041-330 4618
Fax: 0141-330 4940 *Email*: N.D.Hanley@socsci.gla.ac.uk



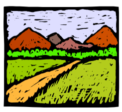
UNIVERSITY OF GLASGOW
DEPARTMENT OF ECONOMICS

IMPACTS FROM RENEWABLE ENERGY DEVELOPMEMT IN SCOTLAND



A SURVEY OF PEOPLE'S VIEWS

AUTUMN 2003



£

The Scottish Executive and the U.K. Government have committed themselves to an expansion of renewable energy development during the next decade. Examples of renewable energy are hydroelectric schemes, windmills (on-shore and offshore), and solar panels for heat or electricity, tidal and wave power, and burning forest and agricultural waste.

This commitment to increase the use of renewable energy sources is partly due to concerns over global warming (climate change). The U.K. has agreed to many European Community and International treaties that mean we have to reduce the amount of green house gasses (climate change gases) produced by the use of fossil fuels (coal, oil and gas) for electric power generation. Investing in renewable energy also offers the prospect of future jobs in Scotland, as a major growth sector.

This survey aims to find out what people would prefer to happen in Scotland from all the new renewable energy construction and development that will occur during the next 10 to 15 years.

1 in every 100 surveys returned will be randomly selected to receive a £20 prize. If you would like to be included, please give us your name and address.

Name________________________
Address ______________________________________

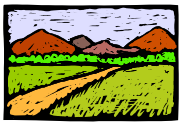
If you would like to receive a copy of our results once they are ready, please tick this box ☐

This survey looks at five different kinds of <u>impacts</u> that renewable energy projects might have. These are:

* Landscape
* Wildlife
* Air Pollution
* Employment
* Price of electricity

All the different kinds of renewable energy (wind farms, hydro power stations, etc.) have some or all of these kinds of impacts and it's these impacts that our survey focuses on.

WHAT ARE THESE IMPACTS?



<u>Landscape</u> – How large a project is can influence how much visual impact results, but the location of the project is also very important. For example, a wind farm could have 3 or 30 windmills and the wind farm could be located in an industrial estate or in a national park. Size and location also matter for new hydroelectric schemes.

<u>Wildlife</u> – The effect on wildlife from renewable energy development can range from harming wildlife a little to actually helping it a little, but in many cases there will be no effect. For example, hydroelectric dams can prevent salmon from swimming up rivers. Farmland that is used to grow energy crops allows for healthier wildlife. However, the government would not allow projects that had large negative effects on wildlife.

Air Pollution – Many types of renewable energy projects create no air pollution at all. Some projects do create a low level of air pollution, for example, burning household rubbish at a power station, but this is a very small amount compared to when electricity is being generated from burning coal or natural gas.

Employment – All renewable energy projects will create new long-term employment in local communities. Renewable energy projects require operational and maintenance workers that tend to be skilled or technically trained. These jobs pay above average wages. People will also be employed during construction, but these are not long-term jobs in the local community.

£

The price of electricity– A large expansion of renewable energy in Scotland may cause an increase in electricity prices. An average household currently pays about £270 a year for electricity (which is about £68 a quarter). However, this would probably go up if Scotland goes ahead with using more and more renewable energy rather than traditional energy from oil, gas, and coal.

In the next part of this questionnaire, we are going to ask you to choose between two possible renewable energy projects that maybe built in Scotland. Each plan is described in terms of its impacts; that is, in terms of what it would mean for landscape, wildlife, air pollution, jobs and electricity prices. Here is an example:

option example

		Plan A	Plan B	Neither
	LANDSCAPE visual impact caused by location and/or size	HIGH	NONE	No increase in renewable energy
	WILDLIFE health of habitat	SLIGHT HARM	SLIGHT HARM	Alternative climate change programs used
	AIR POLLUTION	NONE	NONE	
 jobs	EMPLOYMENT new jobs in local community	8-12 JOBS	1-3 JOBS	North Sea gas fired power stations instead
£	PRICE OF ELECTRICITY additional rates per year	£16 per year	£7 per year	
	YOUR CHOICE: (please tick one only)	A ☐	B ☐	**I would not want either A or B** ☐

You will see that each plan has different combinations of impacts. In this example you can see that Plan A has high visual impact, 8-12 new jobs created and an increase in electricity bills of £16 per year, while Plan B has no visual impact, 1-3 new jobs created, and an increase of £7 per year for electricity. But the impacts on air pollution and wildlife are the same in both Plan A and Plan B.

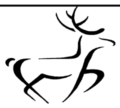
"Neither" means that we do not go ahead with renewable energy at all - we just keep on using fossil fuels like North Sea gas. However choosing this option would mean missing out on all of the benefits of renewable energy. Also, the government would have to pursue other means of reducing the use of fossil fuels, for example, increased petrol taxes and forcing businesses to invest in energy efficiency measures, costs that may be passed on to consumers.

In each of the options that follow, we just ask you which plan you would prefer to go ahead. There are no wrong or right answers; we are simply interested in your opinion. So, please go through each of the 4 options, and for each one tick either "Plan A", "Plan B" or "Neither". Make sure you only tick one box for each option!

Option 1

		Plan A	Plan B	Neither
	Landscape Visual impact caused by Location and/or size	LOW	MODERATE	*No increase in renewable energy * Alternative climate change programs used *North Sea gas fired power instead
	Wildlife Health of habitat	NONE	NONE	
	Air pollution	SLIGHT INCREASE	NONE	
 jobs	Employment New jobs in local Community	8-12 JOBS	20-25 JOBS	
£	Price of electricity Additional rates per year	£29	£7	
	Your Choice: (please tick one only)	A ☐	B ☐	I would not want either A or B ☐

Option 2

		Plan A	Plan B	Neither
	Landscape Visual impact caused by Location and/or size	MODERATE	HIGH	*No increase in renewable energy * Alternative climate change programs used *North Sea gas fired power instead
	Wildlife Health of habitat	SLIGHT IMPROVEMENT	NONE	
	Air pollution	NONE	SLIGHT INCREASE	
 jobs	Employment New jobs in local Community	1-3 JOBS	1-3 JOBS	
£	Price of electricity Additional rates per year	£16	£45	
	Your Choice: (please tick one only)	A ☐	B ☐	I would not want either A or B ☐

Option 3

		Plan A	Plan B	Neither
	Landscape Visual impact caused by Location and/or size	NONE	NONE	*No increase in renewable energy
	Wildlife Health of habitat	SLIGHT HARM	SLIGHT IMPROVEMNT	* Alternative climate change programs used
	Air pollution	SLIGHT INCREASE	NONE	
 jobs	Employment New jobs in local Community	20-25 JOBS	8-12 JOBS	*North Sea gas fired power instead
£	Price of electricity Additional rates per year	£0	£45	
	Your Choice: (please tick one only)	A ☐	B ☐	I would not want either A or B ☐

Option 4

		Plan A	Plan B	Neither
	Landscape Visual impact caused by Location and/or size	MODERATE	HIGH	*No increase in renewable energy
	Wildlife Health of habitat	NONE	SLIGHT HARM	* Alternative climate change programs used
	Air pollution	SLIGHT INCREASE	NONE	
 jobs	Employment New jobs in local Community	8-12 JOBS	8-12 JOBS	*North Sea gas fired power instead
£	Price of electricity Additional rates per year	£29	£16	
	Your Choice: (please tick one only)	A ☐	B ☐	I would not want either A or B ☐

Overall which of these impacts is most important to you? (Please tick only one)

Landscape _____ Wildlife _____ Air Pollution _____

Employment _____ Price of electricity _____

Finally, we would like to ask you some questions about yourself. This will help in understanding your choices and help us to make sure that our survey is representative of the Scottish people. Remember that all information you give will be kept confidential and anonymous.

About yourself:

Do you live in: a city ____ a small town ____ a village/the country ____

Do you have any children? Yes No

Do you work in the energy sector? Yes No

Roughly how much was your last electric bill? _________

Are you a member of a conservation group? Yes No

What is you gross (i.e., before tax) household income?

< £10,000	___	£46,000-£50,999	___
£10,000-£15,999	___	£51,000-£55,999	___
£16,000-£20,999	___	£56,000-£60,999	___
£21,000-£25,999	___	£61,000-£65,999	___
£26,000-£30,999	___	£66,000-£70,999	___
£31,000-£35,999	___	£71,000-£75,999	___
£36,000-£40,999	___	£76,000-£79,999	___
£41,000-£45,999	___	£80,000+	___

How old are you?
younger than 25 ___ 25-40 ___ 41-54 ___ 55-65___ older than 65 ___

Which of the following best describes your level of education?
school only ____ college ____ university ____

We would be interested to have any additional comments you may have on this issue of renewable energy development in Scotland

Thanks for your time – now please post your reply back to us using the envelope provided.

Appendix: Selected quotes from written comments from respondents

'Visual impact not considered a drawback except in reasonably highly populated areas. Windmills in the hills can quite attractive and after initial disturbance would not affect wildlife.' 65+ age, Ardersier

'I think the plan to build wind farms out at sea is a good idea and would like to see progress made in the next few years.' 41-54 age, Alford

'I think the sea and wind should be used more in the future. We have plenty of moors where wind farms could be set up.' 55-65 age, Stonehaven

'Renewable energy projects must relate closely with landscape which, in turn, affects tourism which is a very large industry in Scotland' 65+ age,

'We also need to look at ways of saving energy.' 41-54 age, Wester Ross

'Why can government not grow crops for biofuel? It would help our great agriculture and reduce air pollution. I am all for wind and sea procured energy.' 55-65 age, Aberdeenshire

'I would like to see the use of more recycling, eg., tyres, glass, ect.' 41-54 age, Gavinton Duns

'I think that any project which increases employment in local communities is of great importance in Scotland which has suffered from the impacts of unemployment for some time. Preserving the beautiful landscape and wildlife is also ????? as well as trying to keep costs as low as possible' 25-40 age, Glasgow

'Thank you, most of the public are concerned about many of these issues' 55-65 age, Stonehaven

'Anything that cleans up the environment, causes new jobs, and helps repair the ozone' 65+ age

'I would hate to see the obvious benefits of wind and wave schemes lost because of the "not in my backyard" and the tunnel visioned conservation bodies, who always seem to think that just because we are now a national park that it is their personal and private playground.' 25-40 age, Aveimore

‘All fossil fuel power stations and nuclear power should be decommissioned to be secondary providers to the renewable energy projects. No matter the slight detrimental effects, renewables should eventually phase out fossil fuel.’ 25-40 age,

‘It’s always going to be a tough choice to balance the visual effects with all the other factors, and it will be impossible to keep everyone happy.’ 25-40 age, Stirling

‘I would like to see more emphasis placed on growing crops for fuel.’ 41-54 age, Aboyne

‘….On balance my preference would be a mix of large-scale offshore renewables, small-scale terrestrial developments and gas imports from the continent—no nuclear!’ 25-40 age Arbuthnott

‘I am not in favour of any increase in air pollution, but if a small amount is created by burning household rubbish it is maybe better than dumping so much in landfill sites.’ 25-40 age, Duns

‘As I work in the open cast coal industry it would have been easy to tick the no change boxes, but I am aware better and cleaner sources of energy must become available.’ 55-65 age

‘Against nuclear energy.’ 55-65 age Stornoway

‘I am happy to pay more for electricity (within reason) if the new methods of production or energy would have less impact to the environment, so that mankind and wildlife alike can benefits from a cleaner world.’ 41-54 age, Berwick-upon-Tweed

‘Develop more hydro-electric schemes.’ 65+ age, Laurencekirk

‘I do not think windfarms have a negative impact visually.’ 41-54 age, Dumfries