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The awareness and willingness of air travellers to pay for voluntary carbon offsets and their co-benefits

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Abstract

Several airlines in Australia have initiated voluntary carbon offset (VCO) programs, called 'Fly Carbon Neutral', to encourage their customers to offset the carbon emissions of their flight. A VCO scheme aims to 'neutralise' emissions from a particular activity, by compensating with carbon reduction projects in another sector. As well as carbon sequestration, these activities often bring secondary benefits such as wildlife protection. There are currently few studies about the awareness and willingness to pay to offset carbon emission from flying. This paper conducted a choice experiment study to address this knowledge gap, by estimating Australian air travellers' willingness to pay for different attributes of carbon offset projects. Analyses reveal that values for carbon offset projects depend on respondent's perceptions of the importance of the aviation industry's contribution to the global carbon emissions, membership of environmental organisation, education level, income and their age. Results show that the majority of respondents preferred to not buy an offset. Of those respondents willing to buy an offset, most preferred renewable energy projects located in their own state over reforestation or forest protection projects in other states or overseas. The results will provide a better understanding of air travellers' preference, thus to improve future carbon offset policies making.

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1. Introduction

Aviation is a sector that is increasingly contributing to climate change due to the rapid growth of the industry with considerable additional aircraft capacity and lower airfares in the last two decades (Mair 2011). Aviation's share of greenhouse gas (GHG) emissions is growing the fastest among all emission sources (Economist 2006). In response to the increasing GHG emissions from the aviation industry, various measures are currently under discussion to reduce GHG emissions from the aviation industry, including government implemented market-based measures (e.g. emission trading schemes, emission taxes, fuel taxes or value-added taxes), technological change (improved fuel efficiency or switching to alternative fuels) and structural change (change of public transport form, change of flight altitudes and flight corridors, air travel management) (Gössling *et al.* 2007). Voluntary carbon offset (VCO) schemes are another measure that is increasingly being considered (Gössling *et al.* 2007). The fundamental aim of VCO schemes is to 'neutralise' emissions from a particular activity, by compensating with mitigation projects in another sector (Blasch and Farsi 2012). Although a VCO project primarily targets carbon mitigation, it can bring additional socio-economic and environmental co-benefits. These are known as secondary benefits that go beyond the GHG reduction benefits of the offset project (Kollmuss *et al.* 2008)

In Australia, there are several VCO programs introduced by the government such as the Carbon Farming Initiative (CFI) and the National Carbon Offset Standard (NCOS) Carbon Neutral Program (Department of Climate Change and Energy Efficiency 2012). The CFI scheme is

specific to the farming sector. The NCOS Carbon Neutral Program was introduced in 2010 to meet Australia's emissions reduction targets while providing guidelines to businesses and individuals in any sector to take actions to reduce carbon pollution (Department of Climate Change and Energy Efficiency 2012). In the context of the aviation sector, airlines such as Qantas, Jetstar and Virgin Australia are already offering VCOs to their customers, accredited by the NCOS Carbon Neutral Program. Airlines will use the accumulated customer contributions to purchase offset units (one carbon offset is equal to one tonne of greenhouse gas emissions) provided by an accredited provider and invest in particular offset projects to compensate their GHGs emission (Virgin Australia 2010; Qantas Airways Limited 2011).

There is currently limited information about what customers would be willing to pay to offset carbon emission from flying. Airlines only offer a 'take it or leave it' carbon offset when travellers book a flight, which provides limited information about the demand function for VCOs because the price is constant per CO₂-equivalent that is offset. Furthermore, there exists no information about Australian travellers' willingness to pay (WTP) for potential secondary benefits of carbon offsets. This study aims to fill the above knowledge gaps, by investigating the WTP of air travellers for VCOs in Australia. The estimation of WTP can provide information to assess whether airlines are charging the 'right' price for their offsets. Estimating the WTP gives a better understanding on how people value the projects that are offered by Airlines. There is also a need to examine if secondary benefits of carbon offsets affect the WTP, and whether airlines should thus promote those co-benefits when offering their offset options. Studying the WTP will help to target those packages of offset projects that people prefer most.

Much research to assess air travellers' preferences towards VCOs in aviation has been done in Europe and North America. Studies have shown that travellers' WTP is influenced by their

level of knowledge and awareness of the impacts of flying (Brouwer *et al.* 2008). A previous study has found that, in Canada, there was relatively low overall awareness of the concept of carbon offsetting amongst both travel agents and travellers, mainly due to insufficient information in the context of carbon offsets (Dodds *et al.* 2008). In a recent study, Blasch and Farsi (2012) conducted a choice experiment in Switzerland to analyse individual demand for VCOs in different contexts in the retail sector. This research revealed that the intention to offset seems strongly dependent on the types of mitigation projects, with projects undertaken in developing countries being more preferred. Furthermore, a study assessing the impact of co-benefits on air passengers' WTP for carbon offsets showed that the type of co-benefits played an significant role in regard to respondents' WTP for carbon offsets (MacKerron *et al.* 2009). It is not known how much Australian air travellers are willing to pay for VCOs and their co-benefits. This paper aims to address this knowledge gap by investigating the awareness and willingness of air travellers to pay for VCOs in Australia, as well as the trade-off between co-benefits and air travellers' WTP for carbon offsetting.

This study addresses this issue at a national scale, through conducting a choice experiment survey in several Australian States. The outcome of this survey will provide a better understanding of air travellers' preference for carbon offset schemes and their co-benefits. The results of this study can be used to develop VCO projects that are most valuable for air travellers. The paper proceeds as follows: Section two describes non-market valuation and the technical framework of the choice experiment, Section three provides details of the survey development and choice set design, and Section four describes the results, which are discussed in concluding Section five.

2. Theoretical framework

2.1 Non-market valuation

Many impacts of environmental issues are not directly observable through changes in market behaviour, which means that researchers cannot readily use market prices to infer values of environmental impacts. In such cases, economists use non-market valuation methods to determine the social value of such issues (Haab and McConnell 2002). There are two types of non-market valuation techniques; revealed preference and stated preference approaches. Revealed preference approaches infer the value of a non-market good by studying actual behaviour in a closely related market. Examples of revealed preference techniques are the hedonic pricing method and the travel cost method (Alpizar *et al.* 2001). Revealed preference approaches have the advantage of using actual choices made by individuals. However, valuation using revealed preference approaches is conditional on observing actual changes in the levels of a non-market good or service to which consumers react. Hypothetical future changes cannot be determined using revealed preferences. It is also not possible to measure *non-use* values such as the existence value, altruistic value and bequest value (Alpizar *et al.*, 2001). Because of this, there has been an increased interest in the use of stated preference approaches during the last two decades (Bateman *et al.* 2002).

Researchers can employ stated preference surveys to elicit values for environmental goods or services that are not directly traded in markets. Such survey-based stated preference techniques allow researchers to estimate the economic values that individuals place on a good presented in a hypothetical scenario (Hanley and Barbier 2009). There are two dominant stated preference techniques: contingent valuation and choice experiments. In a contingent valuation (CV) study, respondents are asked for their willingness to pay (WTP) for a one-off defined change in a non-market good or service. CV thus allows researchers to estimate the economic value

associated with that one hypothetical change (Bateman *et al.* 2002). In a choice experiment (CE), on the other hand, it is assumed that a good can be described in terms of multiple characteristics or a set of attributes. A CE survey presents respondents with choices between two or more alternatives (a baseline alternative, or *status quo*, is usually included), that each describes different hypothetical scenarios. Each alternative describes the good or service in terms of a combination of different attribute levels (Figure 1). Respondents are asked to choose their preferred option in each choice set. Researchers can then analyse the trade-offs respondents made between attribute levels, and so infer what attributes are significant determinants of the good (Hanley *et al.* 1998). A CE can give welfare-consistent estimates when including monetary cost as an attribute. This forces respondents to trade-off changes in environmental attribute levels against the costs of making these changes (Bateman *et al.* 2002). Researchers can use those trade-offs to estimate respondents willingness-to-pay (WTP) for changes in environmental attributes.

Please indicate your preferred option: A, B or no offsetting.

	Offset project A	Offset project B	No offsetting
Carbon offset	Yes	Yes	No
Additional benefit	Human development	Conservation & biodiversity	N/A
Certification	None	UK Government certified	
Price	£8	£8	0
Your choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 1. Example alternatives with different combination of attribute levels (MacKerron *et al.* 2009)

There are several advantages of CEs over other stated preference approaches. CEs are cost efficient, since this method allows multiple attributes to be assessed simultaneously (Hanley *et al.* 2001). Also, CEs address the implicit values for each attribute, and can obtain marginal rates of substitution between non-monetary attributes (Alpizar *et al.* 2001). It has also been

claimed that CEs may overcome framing bias, as respondents are explicitly confronted with the multiple attributes affected by their decision (Bennett and Blamey 2001).

This study aims to investigate how people value the different attributes of carbon offset projects in relation to one another. Choice experiments are a suitable method to use in this case, as it allows researchers to simultaneously determine respondents' values towards the characteristics of offsets (e.g. amount of carbon reduction and co-benefits).

2.2 Theoretical framework of choice experiments

Choice experiments are based on two economic theories: the characteristics theory of value (Lancaster 1966) and the random utility theory (Manski 1977). The characteristic theory of value states that goods can be described as a bundle of characteristics, which are the characteristic valued by consumers. Random utility theory states that choices can be used to derive demand curves (Bateman *et al.* 2002). Respondents select the option with attribute levels that provides the highest utility to them. Utility (U) derived from any option is assumed to depend on the levels of the attributes. As not all relevant characteristics of utility can be observed by the researcher, the utility function will always include an error term (Bateman *et al.* 2002). For respondent n , utility from choosing option j is measured as an observable term V_{nj} and an error term, also referred to as a random unobservable term ε_{nj} (equation 1).

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (1)$$

The random component ε_{nj} in the utility function cannot be predicted with certainty. Rather, the analysis becomes one of probabilistic choice.

The probability that respondent n will choose option a over the other options x is given by:

$$P(a) = P[(V_{na} + \varepsilon_{na}) > (V_{nx} + \varepsilon_{nx})] = P[(V_{na} - V_{nx}) > (\varepsilon_{na} - \varepsilon_{nx})] \quad (2)$$

Equation 2 gives rise to the conditional logit model (Bateman *et al.* 2002). The conditional logit model assumes that the random components are independently and identically distributed with an extreme value type 1 distribution (Alpizar *et al.* 2001). In the conditional logit model, the probability of respondent n choosing a from a set with J alternatives is given by:

$$P_{a|nj} = \frac{\exp(\mu V_{na})}{\sum_{j=1}^J \exp(\mu V_{nj})} \quad (3)$$

In equation (3), μ is a scale parameter, which is inversely proportional to the standard deviation of the error distribution.

Typically, a cost attribute is used in CEs to allow researchers to estimate the willingness to pay (WTP). Once the parameter estimates have been obtained, respondents' implicit price or WTP for a change in the level of any of the non-monetary attributes can be found by dividing the coefficient of that attribute α by the coefficient of cost (β_{cost}):

$$WTP_{\alpha} = \frac{-\alpha}{\beta_{cost}} \quad (4)$$

The size of the scale parameter is irrelevant when calculating the WTP for a certain attribute because it cancels out of equation (4) (Alpizar *et al.* 2001; Bateman *et al.* 2002). This study uses the above equations to measure respondent's WTP for each of the attributes included, and to measure the trade-offs made between different attributes of carbon offsetting.

3. Methodology and Methods

3.1 Attribute and level selection

Survey development was based on literature review and focus group interviews. An extensive literature review found a range of feasible attributes and co-benefits to be included into this study (Table 1) (Jindal *et al.*, 2008; MacKerron *et al.* 2009; Blasch and Farsi 2012). These possible attributes and co-benefits were refined through focus group interviews for the choice experiment survey. The literature review also showed how other researchers had measured and presented the attribute levels in choice experiment (CE) survey. For instance, MacKerron *et al.* (2009) defined co-benefits of carbon offsets into three broad descriptive levels: (1) human development; (2) conservation and biodiversity; and (3) technology and market development. Bennett and Blamey (2001) note that quantitative levels may be preferred over descriptive levels, because qualitative descriptions may be ambiguous to respondents. Respondents then make their choices based on their *assumed* meaning of the levels, instead of on a more explicit numeric level. Attributes presented in quantitative levels also enables estimating a continuous utility function, which allows researchers to estimate the welfare of attribute levels other than the specific discrete levels valued in the survey (Figuerola and Font 2009). Initially, this study aimed to use quantitative attributes levels in the choice sets. However, the focus group interviews revealed that it was more appropriate, and more understandable to respondents, to present the attributes for this study in qualitative terms (except for cost).

Table 1. Possible attributes collected from literature review

Possible attributes
Costs of the offset
Amount of carbon/greenhouse gas reduction (mitigation)
Creating local jobs
Protecting native wildlife
Protecting existing native forests
Location of the offset project (in Australia or overseas)
Reforestation through plantation forests
Reforestation by planting native shrubs and trees

(source: Jindal *et al.* 2008; MacKerron *et al.* 2009; Blasch and Farsi 2012)

Focus group interviews were undertaken between the 20th and 25th of July. These interviews were aimed to assess the public's knowledge about carbon offset, which supported the development of the final online survey. Interviews were conducted at Subiaco Square, Dog Swamp Shopping Mall, the UWA Science Library and the UWA Recreational centre. Researcher spent a total of 13 hours interviewing focus group respondents and collected 30 responses. The focus group interviews aimed to further select the attributes for the choice experiment. Respondents were asked an open-ended question about what attributes they related with carbon offsets (Table 2).

Table 2. Additional attributes suggested by focus group respondents (n=number of respondents who mentioned the attributes)

Attributes suggested by respondents (in categories)	n
Time/Duration	6
Cost	4
Environment/pollution	4
Feasibility/effectiveness	4
Air quality/lower emissions	3
Investing in clean technology/renewable energy	4
Developed/developing countries	1
Community	2

The interviews revealed a need to reassure respondents that the offset projects are feasibly and will sequestrate carbon for a long period of time. As such, the final survey included a statement specifying that, "*for all of the offset projects, carbon would be stored and would not be released into the atmosphere for a period of at least 100 years*". The interviews also measured people's willingness to pay (WTP) for offsetting carbon emissions in an open-ended question, to inform the levels of the cost attribute in the final choice experiment survey.

Of the possible attributes identified through the literature review and focus group interviews, wildlife protection was selected to capture an additional biodiversity benefit on top of emission reduction benefits. Three types of project and locations were selected for the final CE survey: forest protection, reforestation and renewable energy; own state, another state and overseas (Table 3).

Table 3. Attributes and levels presented in the survey

Attribute	Description	Levels
Type of project	Greenhouse gas emissions can be reduced by different types of project. Airlines can choose to invest in different project offered by accredited offset project providers.	<ul style="list-style-type: none"> ● Renewable energy ● Forest protection ● Reforestation
Protecting native wildlife	Some forest protection or reforestation projects can also benefit native wildlife by protecting their habitat.	<ul style="list-style-type: none"> ● Yes ● No
Project location	Offset projects can be undertaken at different locations.	<ul style="list-style-type: none"> ● Own state (Australia) ● Another state (Australia) ● Overseas
Costs	The offset cost is the amount that you need to pay, on top of your ticket price, to offset your share of the greenhouse gas emissions. This money will be invested in carbon offset projects.	<ul style="list-style-type: none"> ● \$10 ● \$25 ● \$50 ● \$75 ● \$100

3.2 Survey design and implementation

The survey contains four parts: the first part elicited information about respondent's flying behaviour. It also collected respondents' opinion about climate change and whether they thought the contribution of the aviation industry to global GHG emissions was important or not. The second part described the concept of voluntary carbon offsets, and the process of offsetting to respondents. Respondent's awareness of carbon offsets was also assessed in this part. In the third part, the attributes for choice sets were described, followed by an explanation of the choice questions. The hypothetical scenario that was presented to respondents described that they would fly from their nearest capital city to London, their ticket price, and the amount of emissions that a carbon offset would compensate for. The last part included socio-demographic questions. The complete survey is provided in Appendix 1.

The CE survey was created using the Ngene software package (ChoiceMetrics Pty Ltd 2014). The complete design consisted of 18 choice questions, which were blocked into three treatment blocks. Each respondent was randomly allocated to one of these blocks and presented with six choice questions. The first three alternatives in each choice question described different possible carbon offset projects. A fourth alternative was added to each choice set as a 'status quo' alternative, which was “no carbon offset” at zero cost (Figure 2). The survey was distributed to participants nationwide via an online panel of market research company ResearchNow in September 2014. The distribution of the survey across different States was proportional to the national population distribution in Australia (ABS 2013).

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 3,000 kg CO₂-equivalent emissions.

Please choose your one most preferred option.

You can hover your mouse over each characteristic to see the descriptions again.

Characteristics	Option A	Option B	Option C	
Type of project	Forest Protection	Forest Protection	Reforestation	I would choose not to buy the offset
Wildlife protection	Yes	No	Yes	
Project location	Another State	Overseas	Your State	
Offset costs	\$50	\$50	\$50	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Figure 2. Example choice question included in the survey

4. Results

4.1 Sample characteristics

The online survey was completed by 527 respondents. The socio-demographic characteristics of the survey sample are shown in Table 4. Respondents were first asked about their flying behaviour. 85% of respondents had taken one to five flights per year in the past five years. Table 5 reports additional attitudinal variables. Respondents were asked about their opinions regarding climate change and the contribution of the aviation industry to global carbon emission. 55% of respondents believed that climate change is happening and that it is largely caused by humans, 36% thought that climate change is happening only as a natural variation in the Earth's temperatures, while 4% of respondents were unsure whether climate change is occurring or not. Twenty-seven (5%) respondents did not believe climate change is happening. For the aviation industry's contribution to global carbon emissions, 10% believed that the contribution of the aviation industry is very important, and 32% ranked that the contribution is important. Twenty-six (5%) respondents found that the contribution of the aviation industry was not important at all (Table 5).

Table 4. Socio-demographic characteristics of respondents (n=527 respondents)

Variable name	Description	Response (%)	
Gender	Male	49	
	Female	51	
Age	18-24 years	12	
	25-34 years	18	
	35-44 years	19	
	45-54 years	18	
	55-64 years	15	
	65-74 years	15	
	75-84 years	2	
Personal gross annual income	85 years and over	0	
	Nil income	2	
	\$1 - \$10,399	4	
	\$10,400 - \$15,599	4	
	\$15,600 - \$20,799	5	
	\$20,800 - \$31,199	5	
	\$31,200 - \$41,599	8	
	\$41,600 - \$51,999	10	
	\$52,000 - \$64,999	9	
	\$65,000 - \$77,999	9	
\$78,000 - \$103,999	15		
Highest education completed	\$104,000 - \$179,999	9	
	\$180,000 - \$249,999	2	
	\$250,000 or more	2	
	I would rather not say	15	
	Schooling up to Year 12	19	
	Trade or technical certificate	23	
	University degree (Undergraduate)	36	
	University degree (Postgraduate)	22	
	Member of an environmental/ conservation organisation	Yes	6
		No	94
Flight taken on average per year in the past 5 years	1 to 5 per year	85	
	6 to 10 per year	10	
	11 to 15 per year	3	
	More than 15 per year	1	

Table 5. Survey question asks about the belief about climate change, the aviation industry's contribution to global carbon emissions, and the familiarity of carbon offsets. (n=527 respondents)

Survey question	Question levels	Response (%)
Belief about climate change	I do not think that climate change is happening	5
	I have no idea whether climate change is happening or not	4
	I think climate change is happening, but it's just a natural variation in the Earth's temperatures	36
	I think that climate change is happening, and I think that humans are largely causing it	55
Belief about the aviation industry's contribution to global carbon emissions	1 - Not at all important	5
	2	15
	3	37
	4	32
	5 - Very important	10
Considering who should be the most responsible dealing with climate change	Individual people	10
	Local, State or Federal government	25
	Global organizations	15
	Wealthy countries	4
	Big polluting countries	27
	Australian business companies	2
	Multinational corporations	8
Others	7	
Knowing what offsets are	I do not know what carbon offsets are	16
	I vaguely know what carbon offsets are	55
	I know what carbon offsets are	28
Having seen the option to buy carbon offsets	Yes	53
	No	33
	I am not sure	14
Having bought a carbon offset before	Yes	24
	No	73
	I am not sure	3

When asked about who should be responsible for dealing with climate change, 27% of respondents thought that major polluting countries were responsible, and 25% considered that local, state or federal government were responsible. Respondents were also asked about the

notion of carbon offset projects, before introducing the concept. 28% knew what carbon offsets were, 55% of respondents stated that they vaguely knew what carbon offsets were, while 16% stated that they did not know the notion of carbon offsets. Follow-up questions were asked about offsetting carbon when booking a flight. Of the 53% of respondents who stated they have seen the option to buy a carbon offset when making a flight booking, sixty-eight (24%) had bought carbon offsets for their flight before (Table 5).

4.2 Conditional logit model results

Before estimating models, answers were inspected for protest responses. 31.5% of all respondents chose the “I do not want to buy an offset” option for five or six out of the six choice questions. These respondents may not necessarily have a zero value for offsets, but could be protesting against some other aspect of the survey. Reasons for choosing the “I do not want to buy an offset” are shown in Table 6. Those who stated that they did not believe voluntary carbon offsets were the right way to reduce climate change (33%), or who said that they supported voluntary carbon offsets but thought that they should not be responsible for the issue (21%) were identified as protest respondents (Table 6). As such, 91 respondents were not included in further analyses.

Table 6. Reasons for respondents to choose the “no offset” option

Answers	Response (%)
I do not believe in climate change	17
I do not want to offset my carbon emissions	10
I do not believe that voluntary carbon offsets are the right way to reduce climate change	33
I support voluntary carbon offsets, but could not afford to buy them	13
I support voluntary carbon offsets, but I should not be the one paying for it	21
I found the choice questions confusing.	1
I did not have time to fully consider the choice options	3

A basic conditional logit model was estimated with the attribute levels (cost, project type, wildlife protection, location) and the “no offset” alternative (Model 1). The type of project was set to ‘forest protection’ as the base level, and the base level location was set to ‘overseas’. Results in Table 7 show that, relative to the baseline category of forest protection, respondents derived increased utility from the renewable energy option when located in Australia. Respondents were indifferent between reforestation and forest protection projects (as indicated by the insignificant parameter estimate on reforestation). The positive coefficient on wildlife means that respondents were more likely to choose alternatives with wildlife protection. Respondents strongly preferred projects in their own State over overseas projects. The coefficient on the status quo (‘no offset’) is positive; indicating that –on average- respondents preferred the status quo over buying an offset.

Next, a model was estimated with additional interaction terms to test whether socio-demographic variables would influence respondents' choice behaviour. Different socio-demographic characteristics of respondents were tested, only significant interactions were included in the final Model 2 (Table 7). Respondents' belief about climate change was incorporated through a dummy variable, taking a value of 1 for respondents who believed climate change was caused by humans, and zero otherwise. Respondents' belief about the contribution of aviation industry towards global carbon emissions was also coded as a dummy variable, taking a value of 1 for respondents who thought the contribution of the aviation industry to global carbon emissions was important or very important, and zero otherwise. Highest education level was reclassified as a dummy variable for university degree (= 1 for respondents with a university degree). Age and income were continuous variables and expressed as deviations from the mean value (mean age = 45 years, mean income = \$69,040/year).

Table 7. Conditional logit model results for the basic model 1 and interaction model 2.

Attribute	Model 1		Model 2	
	Coefficient	St.error	Coefficient	St.error
Cost	-0.022***	0.001	-0.020***	0.001
Type of project				
Renewable energy	0.299***	0.079	0.253**	0.086
Reforestation	0.113	0.076	0.066	0.083
Forest protection	base level		base level	
Wildlife protection	0.598***	0.067	0.718***	0.112
Location				
Another state	0.429***	0.075	0.392***	0.081
Own state	1.192***	0.069	1.097***	0.074
Overseas	base level		base level	
Status quo (= no offset)	0.233*	0.095	1.245***	0.135
SQ x climate change belief			-1.145***	0.101
SQ x aviation contribution to global carbon emissions			-0.512***	0.130
SQ x university			-0.581***	0.115
SQ x deviation from mean income			0.003**	0.000
Cost x deviation from mean age			-0.0002**	0.000
Cost x belief of aviation contribution to global carbon emissions			-0.008***	0.002
Cost x environmental organisation membership			0.011***	0.003
Wildlife protection x university			-0.279*	0.135
Number of Respondents	436		371	
Number of choice occasions	2616		2226	
LR chi ² (7)	952.18	LR chi ² (15)	990.43	
Prob > chi ²	0.000		0.000	
Pseudo R ²	0.131		0.161	

Notes: ***, **, * = significant at 1% level, 5% level and 10% level respectively. St.error = standard error

The number of observations in the model 2 is reduced to 371 because of the inclusion of interaction terms. Only significant interactions were included in the model. In model 2, the coefficients on the attributes have the same sign as in model 1. Model 2 shows that respondents holding a university degree, who believed that climate change is human induced and those who indicated that they thought the aviation industry was importantly or very importantly as a contributor to global carbon emissions were less likely to choose the “no offset” alternative. Respondents with higher than average income were more likely to choose the status quo option compared to respondents with lower incomes. For the cost of carbon offsets, older respondents and those who considered the aviation industry was importantly or very importantly as a contributor to global carbon emission were less likely to pay a higher amount. In contrast, membership of an environmental organisation increased the likelihood of paying a higher amount. Finally, respondents with a university degree received disutility from wildlife protection.

The estimates of the interaction model in Table 7 were used to calculate respondents' WTP for the attributes (Table 8). It is important to note that individual characteristics alter both the marginal utility of the offset attributes, and also the marginal utility of cost. Both effects are reflected in the estimates below. Respondents of average age, who did not believe the contribution of aviation industry to global carbon emissions were important were willing to pay \$12.68 more for a renewable energy offset project than for a reforestation or forest protection project. The same group of respondents was willing to pay an additional \$35.96 for a project that provides wildlife protection if they did not have a university degree, and \$21.98 if they did have a university degree. The results in Table 7 show that respondents are willing to pay significantly more for projects located in their own state or another Australian state (WTP = \$54.96 and \$19.64 respectively) compared to projects undertaken overseas.

Table 8. Willingness to pay estimates for different type of respondents (based on Model 2)

Attribute	Willingness to pay				
	contribution=0, envorg=0 ^a Average = 45	contribution=0, envorg=1 Average = 45	contribution=1, envorg=1 Young = 25	contribution=1, envorg=1 Average = 45	contribution=1, envorg=1 Old = 80
Type of project					
Renewable energy	12.68**	27.46*	18.30*	14.79*	11.07*
Reforestation	3.33	7.2	4.8	3.88	2.9
Forest protection	base level	base level	base level	base level	base level
Wildlife protection	35.96***	77.88**	51.90***	41.94***	31.39***
Wildlife protection x university = 1	21.98***	47.61**	31.73***	25.64***	19.19***
Location					
Another state	19.64***	42.54**	28.35***	22.91***	17.15***
Own state	54.96***	119.04**	79.33***	64.11***	47.99***
Overseas	base level	base level	base level	base level	base level

Notes: ^a contribution = respondents belief of aviation industry's contribution to global carbon emissions (0 = do not believe the contribution is important; 1 = believe the contribution is important or very important); envorg = membership of environmental organisation (0 = no; 1 = yes). ***, **, * = significant at 1% level, 5% level and 10% level respectively.

In contrast, respondents who did not believe the aviation industry was a (very) important contributor to global carbon emissions, but who were members of environmental organisation, and aged 45 were willing to pay significantly more than other categories of respondents. In particular, the WTP for this group of respondents increased to \$77.88 for projects that included wildlife protection. Respondents who believed the aviation industry was a (very) important contributor to global carbon emissions were less likely to pay for renewable energy project, wildlife protection and locations of project than the respondents from other categories. All types of respondents were indifferent between reforestation and forest protection projects. The results of WTP estimates for different categories of respondents were different because their characteristics influenced the attitudes towards the cost attribute. Older respondents tended to pay a lower amount for each of the attributes. For the same type of respondents but of an older age, they were willing to pay less compared to respondents of younger or average age. A full set of WTP estimates for various respondent characteristics is provided in Appendix 2.

As offset projects are provided as a package by airlines, it is useful to estimate the WTP for an offset package. Table 9 shows the WTP for different types of offset packages for different categories of respondents. These estimates include the contribution of the status quo effect in Table 8. The WTP for respondents of average age, who believed climate change was human induced, believed that the contribution of aviation industry to global carbon emissions is important or very important, with a university degree, at mean income were \$72.79 for a renewable energy project implemented overseas. This category of respondents was willing to pay \$164.05 for a forest protection project with wildlife protection located in their own state, and \$122.85 if it was located in another state.

Table 9 also shows the WTP results for respondents with characteristics set to the sample average. This shows that, on average, respondents were willing to pay \$8.38 for renewable energy projects that are located overseas. Their WTP for a forest protection project with wildlife protection in their own state or another state was \$77.39 or \$46.24 respectively. These average values will be used in the next section to compare WTP with the costs of offset packages provided by airlines.

Table 9. Example WTP estimates for different offset packages (high paying and average respondents)

Offset Package	WTP	St. error
High paying respondents ^a		
Renewable energy project overseas	72.79***	13.842
Forest protection project with wildlife protection in own state	164.05***	21.439
Forest protection project with wildlife protection in another state	122.85***	15.093
Average respondents ^b		
Renewable energy project overseas	8.38*	3.740
Forest protection project with wildlife protection in own state	77.39***	5.515
Forest protection project with wildlife protection in another state	46.24***	5.400

Notes: ^a Respondents of average age, who believed climate change was human induced, believed that the contribution of aviation industry to global carbon emissions was (very) important; who hold a university degree; who are a member of environmental organisation and have a mean income of \$69,040/year. ^b Respondents of average age, who believed climate change was human induced (55%), believed that the contribution of aviation industry to global carbon emissions was (very) important (42%); who hold a university degree (58%); who are a member of environmental organisation (6%) and have a mean income of \$69,040/year, in proportion to the sample size. ***, **, * = significant at 1% level, 5% level and 10% level respectively. St.error = standard error

5. Discussion and conclusion

This study investigated the awareness and willingness to pay (WTP) for voluntary carbon offsets (VCOs) in Australia. The results of this study suggest that there may be a need to better communicate the concept of carbon offsets in the aviation sector, as more than half of the respondents only vaguely knew what carbon offsets were. In the focus group discussions and the survey, some respondents expressed concern that money paid for an offset would not be used properly toward offset projects. This expression suggests that campaigns are needed to increase public confidence in the administrators of such projects.

5.1 Elicited values

Respondents who believed that the aviation industry is an important or very important contributor to global carbon emissions were less likely to choose the “no offset” option than respondents who believed that the aviation industry was not an important contributor. It was therefore expected that these respondents would also be willing to pay a higher price for the offset projects. In the conditional logit model, however, it was found that respondents who believed the aviation industry was a (very) important contributor had a larger disutility from the cost than other respondents. Further studies are needed to explain the possible reasoning behind this finding.

Contrary to expectations, respondents with higher than mean income were more likely to choose the “no offset” option. Result showed that there is a positive correlation between flight class and respondents' income. It may therefore be the case that these high income respondents may not be willing to pay any extra cost on top of their flight ticket, especially for those who fly business or first class. Moreover, results from Model 2 (Table 7) show that respondents holding a university degree had a higher disutility for projects that included wildlife protection compared to a project without wildlife protection. This result is different from the previous study by Brouwer *et al.* (2008), who found that WTP is positively influenced by the level of knowledge. It is possible that respondents with higher education are focusing on the context of carbon and not be distracted by the 'charisma' of wildlife protection. People without university education may choose wildlife protection as a way to receive a 'warm glow' of protecting multiple things (Alpizar *et al.* 2001). Higher educated people may specifically target climate change mitigation impacts, thereby paying less attention to the benefits from wildlife protection.

5.2 Implications of WTP estimates

The WTP estimates from Model 2 (Table 8) showed that respondents were indifferent between reforestation and forest protection projects. It is possible that respondents preferred innovative technologies such as renewable energy projects, which present a more explicit improvement in the technological context than the other two types of project. It may also be the case that respondents relate renewable energy more directly with carbon offsets, while reforestation and forest protection may be more associated with biodiversity protection projects rather than carbon offsets. Respondents mostly preferred offset projects that are located in their own state, compared to projects in other states or overseas. This could indicate that respondents value projects that they could directly see being implemented, which can gain credibility from the respondents' perspective. It is also possible that respondents more prefer offset projects that benefit their local/state community.

In this study, the WTP estimates for respondents who did not believe aviation industry was an important contributor, were not a member of an environmental organisation, and were 45 years of age is \$12.68 for a renewable energy project compared to a forest protection project. This is lower than the average WTP of €23.1 euros per flight that was found in a previous study in the Netherlands (Brouwer *et al.* 2008). One may conclude that Australian travellers are less willing to pay for carbon offsets compared to air travellers in Europe. However, the offset project characteristics in Brouwer *et al.*

(2008) were not described in details, it is difficult to compare the WTP estimates. Our study shows that respondents' WTP will vary with the characteristics of the offsets, which suggests that future studies should include a more detailed description of the offset that is offered to respondents.

In this study, it also found that including wildlife protection in an offset option increases respondents' WTP substantially. The WTP estimates for offsets with wildlife protection for different types of respondents were more than double compared to offsets without. This result matches findings from a previous study in Spain, which showed that WTP estimates increase significantly when ancillary benefits are included (Longo *et al.* 2011).

This study estimates the WTP for different offset packages. Results are reported for an “average” respondent as well as respondents who had a particularly high value for them: those who believed climate change was human induced, believed the contribution of the aviation industry to global carbon emissions was (very) important, held a university degree and had an average income of \$69,040/year. These values can be used to assess whether there is agreement between the WTP values found in this study and the price for offset projects charged by airlines. For instance, the average WTP estimated for our sample for an overseas renewable energy project is \$8.38. Qantas Airlines invested in such an overseas renewable energy project in 2011; the Xinjiang Wind Power Project (Qantas Airways Limited 2011). Our estimated WTP of \$8.38 gives an indication of the implicit price that respondents would be willing to pay for an offset based on the Xinjiang Wind Power Project. Another example is a forest protection project in another state, with a WTP estimate of \$46.24. This could be used to as an indication of the price for a forest protection project in Tasmania started in 2011, invested in by Virgin Australia (Climate Friendly n.d.; Virgin Australia 2014).

The typical market price for offsets of a domestic and international return flight ranges from approximately \$5 to about \$30 (Qantas Airways Limited 2014). Although this current offset price is proportional to the distance of flight and is set constant per CO₂-equivalent emitted, the amount of offset is relatively low compared to the WTP estimates for forest protection projects that have wildlife protection located in Australia in this study. It suggests that airlines could ask a higher price for their offsets as long as the co-benefits of the projects are properly communicated to potential buyers.

5.3 Recommendations for policy-making

The results of this study suggest that, in order to achieve an efficient VCO scheme, airlines could provide certain types of offset project to air travellers. Firstly, this study showed that respondents value renewable energy projects the most (generate the highest utility). Airlines could thus decide to offer this type of project to their customers to receive a higher uptake of VCOs. On the other hand, result shows that offset projects with additional wildlife protection could substantially increase WTP. Although reforestation and forest protection projects on their own give a relatively low WTP, the overall WTP for an offset package that includes wildlife protection will be much higher. Airlines should therefore promote the wildlife protection co-benefit when promoting their reforestation or forest protection offset options to customers. Furthermore, since respondents were willing to pay substantially more for offset project occurring in their own state, airlines could invest in projects that are located in those regions where the majority of their customers are from.

Furthermore, of the respondents who chose “no offset” for five or six out of the six choice questions, a quarter of them stated that they did not believe in climate change. It is possible for policy makers to communicate to people that climate change is occurring, thereby potentially increasing the participation levels of VCO schemes. Comments that were made by respondents to the survey indicate that some respondents thought that carbon offset schemes should be mandatory rather than voluntary, and that the offset costs should be included into the ticket price. As such, airlines could consider internalising the offset cost into their ticket cost (with appropriate marketing and communication). Airlines may also seek for government subsidy to promote VCO scheme in order to increase air travellers' awareness.

5.4 Limitations and possible improvements to the study

This study uses choice experiments technique to assess the respondents' WTP. The choice questions are based on hypothetical scenarios, which may not fully reflect the actual situation for respondents to choose the offset options. Furthermore, some interactions observed between attributes and respondent characteristics are not fully understood such as wildlife protection and university. Therefore, a further investigation into the relationship between these interactions needs to be conducted. This research was based on respondents who had booked a flight and flown in the past five years. Future studies might also extend the investigation by examining alternative emissions contexts such as automotive industry; or presenting different payment vehicles. Furthermore, future studies will need to be conducted on the motivations for purchase and to develop a better communication strategy to increase public awareness of carbon offset.

5.5 Conclusion

This study assesses Australian air travellers' awareness of VCO in the aviation sector. It estimates air travellers' values for different offset project and project attributes by conducting a choice experiment survey. The results provide a better picture of the demand for VCOs. It suggests that air travellers prefer renewable energy projects over reforestation and forest protection project, while projects located in their own state are preferred over projects in another state or overseas. It may be beneficial to emphasise the co-benefits of wildlife protection to potential offset buyers, as this secondary benefit leads to a substantial increase of WTP. Additionally, comments that were made by respondents indicate that airlines should provide more information (and evidence) about their carbon offset projects to travellers; to increase transparency and public confidence that offset money is truly invested in offsetting carbon emissions.

References

- ABS (2013). *Australian Demographic Statistics 2013*. Australian Bureau of Statistics, Canberra.
- Alpizar, F., Carlsson, F. and Martinsson, P. (2001). Using choice experiments for non-market valuation. *Economic Issues* 8, 83-110.
- Bateman, I., Carson, T., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, W., Sugden, R. and Swanson, J. (2002). *Economic Valuation with Stated Preference Techniques: A Manual*. Edward Elgar, Cheltenham, UK.
- Bennett, J. and Blamey, R. (2001). *The Choice Modelling Approach to Environmental Valuation*. Edward Elgar, Cheltenham, UK.
- Blasch, J. and Farsi, M. (2012). Retail demand for voluntary carbon offsets - A choice experiment among Swiss consumers. *IED working paper series (18th ed.)*.
- Brouwer, R., Brander, L. and Van Beukering, P. (2008). "A convenient truth": air travel passengers' willingness to pay to offset their CO₂ emissions. *Climate Change* 90, 299-313.
- ChoiceMetrics Pty Ltd (2014). Available from URL: <http://www.choice-metrics.com/> [accessed 10 October 2014].
- Climate Friendly (n.d.). Tasmanian Native Forest Protection Project (2): Protecting Tasmania's Valuable Native Forests. Available from URL: [http://www.climatefriendly.com/Projects/Projects/Tasmanian_Native_Forest_Protection_Project_\(2\)/](http://www.climatefriendly.com/Projects/Projects/Tasmanian_Native_Forest_Protection_Project_(2)/) [accessed 27 April 2014].
- Department of Climate Change and Energy Efficiency (2012). *National Carbon Offset Standard*. Government of Australia. Available from URL: <http://www.climatechange.gov.au/climate-change/carbon-neutral/national-carbon-offset-standard-ncos/national-carbon-offset-standard> [accessed 27 April 2014].
- Dodds, R., Leung, M. and Smith, W. (2008). Assessing awareness of carbon offsetting by travellers and travel agents. *Anatolia: An International Journal of Tourism and Hospitality Research* 19(1), 135-148.
- Economist (2006). Aircraft emissions: the sky's the limit. Available from URL: <http://www.economist.com/node/7033931> [accessed 24 March 24 2014].
- Figuerola, C.M. and Font, A.R. (2009). Defining environmental attributes as external costs in choice experiments: a discussion. *Documents de Treball CRE* 1, 1-29.
- Gössling, S., Broderick, J., Upham, P., Ceron, J.P., Dubois, G., Peeters, P. and Strasdas, W. (2007). Voluntary carbon offsetting schemes for aviation: efficiency, credibility and sustainable tourism. *Journal of Sustainable Tourism* 15(3), 223-248.
- Haab, T.C. and McConnell, K.E. (2002). *Valuing environmental and natural resources: The econometrics of non-market valuation*. Edward Elgar Publishing Limited, Cheltenham, UK.
- Hanley, N. and Barbier, E.B. (2009). *Pricing Nature: Cost-Benefit Analysis and Environmental Policy*. Edward Elgar, Cheltenham, UK.
- Hanley, N., Wright, R. and Adamowicz, V. (1998). Using choice experiments to value the environment. *Environmental and Resource Economics* 11(3-4), 413-428.
- Jindal, R., Swallow, B. and Kerr, J. (2008). Forestry-based carbon sequestration projects in Africa: potential benefits and challenges. *Natural Resources Forum* 32, 116-130.
- Kollmuss, A., Zink, H. and Polycarp, C. (2008). Making sense of the voluntary carbon market: a comparison of carbon offset standards. *WWF Germany*.
- Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economy* 74 (2), 132-157.

- Longo, A., Hoyos, D., and Markandya, A. (2012). Willingness to pay for ancillary benefits of climate change mitigation. *Environmental Resource Economics* 51, 119-140.
- MacKerron, G., Egerton, C., Gaskell, C., Parpia, A. and Mourato, S. (2009). Willingness to pay for carbon offset certification and co-benefits among (high-)flying young adults in the UK. *Energy Policy* 37, 1372-1381.
- Mair, J. (2011). Exploring air travellers' voluntary carbon-offsetting behaviour. *Journal of Sustainable Tourism* 19(6), 215-230.
- Manski, C. (1977). The structure of random utility models. *Theory and Decision* 8(3), 229-254.
- Qantas Airways Limited (2011). NCOS Carbon Neutral Program Public Disclosure Summary. Available from URL:
<http://www.climatechange.gov.au/climate-change/carbon-neutral/carbon-neutral-program/accredited-businesses/qantas> [accessed 27 April 2014].
- Qantas Airways Limited (2014). Fly Carbon Neutral. Available from URL:
<http://www.qantas.com.au/travel/airlines/fly-carbon-neutral/global/en> [accessed 27 April 2014].
- Virgin Australia (2010). NCOS Carbon Neutral Program Public Disclosure Summary. Available from URL:
<http://www.climatechange.gov.au/climate-change/carbon-neutral/carbon-neutral-program/accredited-businesses/virgin-australia> [accessed 27 April 2014].
- Virgin Australia (2014). Fly Carbon Neutral. Available from URL:
<http://www.virginaustralia.com/au/en/about-us/sustainability/carbon-offset-program/> [accessed 11 October 2014].

Appendix 1. Survey

UWA choice experiment survey

"Awareness and WTP of air travellers for voluntary carbon offsets and their co-benefits"



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieve International Excellence

Please read the following information carefully before proceeding with the survey. Click [here](#) to print a copy of the information sheet.

Dear Sir/Madam,

Thank you for participating in this **independent** research project being conducted at the University of Western Australia. You have been selected at random from the Australian population to participate in this research. It will involve completing a survey – this will take approximately 15 minutes of your time.

The purpose of this survey is to determine whether people are willing to pay (or not willing to pay) to support carbon offset projects. We are specifically interesting in the things that may be important to you when choosing to buy a carbon offset or not.

Through answering the survey questions, you will have the opportunity to express your opinions. This study is primarily for research purposes, but our results will also help to make better decisions about climate change policies. You don't need to know about carbon offsets to participate. We are interested in your opinion!

Participation in this survey is voluntary and completely anonymous. No individual data will be revealed in any publications arising from this study; only summary statistics will be reported for the survey as a whole.

Participation should involve no physical or mental discomfort, and no risks beyond those of everyday living. If, however, you should find any question or procedure to be invasive or offensive, you are free to withdraw from the survey at any time.

If you consent to participate in this study, please complete the survey that follows. If you have any queries or concerns with any aspect of this survey please contact me at the address above.

Kind regards,

Marit Kragt

Assistant Professor, School of Agricultural and Resource Economics

University of Western Australia

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

In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at The University of Western Australia on (08) 6488 3703 or by emailing to hreo-research@uwa.edu.au. All research participants are entitled to retain a copy of this Participant Information Form.

Screening questions

S1. What is your gender?

Male

Female

<next page>

S2. What is your age?

17 years or under → *terminate survey*

18-24 years

25-34 years

35-44 years

45-54 years

55-64 years

65-74 years

75-84 years

85 years and over

<next page>

S3. Where do you live?

NSW Metro (Sydney and surrounds)

NSW Regional

VIC Metro (Melbourne and surrounds)

VIC Regional

QLD Metro (Brisbane and surrounds)

QLD Regional

SA Metro (Adelaide and surrounds)

SA Regional

WA Metro (Perth and surrounds)

WA Regional

Somewhere else, namely _____ → *terminate survey*

<next page>

S4. Have you travelled in an airplane in the past 12 months?

Yes

No --> terminate survey

<next page>

S5. Have you booked and paid for (any of) your flight(s) yourself in the past 12 months?

Yes

No --> terminate survey

<next page>

Part 1. Background Information

The following questions are about your personal flights. By *personal flights*, we mean any flight for leisure or business purposes that you booked and paid for yourself (i.e. not booked or paid by a third party).

Q1. In the past 5 years, how many personal flights have you taken on average per year?(count a return trip as one flight)

Less than 1 a year --> terminate survey

1 to 5 per year

6 to 10 per year

11 to 15 per year

More than 15 per year

Don't know --> exit survey

<next page>

Q2. Please choose the class that you use most frequently for personal flights
select one in each column>

<Please

For Domestic flights

For International flights

Economy Class

Economy Class

Economy Plus/Premium Economy

Economy Plus/Premium Economy

Business Class

Business Class

First Class

First Class

I never fly domestically

I never fly internationally

<next page>

Q3. How much did you spend on your most recent return flight ticket?

\$0-\$300

\$301-\$600

\$601-\$900

\$901-\$1,200

\$1,200-\$1,600

\$1,601-\$2,000

\$2,001-\$2,400

\$2,401-\$3,200

\$3,201-\$4,000

Over \$4,000

I cannot recall the cost of the flight ticket

NA

Q3a. Was your most recent flight a Domestic or International flight?

Domestic

International

<next page>

This survey is about people's opinions on climate change.

Climate change refers to a measurable change in the state of the climate, where the change persists for an extended period of time, typically decades or longer.

Q4. What are your beliefs regarding climate change?

Please choose the one statement that most closely reflects your beliefs

I do not think that climate change is happening

I have no idea whether climate change is happening or not

I think climate change is happening, but it's just a natural variation in the Earth's temperatures

I think that climate change is happening, and I think that humans are largely causing it.

<next page>

Scientists have suggested that human activities are a significant cause of recent climate change.

For example, many industrial activities generate greenhouse gases that contribute to climate change.

One of these industries is aviation. Globally, the aviation industry contributed 689 million tonnes of CO₂ equivalent (t CO₂-e) emissions in 2012. This is equivalent to the greenhouse gas emission from approximately 167.5 million passenger vehicles per year.

Q5. How significant do you think the contribution of the aviation industry is to carbon emissions?

Not at all important					Very Important
1	2	3	4	5	

<next page>

Part 2. Voluntary carbon offsets

This section is about carbon offsets in the aviation industry. Voluntary carbon offsetting is a scheme that compensates the greenhouse gas emissions from an activity such as flying.

People can buy carbon offsets for their share of the emissions caused by the flight. The money they pay is invested in projects that save the same amount of CO₂-equivalents. These projects could take place anywhere in the world.

Q6. How familiar are you with the notion of carbon offset projects?

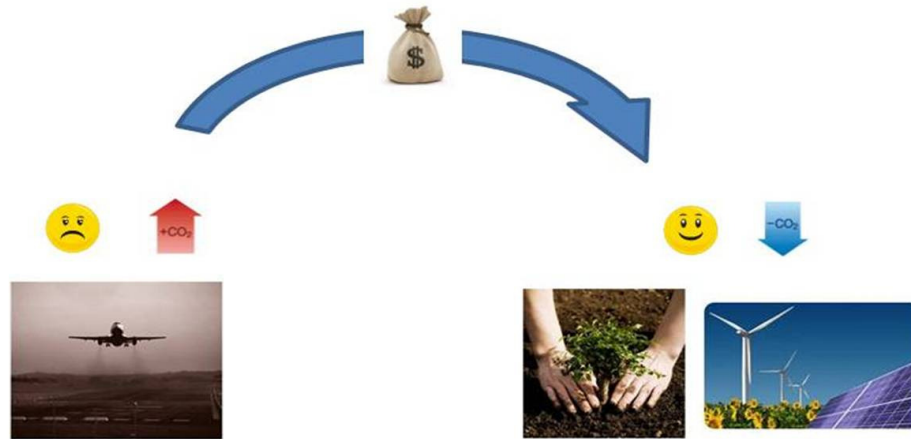
I don't know what carbon offsets are

I vaguely know what carbon offsets are

I know what carbon offsets are

<next page>

If you were to buy a voluntary carbon offset, the greenhouse gas emissions from your consumption are saved elsewhere, by investing in specific activities. There are different types of offset projects possible. For example, supporting renewable energy, investing in energy-efficiency, planting trees and conservation projects.



Q7. After this description, do you feel you understand the term carbon offsets?

I do not understand the term carbon offsets

I somewhat understand the term carbon offsets

I fully understand the term carbon offsets

<next page>

When you book a flight ticket, there is an option for air travellers to buy carbon offsets.

Q8. Have you ever seen the option to buy a carbon offset when making a flight booking?

Yes --> (Move to Q8a)

No --> (Move to part 3)

I am not sure --> (Move to part 3)

<next page>

Q8a. Have you ever bought carbon offsets for any flights in the past?

Yes

No

I am not sure

<next page>

Part 3. Attributes and choice questions



Carbon offset projects can be implemented in different ways. Different projects will have different economic, social and environmental impacts.

In the next questions, we will ask you to imagine that you are booking a personal flight. We will show you projects that can offset the carbon emissions of your flight.

Each of these projects will be slightly different. They can vary in their type of project, the location of the offset project and the cost of your offset. The table below explains these impacts in more detail.

Please carefully read the following information, as you will need it later in the survey.

CHARACTERISTICS OF OFFSET PROJECTS

Type of project

Greenhouse gas emissions can be reduced by different types of project. Airlines can choose to invest in different project offered by accredited offset project providers.

- **RENEWABLE ENERGY:** Investing in projects that generate renewable energy helps to switch energy production from fossil fuels to renewable energy, which reduces greenhouse gas emissions.
- **FOREST PROTECTION:** Protecting existing native forests from logging, processing and use as timber. This minimises greenhouse gas emissions by preventing the release of the carbon that is stored in the trees.
- **REFORESTATION:** Planting native trees to create new forests. These new trees store carbon which reduces carbon in the atmosphere.

Protecting native wildlife

Some forest protection or reforestation projects can also benefit native wildlife by protecting their habitat.

- **YES:** Additional protection of native wildlife
- **NO:** No additional wildlife protection

Project location

Offset projects can be undertaken at different locations.

- **YOUR STATE:** project is undertaken in your own state
 - **ANOTHER STATE:** project is undertaken in another Australian state
 - **OVERSEAS:** project is undertaken overseas
-

CHARACTERISTICS OF OFFSET PROJECTS

Costs

The offset cost is the amount that you need to pay, on top of your ticket price, to offset your share of the greenhouse gas emissions. This money will be invested in carbon offset projects.

- \$10
- \$25
- \$50
- \$75
- \$100

<next page>

In the next 6 (six) questions you are asked to choose between two offset projects.

Imagine that you are booking a long-distance flight, e.g. from your nearest capital city to London. The ticket will cost you \$2,000 (return). During the booking, you are told that your flight causes 1,000 / 3,000 / 5,000 kg CO₂-e emissions per passenger. You are then offered three options to fully offset the CO₂-e emissions from your trip. For all of the offset projects, carbon will be stored and will not be released into the atmosphere for a period of at least 100 years.

You will need to choose your most preferred offset project from the set.

<next page>

CHOICE QUESTION 1

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Forest Protection	Forest Protection	Reforestation	I would choose not to buy the offset
Wildlife protection	Yes	No	Yes	
Project location	Another State	Overseas	Your State	
Offset costs	\$50	\$50	\$50	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

CHOICE QUESTION 2

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Reforestation	Forest Protection	Reforestation	I would choose not to buy the offset
Wildlife protection	No	Yes	No	
Project location	Your State	Overseas	Another State	
Offset costs	\$75	\$100	\$25	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

CHOICE QUESTION 3

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Reforestation	Renewable Energy	Reforestation	I would choose not to buy the offset
Wildlife protection	No	No	No	
Project location	Overseas	Another State	Your State	
Offset costs	\$25	\$10	\$75	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

CHOICE QUESTION 4

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Forest Protection	Forest Protection	Renewable Energy	I would choose not to buy the offset
Wildlife protection	Yes	No	No	
Project location	Overseas	Your State	Another State	
Offset costs	\$25	\$50	\$75	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

CHOICE QUESTION 5

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Reforestation	Renewable Energy	Renewable Energy	I would choose not to buy the offset
Wildlife protection	No	No	No	
Project location	Your State	Another State	Your State	
Offset costs	\$10	\$75	\$50	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

CHOICE QUESTION 6

Please carefully consider the following options for carbon offset projects. Suppose that there are only three options available to fully offset your 1,000 / 3,000 / 5,000 kg CO₂-equivalent emissions. Please choose your **one** most preferred option.

(Click [here](#) to see a description of the project characteristics again)

Characteristics	Option A	Option B	Option C	
Type of project	Reforestation	Forest Protection	Reforestation	I would choose not to buy the offset
Wildlife protection	Yes	No	Yes	
Project location	Another State	Your State	Overseas	
Offset costs	\$75	\$10	\$10	
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<next page>

Part 4. Choice questions follow-up

Q9. Thank you for your answers.

Please indicate below whether you thought the offsetting scenarios presented in the previous questions were easy to understand or confusing.

Extremely confusing			Not confusing and not easy			Extremely easy to understand
1	2	3	4	5		

<next page>

<The next questions “protest responses” should only be asked if respondents chose option D at least 5 or 6 times out of all the six choice questions>

Q10. We noticed that you chose option D in nearly every choice question. What is the main reason you chose this?

I do not believe in climate change

I do not want to offset my carbon emissions

I do not believe that voluntary carbon offsets are the right way to reduce climate change

I support voluntary carbon offsets, but could not afford to buy them

I support voluntary carbon offsets, but I should not be the one paying for it

I found the choice questions confusing.

I did not have time to fully consider the choice options

Other, please specify: _____

<next page>

Q11. Who do you think should be MOST responsible for dealing with climate change?

Individual people

Local, State or Federal government

Global organizations

Wealthy countries

Big polluting countries

Australian business companies

Multinational corporations

Other, please specify: _____

<next page>

Part 5.

Finally, a few questions about you to make sure that we are reaching a representative sample of the population.

Q12. What is your current marital status?

Single

Married/de facto

Divorced/separated

Widowed

Other, namely _____

<next page>

Q13. What is the highest level of education you have completed?

Schooling up to Year 12

Trade or technical certificate

University degree (Undergraduate)

University degree (Postgraduate)

Other, namely _____

<next page>

Q14. Are you a member of an environmental/conservation organisation?

Yes

No

<next page>

Q15. What is your current employment status?

Full-time employed (more than 30hrs/week)

Part-time employed (less than 30hrs/week)

Self-employed

Unemployed

Trainee/student

Fulltime home/carer duties

Retired

Other, namely _____

<next page>

Q16. What is your personal gross annual income before tax?

Nil income

\$1-\$10,399

\$10,400-\$15,599

\$15,600-\$20,799

\$20,800-\$31,199

\$31,200-\$41,599

\$41,600-\$51,999

\$52,000-\$64,999

\$65,000-\$77,999

\$78,000-\$103,999

\$104,000-\$179,999

\$180,000-\$249,999

\$250,000 or more

I would rather not say

<next page>

Q17. Please let us know if you have any comments about this survey

Thank you very much for your time!
Your effort in completing this survey is very valuable to us.

Appendix 2. Output of full conditional logit model

Attribute	Willingness to pay											
	contribution=0 envorg=0			contribution=0 envorg=1			contribution=1 envorg=0			contribution=1 envorg=1		
	25	45	80	25	45	80	25	45	80	25	45	80
Typeren	15.17**	12.68**	9.84**	42.66	27.46*	16.91*	10.30**	9.08**	7.53**	18.30*	14.79*	11.07*
Typeref	3.98	3.33	2.58	11.19	7.20	4.44	2.70	2.38	1.98	4.80	3.88	2.90
Wildprot	43.04***	35.96***	27.92***	121.01	77.88**	47.96***	29.21***	25.76***	21.36***	51.90***	41.94***	31.39***
Wildprot*uni	26.32***	21.98***	17.07***	73.99	47.61**	29.32***	17.86***	15.75***	13.06***	31.73***	25.64***	19.19***
Locas	23.51***	19.64***	15.25***	66.11	42.54**	26.20***	15.96***	14.07***	11.67***	28.35***	22.91***	17.15***
Locys	65.79***	54.96***	42.67***	184.98*	119.04**	73.31***	44.65***	39.38***	32.64***	79.33***	64.11***	47.99***

Notes: contribution= respondents belief of aviation industry's contribution to global carbon emissions (0= do not believe the contribution is important; 1=believe the contribution is important or very important); envorg=membership of environmental organisation (0=no; 1=yes).

Notes: ***, **, * = significant at 1% level, 5% level and 10% level respectively. St.error = standard error