Economic Analysis and Policy 81 (2024) 1371–1381

Contents lists available at ScienceDirect

Economic Analysis and Policy

journal homepage: www.elsevier.com/locate/eap

Modelling Economic Policy Issues

Is carbon footprint reduction always preferred over offsetting? An analysis of tourists' preferences in the Mallorca region

Llorenç B. Femenias Rosselló *, Angel Bujosa Bestard, Antoni Riera Font

Universitat de les Illes Balears, Departament d'Economia Aplicada, Ctra. De Valldemossa, km. 7.5, Palma de Mallorca, 07122, Spain

A R T I C L E I N F O

JEL codes:
Q51
Q54
Z38

Keywords:
Choice experiment
Willingness to pay
Climate change mitigation
Reduction
Offsetting
Sun-and-beach tourism

A B S T R A C T

This research is devoted to the analysis of tourists' preferences for climate change (CC) mitigation policies in the Mallorca region. The stated choice experiment, used for evaluation, was designed combining a set of alternatives, characterised by carbon footprint reduction and offset policies, taking into account the existence of environmental direct benefits, but also indirect benefits that improve tourist experience or co-benefits derived from the location of policy projects. Economic welfare in form of willingness to pay (WTP) was estimated, and the alternatives were compared using compensating variation values. The study's findings validate the prevailing preference for carbon reduction policies over offsetting measures, except when the first don't have co-benefits and the latter are implemented locally. In the latter case, there is no significant difference in WTP between reducing the carbon footprint and locally offsetting it. Results not only contributes to the ongoing economic debate surrounding CC mitigation policies but also provides key information for designing mitigation schemes in diffuse emission sectors such as tourism.

1. Introduction

In December 2019, the European Commission presented the European Green Deal, its project for Europe to be climate neutral by 2050 in order to meet the 1.5 °C warming threshold established by the Intergovernmental Panel on Climate Change (IPCC) in the Paris Agreement (Masson-Delmotte et al., 2022). This target became legally binding when the European Parliament and the European Council adopted the Climate Law in 2021.[1] In this context, implementing climate change (CC) mitigation policies in all economic sectors must be stepped up immediately (Salvia et al., 2021). However, due to the numerous technical and operational limitations of achieving the deep decarbonization of the economy in a short period of time (Geels et al., 2017), the design of climate neutral schemes must consider a comprehensive policy framework that combines carbon reduction and offset strategies. To achieve climate neutrality and, thus, international climate objectives, one of the most promising drivers to ensure optimal design and public acceptability is social preferences analysis (Drews and van den Bergh, 2016). This is because translating social preferences into willingness to pay (WTP) indicators allows, on the one hand, to incorporate these preferences into efficiency evaluation frameworks (Hanley et al., 2009) and, on the other hand, to obtain a reliable and robust indicator of its public acceptability (Ščasný et al., 2017; Faure et al., 2022; Albidrupt et al., 2023).

* Corresponding author at: Universitat de les Illes Balears, Departament d'Economia Aplicada, Ctra. De Valldemossa, km. 7.5, Palma de Mallorca, 07122, Spain.

E-mail address: l.femenias@uib.es (L.B. Femenias Rosselló).

[1] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

https://doi.org/10.1016/j.eap.2024.02.018
Received 17 October 2023; Received in revised form 31 December 2023; Accepted 13 February 2024
Available online 14 February 2024

The estimation of the WTP for mitigation policies is particularly relevant in those sectors that are not subject to mandatory emission rights markets, since they do not have such a wide range of economic indicators related to their GHG emissions. In addition, in these sectors, known as diffuse emission sectors, it is extremely difficult to implement reduction policies within the companies' operations, since a substantial part of their emissions depend on third parties (Chan, 2021). This makes offset policies particularly relevant.

This is particularly applicable to the tourism industry. Not only because of its significant contribution to global GHG emissions (Perch-Nielsen et al., 2010; Gössling et al., 2013), representing approximately 5% of total emissions in 2016 (UNWTO, 2019), but mainly because of the transversality of the activities linked to the tourism value chain and the wide range of mitigation policies that can be developed. This makes tourism an ideal case study. In the first place, because the reduction policies can lead to co-benefits for the tourist experience, by replacing, for example, frozen processed products with fresh and local products. Likewise, benefits derived from the location of offset policies can be considered, since it is possible to develop projects, such as reforestation, both in the destination itself and in developing countries. This wide range of options makes it possible to carry out, under the same context and on the same sample, an exhaustive evaluation of the preferences of tourists and compare their WTP for various mitigation policies.

For all these reasons, this paper reviews, on the one hand, the role of public preferences in evaluating CC mitigation policies and, on the other, develops an empirical application to estimate, in terms of WTP, the preferences of tourists for mitigation policies carried out by the establishments in which they stay during their vacations in Mallorca (Spain). To achieve this goal, this study implements a preference-based measurement approach, through a choice experiment (CE). In this measurement approach, subjects make resource allocation decisions and the design ensures comparability of different revealed preferences (i.e., people's willingness to reduce or offset carbon footprint through payments that support different local projects or include an improvement of the tourist experience) using a unified valuation framework. A Mixed Logit model (MXL) is implemented to quantify the WTP for different policy benefits as well as for identify variations among different policy options.

The paper is organized as follows. The following section summarizes the main contributions of the academic literature on the assessment of public preferences regarding the implementation of emission reduction and offset policies. Section three presents the CE application detailing the mitigation policies under assessment as well as the experimental design. Section four introduces the most relevant aspects of the survey design, sample characteristics and the modelling approach which involves a MXL model in WTP-Space. The main results are presented in section five and, finally, some conclusions and further extensions are discussed in section six.

2. Evaluation of climate change mitigation policies

2.1. Efficiency analysis

To date, most studies evaluating different CC mitigation policies have been based on the concept of efficiency through the lens of opportunity cost, where the most efficient alternative is deemed as the one with lower costs (Anderson and Bernauer, 2016). This perspective has led to the development of marginal abatement cost curves, extensively explored in literature (Kesicki and Strachan, 2011; Kesicki and Ekins, 2012; McKinsey & Company, 2013; Vogt-Schilb and Hallegatte, 2014), thereby excluding social preferences regarding such policies from the evaluation framework.

These studies have concluded that offsetting presents a wider array of greenhouse gas emissions (GHG) mitigation projects that are generally more cost-efficient and inexpensive compared to the limited options available for reducing emissions within a firm's operations (Tatsutani and Pizer, 2008). Furthermore, when international offsetting is permitted rather than restricting it to the emitter's home country, the costs per unit of GHG mitigation tend to be even lower (Gollier and Tirole, 2015). Thus, while reduction policies are environmentally superior, since they reduce emissions directly at their source, which translates into immediate and tangible environmental and climatic benefits, the perspective of economic efficiency favors offset policies (Anderson and Bernauer, 2016). However, it cannot be ignored that offset policies depend on external projects that may not guarantee the additionality principle of carbon offsetting (Schneider, 2009; Hyams and Fawcett, 2013; Bono et al., 2015) and can generate uncertainties (Galik and Jackson, 2009; Haya et al., 2020). Thus, aspects of ethics (Hyams and Fawcett, 2013; Page, 2013), equity (Boyce, 2018) and effectiveness (Benecke, 2009; Newell, 2012) become particularly relevant in questioning the appropriateness of offsetting policies.

The cost-centered efficiency assessment neglects the existence of other benefits beyond climatic ones. While it is true that the primary climate benefits associated with the reduction or offset of a unit of GHG emissions can be considered equivalent, the existence of indirect benefits or co-benefits (Rübbelke, 2002; Bollen et al., 2009; West et al., 2013) that affect the welfare of people through non-climate mechanisms can lead to divergences in public preferences between the two policies (Abildtrup et al., 2023).

2.2. Social preference analysis

On the public acceptability side, understanding public support for climate policies holds significant importance for several reasons, as noted by Drews and van den Bergh (2016). Firstly, within democratic nations, public opinion wields substantial influence over the course of policy changes (Page and Shapiro, 1983; Burstein, 2003). Secondly, scholars have identified a lack of widespread public support as a significant obstacle hindering the transition to a carbon neutral economy (Geels, 2013; Wiseman et al., 2013). However, very little is known about public preferences for combining reduction and offset policies within the design of CC mitigation schemes. Anderson and Bernauer (2016) shed light on the debate around individual preferences for combining mitigation policies. Their study seeks to empirically identify how the arguments for and against carbon offsetting influence public preferences for mitigation policies. Their results suggest a preference for reduction policies over national offset policies which, in any case, are more preferred than international offset policies. The researchers demonstrated that public preferences regarding carbon offsetting are influenced by considerations of economic efficiency, effectiveness in reducing GHG emissions, and ethical implications. Despite the valuable information provided by these results, their measurement unit does not allow these preferences to be translated into environmental policy evaluation frameworks.

The most common way to assess public preferences regarding the implementation of CC mitigation policies has been through the measurement of WTP for the implementation of emission reduction and offset measures in different contexts (see, for example, Alló and Loureiro, 2014; Drews and van den Bergh, 2016; Alberini et al., 2018). However, the evidence on the relationship between social preferences, approximated through WTP, and CC mitigation policies is partial, because it has mostly been constructed considering reduction policies that target specific sectors (Achtnicht, 2012; Mao et al., 2012; Jones et al., 2017; Chalak et al., 2012; Caspersen et al., 2022; Echeverria et al., 2014; Li et al., 2016; Zahedi et al., 2019; Faure et al., 2022; Xu et al., 2022) separately from carbon offset policies (Brouwer et al., 2008; MacKerron et al., 2009; Lu and Shon, 2012; Choi and Ritchie, 2014; Lim and Yoo, 2014; Yang and Solgaard, 2015; Rotaris et al., 2020; Heintzman, 2021; Berger et al., 2022; Zerbini and Vergura, 2022) and using valuation frameworks that do not facilitate direct comparisons.

Indeed, to date, there are no studies estimating the WTP for the implementation of reduction and offset policies in a scenario where both policies are combined. Furthermore, there are few studies providing valuations for both policies. The work of Raffaelli et al. (2022) provides estimations of WTP for both policies, but by using different samples and experimental designs, it fails to compare them. Another work that follows a similar line is that by Albidrupt et al. (2023), which estimates the WTP for different reduction policies that can be carried out both locally and offshore, transforming the latter, in practice, into offset policies. However, this study does not seek to obtain indicators of public acceptability for these policies in a scenario involving a combination of emission reduction and offset policies to achieve specific climatic goals. Therefore, in its experimental design, it presents each of these policies as mutually exclusive alternatives. This makes it impossible to draw precise conclusions about social preferences in a policy combination scenario. Thus, there is no evidence available regarding whether the preference scale introduced in Anderson and Bernauer (2016) is applicable in a similar manner when examining preferences using WTP. Well, to date, there are no robust estimators that can be easily integrated into cost-benefit analyzes to design effective mitigation schemes.

Thus, this study endeavors to address an existing gap in the literature by providing monetary indicators designed for the comparative analysis of public preferences towards different CC mitigation policies. To the best of our knowledge, this paper is the first to use a unified valuation framework (considering the same sample, relativization units and experimental context) for the simultaneous analysis of WTP for emission reduction and offset policies.

3. Choice experiment application

3.1. Mitigation policies in tourism

Many regions highly specialized in tourism have already embarked on the path towards climate neutrality through the implementation of CC mitigation policies (Gössling, 2009; Gössling and Schumacher, 2010; Gössling and Higham, 2021). This is the case of the Mallorca region (Spain), a leading sun and beach tourist destination in the Mediterranean Sea that received 16.4 million tourists during the year 2022. Thanks to the extensive legislation that regulates the efforts that the island must make in the fight against CC,[2] which in turn is transferred to the tourism industry through specific legislation,[3] the region has established itself as an international benchmark in addressing the tourism sector's transition toward climate neutrality.

Among the efforts made in the fight against CC, the legislation sets specific targets and requirements for the tourism industry to reduce its carbon footprint and transition to a more sustainable model. The carbon footprint, which is usually defined as the quantity of GHGs expressed in terms of CO_2 equivalent released into the atmosphere as a result of human activities or the production and consumption of goods and services (Pandey et al., 2011), has become a widely accepted indicator when evaluating emission mitigation policies (Wiedmann and Minx, 2008). In the same way, the high number of studies and publications focused on the estimation and measurement of the carbon footprint associated to tourism activities in regions that share many similarities with the Mallorca region, demonstrates the relevance and applicability of this metric in the context of tourism (Rico et al., 2019). In line with this understanding, this application focuses on those measures aimed at reducing or offsetting the carbon footprint associated with tourism activity to contribute, in this way, to the design of CC mitigation policies in the tourism sector. Based on the evidence provided by previous literature (Abildtrup et al., 2023), the application will delve into the role of different benefits associated with reduction measures (Burtraw et al., 2003; Rodríguez-Entrena et al., 2014; Smith et al., 2015; Baranzini et al., 2018) and the localization of offset projects (Karousakis, 2009; Torres et al., 2015) as a determinant of public acceptance of these policies.

It is noteworthy that, in contrast to other CE applications in the realm of climate policies, our study is centered on the assessment of the WTP specifically for the policy itself rather than the tangible benefits derived from its implementation. Consequently, the WTP is relativized by percentage of carbon footprint reduced or offset and not in terms of the benefits derived from these measures. Our approach is grounded in other studies (Alberini et al., 2018; Caspersen et al., 2022) where climate policies are assessed in terms of mitigated GHG units. The rationale behind this methodology lies in our intention to prioritize policies on the basis of public preferences

[2] Law 10/2019, of February 22, on Climate Change and Energy Transition adopted by the regional government of the Balearic Islands.

[3] Decree Law 3/2022, of June 15, on Urgent Measures for the Sustainability and Circularity of Tourism in the Balearic Islands adopted by the regional government.

and not to assess the welfare impacts of these policies. This approach is particularly relevant in a legislative framework, such as the European one, in which it is mandatory to achieve certain mitigation standards regardless of the public perceived benefits.

3.2. Choice experiment design

The design of the CE involved five different attributes carefully constructed to represent realistic and credible carbon footprint reduction and offset projects. The first attribute, *reduction*, quantifies the percentage of the tourist's carbon footprint that can be reduced by implementing reduction measures in accommodation establishments. In line with the climate objective committed by the European Union to reduce emissions by 55% in 2030,[4] and the widespread perception that a complete decarbonization of the economy is unattainable in the short term,[5] the levels of this attribute have been set at a range of four realistic and achievable values between 10 and 40%. The intermediate levels have been distributed evenly between both values at 20 and 30%.

Beyond the contribution to CC mitigation inherent to any reduction of GHG emissions (direct benefit), the reduction of the carbon footprint can also generate indirect benefits for residents and tourists. In an attempt to analyse how the existence of indirect benefits determines the preferences and support that tourist give to carbon footprint reduction projects, the second attribute, *benefits* of the reduction project, takes two levels. They include: benefits limited to its positive contribution to environmental quality or, in other words, the positive effect on the total GHG emissions made by the tourist during his vacation; and extra benefits, beyond the environmental ones, that appeal to the improvement in the tourist experience and its well-being. It is important to note that this attribute is inherently linked to the first attribute (*reduction*) since the benefits are contingent on the level of reduction achieved, as long as it is positive. Therefore, as the level of reduction increases, tourists should perceive increasing utility in the benefits associated with these projects. To guarantee that all respondents have the same understanding of the co-benefits associated to the *benefits* attribute, the survey employed the script outlined in Table 1. This script was utilized to elucidate to respondents the different levels of the *benefits* attribute, along with other attributes encompassed in the CE.

The third attribute, the percentage of carbon footprint *offset*, is introduced to complement the efforts in reducing tourist carbon footprint through projects with a positive emissions balance. To ensure the credibility and viability of all combinations between *reduction* and *offset* attributes, a maximum level of 60% has been set. For this reason, the four levels of this attribute have been distributed evenly between 15 and 60%. Carbon footprint offset projects can be done either locally (in the destination) or in another location (elsewhere). Although the location of these projects does not alter in any way the expected reduction of GHG emissions, when carried out in the destination itself they also have the potential to improve the well-being of residents and future tourists. For this reason, the fourth attribute focusses on the *location* of the offset projects to differentiate between measures taking place within the same tourist destination, Mallorca, or elsewhere. In the same way as with the *benefits* attribute, the utility derived from the *location* is expected to increase with the percentage of carbon footprint *offset* achieved, provided that this is positive. Consequently, both attributes (*benefits* and *location*) have been included in the specification (and in the experimental design) as interactions with their corresponding policy attributes (carbon footprint *reduction* and *offset*). It is important to note that, despite this joint effect on individual utility, the attributes are expected to be independent of each other. This is because the level of carbon footprint *reduction* does not determine the level of the attribute *benefits*, and vice versa.

Finally, a monetary attribute has been included in the CE to capture the trade-offs individuals are willing to make between the costs of implementing CC mitigation measures and the benefits they expect to achieve. The attribute *cost* is defined as the increase in the daily accommodation fee that the tourist will have to pay with the commitment that the funds collected will be used, in full, to co-finance the projects aimed to reduce and offset the carbon footprint of tourism activities. The levels of the cost attribute varied from €1 to €5.5, based on prior CE studies in the same geographical area (Bujosa et al., 2018; Bestard and Font, 2019; Enriquez and Bujosa, 2020; Bestard and Font, 2021) and on the results of a pilot survey.

The five attributes and their levels were combined to create the choice sets included in the survey. The choice sets were created using Ngene software (version 1.3) with a Bayesian d-efficient design (Scarpa and Rose, 2008) for a mixed logit model. Prior information on the parameter values was derived from a preliminary model estimated using data from a pilot study. The experimental design resulted in 24 profile combinations, further organized into four versions of six choice sets. Each choice set included two policy alternatives and a no-policy option. The policy alternatives described a scenario in which different measures were carried out to reduce and offset the carbon footprint of tourism activities using a combination of the attributes and levels in Table 2. Instead, the no-policy option presented a no-cost alternative where the respondent preferred to maintain the current carbon footprint and, therefore, no reduction or offset measures were implemented. An example of a choice card is provided in Fig. 1.

4. Data and methods

4.1. Survey and sample

The survey and data used in this article are part of a larger study on the activities that can be developed to reduce and offset the

[4] EU's fitt-for-55 plan: https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/.

[5] For instance, data from the European Social Survey (2020) demonstrate that 56.2% of Europeans consider it unlikely or highly unlikely that a significant number of individuals will restrict their energy consumption in an effort to combat CC: https://ess-search.nsd.no/en/study/172ac431-2a06-41df-9dab-c1fd8f3877e7.

Table 1
Information scripts provided to respondents.

Attribute	Description
Carbon footprint	Scientists have developed objective measurements, such as carbon footprint, to enable us to quantify daily emissions by tourists measured in kilograms of CO_2 equivalent. The latest scientific studies point to a footprint of 96.9 kg of CO_2 equivalent per tourist per day (Rico et al., 2019). This information is key to approximating the scope of the challenge faced by tourist destinations and determining, in each instance, the carbon footprint reduction/compensation effort that must be made.
Reduction	Efforts to reduce carbon footprint include decarbonisation activities by replacing sources of fossil fuel energy with renewables, as well as activities in the circular economy, such as recycling waste and reusing materials. Although all these activities take place at local level, they all make a positive contribution to environmental quality in destinations and around the planet.
Benefits	The activities to reduce carbon footprint may also help improve tourist experience and well-being. A good example of this is the ever-higher presence of fresh, local food, as well as the increasing replacement of chemical products for natural alternatives. This not only reduces the negative emissions balance but also offers healthier products for tourists.
Offset	As the name implies, these activities aim to counteract the carbon footprint of tourism through projects with a positive emissions balance. The most common example is revegetation projects that raise the number and density of planted trees and bushes to increase carbon capture capacity.
Location	Unlike reduction activities, offsets can be done either locally or in another location. Nevertheless, the location of offset projects is not arbitrary since, if they are done in the destination itself (and not elsewhere), they also increase the well-being of residents and future potential tourists.
Cost	Given the cost of implementing these activities, these establishments have also agreed to raise accommodation fees per tourist and day, under the commitment that any price increase will be used, in full, to co-finance this effort.

Table 2
Attributes and their levels.

Attribute	Definition	Levels
Reduction	Percentage of carbon footprint reduction	10%, 20%, 30%, 40%
Benefits	Benefits associated with the reduction project	- Environmental quality improvement - Environmental quality and tourist experience/well-being improvement
Offset	Percentage of carbon footprint offset	15%, 30%, 45%, 60%
Location	Location of the offset project	- Elsewhere - In the destination
Cost	Increase in the daily accommodation fee per tourist aimed at financing reduction and offset projects	€1, €2.5, €4, €5.5

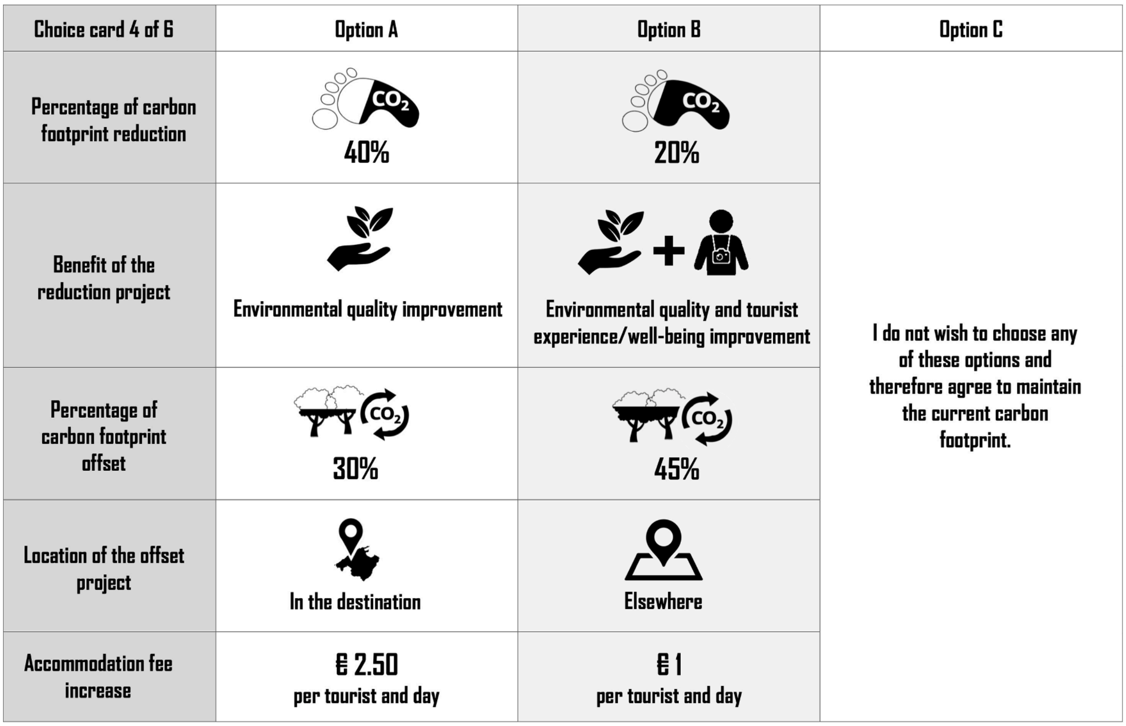

Fig. 1. Choice card example.

carbon footprint of tourism. In this particular case, the questionnaire has been divided into three parts. The first section is designed to capture essential information regarding the characteristics of the trip and the accommodations where respondents stayed during their vacations. Thus, this part of the questionnaire covers aspects such as the way in which tourists booked their vacations, the means of transport used at the destination, the duration of their stay and the type of lodging establishment chosen.

The second section introduces the carbon footprint associated with tourism activities as well as the carbon reduction and offset policies that can be implemented within the hotel industry, along with their main characteristics. Table 1 contains the information scripts provided to respondents for each of the attributes included in the experiment. According to the recommendations of Mariel et al. (2021), follow-up questions were incorporated to ensure respondents' comprehension of the information provided. The purpose of this part of the questionnaire was to familiarize participants with the subject matter of the study before presenting them with the six choice sets (see Fig. 1). Finally, the third section of the questionnaire is explicitly designed to collect socioeconomic data from the participants, enabling a comprehensive understanding of the demographic and economic profiles of the respondents.

Prior to the launch of the survey, a pilot study with 150 participants was conducted to test the questionnaire on high-season tourists, perform preliminary statistical tests and estimate the priors required for the experimental design. The final survey was administered in the departure terminal of Mallorca Airport between August and September 2022, coinciding with the high season, in three languages (Spanish, English and German). Using a random interception approach, trained interviewers approached tourists waiting at boarding gates and invited them to participate in face-to-face interviews. The survey achieved a response rate of 78,4%, with a total of 306 individuals agreeing to partake, resulting in an average interview duration of 19 min. In accordance with standard practice in CE literature, incomplete questionnaires (18) and respondents who opted for the no-policy alternative (18) due to objections regarding specific survey features (e.g., payment method) were excluded from the sample.

Table 3 presents the socioeconomic characteristics of the final sample, which consisted of 270 individuals. On average, respondents were 38.7 years old and report a monthly personal income of 2093 euros. In addition, 50.7% were women and 21.9% held a university degree. Regarding nationality, the three main nationalities of the respondents coincide with the three most common tourist markets to the Balearic Islands: British (34.1%), Spanish (19.6%) and German (17.4%), being the remainder (28.9%) of other nationalities. Trip-related details indicated that individuals in the sample had, on average, made 2.1 trips to Mallorca within the past five years. During their most recent visit, the average duration of stay was 5.9 days, and the average group size of individuals traveling together was 2.9.

4.2. Methodology

The preferences for carbon footprint reduction and offset policies are estimated using a discrete choice econometric model based on McFadden's random utility maximization (RUM). In this way, the utility level U_{njt} derived by individual n from alternative j in a choice situation t is assumed to be decomposed into a deterministic and a stochastic part (McFadden, 1973; Manski, 1977). On the one hand, the deterministic part of utility follows a linear function of the cost attribute (c_{njt}), the policy attributes (x_{njt}) and their corresponding utility coefficients (α_n, β_n) varying over individuals with a density distribution f. On the other hand, the stochastic component (ε_{njt}) captures the unobserved factors that determine the choice but remain unknown to the researcher and is IID extreme value distributed with variance equal to $\pi^2/6$. This specification is usually known as the model in preference space (Thiene and Scarpa, 2009):

$$U_{njt} = \alpha_n c_{njt} + \beta_n^{'} X_{njt} + \varepsilon_{njt} \quad (1)$$

Given the interest in the implicit price of policy attributes, Train and Weeks (2005) suggest to rescale Eq. (1) to obtain coefficients that can be directly interpreted in terms of WTP. By using the fact that WTP is given by the ratio of each policy attribute's coefficients to the cost coefficient $(WTP_n = \beta_n/\alpha_n)$, Eq. (1) can be rewritten as the model in WTP space (Hole and Kolstad, 2012; Ladenburg and Skotte, 2022):

$$U_{njt} = \alpha_n \left[c_{njt} + WTP_n^{'} X_{njt}\right] + \varepsilon_{njt} \quad (2)$$

Although models in 1 and 2 are behaviorally equivalent, the WTP space approach has the advantage that it allows to estimate the WTP for the policy attributes directly.

Since the impact of the attributes reduction project *benefits* and offset project *location* on the utility of individuals is increasing for higher levels of carbon footprint *reduction* or *offset* policy, they have been included in the specification as interactions with their corresponding policy attributes carbon footprint *reduction* and *offset*, respectively. Consequently, the baseline level of the *benefits* attribute's interaction corresponds to a reduction project having only environmental benefits. In the same way, the reference level of the *location* attribute's interaction is a delocalized offset project, that is, a project not carried out at the destination (Mallorca). An alternative-specific constant for the no policy option has been included in the specification (ASC_j). With all this, the following specification of the utility function is adopted:

$$\begin{aligned} U_{njt} = & \alpha_n \left[cost_{njt} + WTP_n^1 reduction_{njt} + WTP_n^2 reduction_{njt} * benefits_{njt} + WTP_n^3 offset_{njt} \right. \\ & \left. + WTP_n^4 offset_{njt} * location_{njt} + WTP_n^5 ASC_{njt}\right] + \varepsilon_{njt} \end{aligned} \quad (3)$$

Table 3
Socio-demographic characteristics of the sample.

Variable	Mean	Std. Dev.
Gender (percentage):		
- Female	50.74	
- Male	49.26	
Age (years)	38.66	12.18
Education (percentage):		
- Less than upper secondary	24.07	
- Upper secondary and post-secondary	54.07	
- Tertiary and university	21.85	
Monthly income (in Euros):	2093.22	1488.00
Nationality (percentage):		
- British	34.07	
- Spanish	19.63	
- German	17.41	
- Other	28.89	
Trips to Mallorca within the past five years (trips)	2.13	1.33
Length of stay (overnights)	5.86	2.44
Travel group size (persons)	2.88	1.40
Number of respondents	270	

5. Results

The results of the MXL WTP space model, presented in Table 4, were estimated in Matlab using the simulated maximum likelihood method with 10,000 Sobol draws with random linear scramble and random digital shift (Czajkowski and Budziński, 2019).[6] All the coefficients were given an uncorrelated normal distribution except the cost attribute that was specified to be lognormally distributed.[7]

All estimated parameters are statistically significant, except the standard deviation of the interaction between carbon footprint *offset* and offset project *location*, and present the expected sign.[8] More specifically, although there is considerable heterogeneity in the preferences among respondents indicated by the significant standard deviations of distributions, tourists show a positive preference towards all policy attributes. In contrast, the negative signs of the cost attribute (α) and the ASC capture the preference of respondents for cheaper alternatives and for implementing measures to reduce and offset their carbon footprint.

The estimated coefficients in this study can be readily interpreted as the WTP for the policy attributes, measured in euros per person and day. In this way, the findings indicate that tourists are willing to pay 8 euro cents to reduce the carbon footprint associated with their vacation by 1%. This value is increased by 4 euro cents if the reduction project generates additional benefits improving the tourist experience and its well-being. Regarding offset policies, respondents show a WTP of 3 euro cents, per person and day, to offset their carbon footprint by 1% if the offset project is located outside the destination. Instead, the WTP is increased by 5 euro cents if the offset project is implemented locally in Mallorca.

These findings confirm that WTP for carbon footprint reduction surpasses that observed for offset policies. This conclusion is drawn under the assumption of a scenario where the reduction measures do not generate additional benefits for the respondents, and the offset project takes place outside the tourist destination. These results align with previous research in the field of public preferences concerning carbon reduction and carbon offsetting (Anderson and Bernauer, 2016). These authors find that the prevailing preference for reduction strategies over offset policies can be attributed to ethical and effectiveness considerations. Namely, offset policies are perceived as violating the principle of responsibility towards the entities responsible for environmental issues, as they do not directly address the source of the problem. Furthermore, the effectiveness of offset policies is brought into question due to concerns about the principle of additionality, a crucial factor in ensuring the environmental efficiency of offsetting measures.

Nevertheless, a notable shift in the findings occurs when the offset policy is implemented locally in the tourist destination itself. Under such circumstances, the WTP for offsetting the carbon footprint by 1% reaches 8 euro cents, equaling the value of a reduction policy. Again, this outcome aligns with earlier research, which highlights a strong preference among respondents for locally executed mitigation measures (Carlsson et al., 2012; Longo et al., 2012; Torres et al., 2015; Buntaine and Prather, 2018; Abildtrup et al., 2023). Furthermore, if the implementation of a reduction policy results in an enhancement of the tourists' vacation experience, thereby providing co-benefits (e.g., substituting frozen products with fresh and locally sourced items on restaurant menus), the tourist's WTP increases by 4 euro cents. Consequently, the overall WTP for a 1% reduction in their carbon footprint rises to 12 euro cents per day, emerging as the option with the highest value. Once again, these findings correspond with existing literature, which indicates a heightened WTP among respondents for the adoption of emission reduction policies when associated with co-benefits (Baranzini et al.,

[6] The models were estimated using Matlab codes available from https://github.com/czaj/DCE under a Creative Commons Attribution 4.0 License.
[7] The same specification with correlated random parameters failed to achieved convergence.
[8] It should be noted that the absence of heterogeneity of preferences in the *location* of the project is in line with the results obtained in Albidrupt et al. (2023).

Table 4
WTP space model results in euros per individual and day.

Variable		Coefficient	S.E.
Reduction	Mean	0.0823**	0.0130
	S.D.	0.1170**	0.0204
Benefits	Mean	0.0419**	0.0090
	S.D.	0.0788**	0.0149
Offset	Mean	0.0340**	0.0069
	S.D.	0.0519**	0.0135
Location	Mean	0.0497**	0.0085
	S.D.	0.0060	0.0442
ASC	Mean	−13.1726**	2.3630
	S.D.	10.3761**	1.9382
α	Mean	−0.7845**	0.1559
	S.D.	0.3857*	0.2313
Log-likelihood		−1181.37	
Restricted log-likelihood		-1488.59	
Ben-Akiva-Lermans pseudo R^2		0.4955	
Number of observations		1620	
Number of individuals		270	

Parameters denoted by ** and * are significantly different from zero at the 1% and 10% significance levels, respectively.

2018).

Finally, the complete combinatorial approach by Poe et al. (2005) is used to confirm the statistically significance of the differences among the CC mitigation policies discussed above and presented in Table 4. More specifically, this approach tests the null hypothesis that the disparity between the WTP distributions for each attribute is statistically equivalent to zero.[9] The p-values of the test are presented in Table 5 revealing that the null hypothesis of equivalence between distributions can be rejected for all combinations of attributes at a 5% significance level, except for the attributes of reduction and local offset. In the latter case, we cannot assert that there is a significant difference between both distributions, and therefore, we confirm the indifference revealed by tourists towards the implementation of reduction, with no benefits on their experience, and local offset policies.

6. Conclusions

This paper presents an empirical application of the stated CE to CC mitigation policy design. Identification of public preferences for emission reduction and offset policies and estimation of projects' economic welfare provide invaluable information for policy makers in a scenario where the combination of both types of policies is essential to achieve the objectives set by the international climate agenda.

A complex trade-off between environmental quality benefits, improvements in the tourist experience and other co-benefits derived from the location of policy projects plus policy costs require careful valuation of all aspects. The CE survey includes graphical representation of different policy alternatives, differing in terms of direct, indirect, and other co-benefits using a unified valuation framework. Using the MXL, we estimated significance of every type of benefit and found them varying for different policies. Results confirm the public predilection for reduction policies over carbon offset policies (Anderson and Bernauer, 2016). However, thanks to the inclusion of design considerations the WTP analysis reveals an indifference between reduction policies, that do not yield co-benefits, and on-site offset policies. These results are the first to allow comparison, in monetary units, of preferences for on-site compensation with respect to different reduction policy designs.

These insights contribute significantly to the understanding of the efficiency of carbon mitigation schemes, shifting the focus from a purely cost-based analysis to one that considers benefits and, consequently, social welfare. Contrary to concerns that higher benefits associated with reduction policies might skew the results of efficiency analyses towards these policies, our results underscore that, between a reduction policy with no associated co-benefits and a local offset policy, the more efficient option remains the one with lower costs.

This result is especially relevant in diffuse emissions sectors (as tourism) where the possibility of reducing emissions within the companies' own operations is particularly difficult. Thus, the option for tourist companies to offset the emissions associated with their activity locally is revealed to be an equally valid option as reduction when it comes to generating value and social welfare. Beyond efficiency considerations, our findings provide valuable information for assessing the public acceptability of CC mitigation policies. Thus, it is concluded that the preferred mitigation policy is reduction with associated co-benefits, followed, at the same level, by reduction without co-benefits and on-site offsetting, with delocalized offsetting being the least desired option.

However, it is essential to acknowledge that our sample, comprised of tourists, raises questions about the underlying motivations behind their preferences. Despite not receiving co-benefits directly, tourists still exhibit a preference for local offset policies. This raises the possibility that tourists may be willing to pay more for such policies due to altruistic reasons, a sense of responsibility, ties to the

[9] A parametric bootstrapping method based on Krinsky and Robb (1986) has been employed, generating 10ˆ4 multivariate normal draws, to estimate the WTP distributions of the different attributes.

Table 5
Poe test p-values.[101]

Variables	Reduction	Reduction + Benefits	Offset	Offset + Location
Reduction	–	2.13%	0.04%	45.91%
Reduction + Benefits	2.13%	–	0.00%	1.78%
Offset	0.04%	0.00%	–	0.00%
Offset + Location	45.91%	1.78%	0.00%	–

destination, or even an option value if they intend to revisit the destination in the future and benefit from these co-benefits.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the regional government of the Balearic Islands (Conselleria de Fons Europeus, Universitat i Cultura) [grant numbers AP_2021_043, 2021]

References

Abildtrup, J., Jacobsen, J., Vedel, S., Mantau, U., Mavsar, R., Pettenella, D., 2023. Preferences for climate change policies: the role of co-benefits. J. Environ. Econ. Policy 1–19.
Achtnicht, M., 2012. German car buyers' willingness to pay to reduce CO2 emissions. Clim. Change 113, 679–697.
Alberini, A., Bigano, A., Ščasný, M., Zvěřinová, I., 2018. Preferences for energy efficiency vs. renewables: what is the willingness to pay to reduce CO2 emissions? Ecol. Econ. 144, 171–185.
Alló, M., Loureiro, M., 2014. The role of social norms on preferences towards climate change policies: a meta-analysis. Energy Policy 73, 563–574.
Anderson, B., Bernauer, T., 2016. How much carbon offsetting and where? Implications of efficiency, effectiveness, and ethicality considerations for public opinion formation. Energy Policy 94, 387–395.
Baranzini, A., Borzykowski, N., Carattini, S., 2018. Carbon offsets out of the woods? Acceptability of domestic vs. international reforestation programmes in the lab. J. Forest Econ. 32, 1–12.
Benecke, G., 2009. Varieties of carbon governance: taking stock of the local carbon market in India. J. Environ. Dev. 18 (4), 346–370.
Bento, A., Kanbur, R., Leard, B., 2015. Designing efficient markets for carbon offsets with distributional constraints. J. Environ. Econ. Manage. 70, 51–71.
Berger, S., Kilchenmann, A., Lenz, O., Schlöder, F., 2022. Willingness-to-pay for carbon dioxide offsets: field evidence on revealed preferences in the aviation industry. Glob. Environ. Chang. 73, 102470.
Bestard, A., Font, A., 2019. Estimation of implicit discount rates for climate change adaptation policies. J. Environ. Manage. 252, 109671.
Bestard, A., Font, A., 2021. Attribute range effects: preference anomaly or unexplained variance? J. Choice Modell. 41, 100321.
Bollen, J., Guay, B., Jamet, S., & Corfee-Morlot, J. (2009). Co-benefits of climate change mitigation policies: literature review and new results.
Boyce, J., 2018. Carbon pricing: effectiveness and equity. Ecol. Econ. 150, 52–61.
Brouwer, R., Brander, L., Van Beukering, P., 2008. "A convenient truth``: air travel passengers' willingness to pay to offset their CO 2 emissions. Clim. Change 90, 299–313.
Bujosa, A., Torres, C., Riera, A., 2018. Framing decisions in uncertain scenarios: an analysis of tourist preferences in the face of global warming. Ecol. Econ. 148, 36–42.
Buntaine, M., Prather, L., 2018. Preferences for domestic action over international transfers in global climate policy. J. Exp. Polit. Sci. 5 (2), 73–87.
Burstein, P., 2003. The impact of public opinion on public policy: A review and an agenda. Polit. Res. Q. 56 (1), 29–40.
Burtraw, D., Krupnick, A., Palmer, K., Paul, A., Toman, M., Bloyd, C., 2003. Ancillary benefits of reduced air pollution in the US from moderate greenhouse gas mitigation policies in the electricity sector. J. Environ. Econ. Manage. 45 (3), 650–673.
Carlsson, F., Kataria, M., Krupnick, A., Lampi, E., Löfgren, Å., Qin, P., Sterner, T., 2012. Paying for mitigation: a multiple country study. Land. Econ. 88 (2), 326–340.
Caspersen, E., Navrud, S., Bengtsson, J., 2022. Act locally? Are female online shoppers willing to pay to reduce the carbon footprint of last mile deliveries? Int. J. Sustain. Transp. 16 (12), 1144–1158.
Chalak, A., Hecht, J., Reid, S., Abiad, M., 2012. Willingness-to-pay for greenhouse gas reductions: a Bayesian investigation of distributional patterns. Environ. Sci. Policy 19, 147–157.
Chan, E., 2021. Why do hotels find reducing their carbon footprint difficult? Int. J. Contemp. Hospital. Manag. 33 (5), 1646–1667.
Choi, A., Ritchie, B., 2014. Willingness to pay for flying carbon neutral in Australia: an exploratory study of offsetter profiles. J. Sustain. Tourism 22 (8), 1236–1256.
Company, M., 2013. *Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve.* technical. McKinsey & Company.
Czajkowski, M., Budziński, W., 2019. Simulation error in maximum likelihood estimation of discrete choice models. J. Choice Modell. 31, 73–85.
Drews, S., Van den Bergh, J, 2016. What explains public support for climate policies? A review of empirical and experimental studies. Climate Policy 16 (7), 855–876.
Echeverria, R., Hugo Moreira, V., Sepúlveda, C., Wittwer, C., 2014. Willingness to pay for carbon footprint on foods. Brit. Food J. 116 (2), 186–196.
Enríquez, A., Bujosa Bestard, A., 2020. Measuring the economic impact of climate-induced environmental changes on sun-and-beach tourism. Clim. Change 160 (2), 203–217.
Faure, C., Guetlein, M.-C., Schleich, J., Tu, G., Whitmarsh, L., Whittle, C., 2022. Household acceptability of energy efficiency policies in the European Union: policy characteristics trade-offs and the role of trust in government and environmental identity. Ecol. Econ. 192, 107267. Retrieved from. https://www.sciencedirect.com/science/article/pii/S0921800921003268.
Galik, C., Jackson, R., 2009. Risks to forest carbon offset projects in a changing climate. For. Ecol. Manage. 257 (11), 2209–2216.
Geels, F.W., 2013. The impact of the financial–economic crisis on sustainability transitions: financial investment, governance and public discourse. Environ. Innov. Soc. Transit. 6, 67–95.
Geels, F., Sovacool, B., Schwanen, T., Sorrell, S., 2017. Sociotechnical transitions for deep decarbonization. Science 357 (6357), 1242–1244.
Gollier, C., Tirole, J., 2015. Negotiating effective institutions against climate change. Econ. Energy Environ. Policy 4 (2), 5–28. Retrieved from. https://www.jstor.org/stable/26189377.
Gössling, S., 2009. Carbon neutral destinations: a conceptual analysis. J. Sustain. Tourism 17 (1), 17–37.
Gössling, S., Higham, J., 2021. The low-carbon imperative: destination management under urgent climate change. J. Travel Res. 60 (6), 1167–1179.

Gössling, S., Schumacher, K., 2010. Implementing carbon neutral destination policies: issues from the Seychelles. J. Sustain. Tourism 18 (3), 377–391.
Gössling, S., Scott, D., Hall, C., 2013. Challenges of tourism in a low-carbon economy. Wiley Interdiscip. Rev. Clim. Change 4 (6), 525–538.
Hanley, N., Barbier, E., Barbier, E., 2009. Pricing Nature: Cost-Benefit Analysis and Environmental Policy. Edward Elgar Publishing.
Haya, B., Cullenward, D., Strong, A., Grubert, E., Heilmayr, R., Sivas, D., Wara, M., 2020. Managing uncertainty in carbon offsets: insights from California's standardized approach. Climate Policy 20 (9), 1112–1126.
Heintzman, P., 2021. The potential for voluntary carbon offset programs in the Canadian snow-based outdoor recreation industry. J. Outdoor Recreat. Tourism 36, 100422.
Hole, A., Kolstad, J., 2012. Mixed logit estimation of willingness to pay distributions: a comparison of models in preference and WTP space using data from a health-related choice experiment. Empir. Econ. 42, 445–469.
Hyams, K., Fawcett, T., 2013. The ethics of carbon offsetting. Wiley Interdiscip. Rev. Clim. Change 4 (2), 91–98.
Jones, B., Ripberger, J., Jenkins-Smith, H., Silva, C., 2017. Estimating willingness to pay for greenhouse gas emission reductions provided by hydropower using the contingent valuation method. Energy Policy 111, 362–370.
Karousakis, K. (2009). Promoting biodiversity co-benefits in REDD.
Kesicki, F., Ekins, P., 2012. Marginal abatement cost curves: a call for caution. Climate Policy 12 (2), 219–236.
Kesicki, F., Strachan, N., 2011. Marginal abatement cost (MAC) curves: confronting theory and practice. Environ. Sci. Policy 14 (8), 1195–1204.
Krinsky, I., Robb, A.L., 1986. On approximating the statistical properties of elasticities. The Review of Economics and Statistics, 65. The MIT Press, pp. 715–719.
Ladenburg, J., Skotte, M., 2022. Heterogeneity in willingness to pay for the location of offshore wind power development: an application of the willingness to pay space model. In: Energy, 241, 122900.
Li, X., Jensen, K., Clark, C., Lambert, D., 2016. Consumer willingness to pay for beef grown using climate friendly production practices. Food Policy 64, 93–106.
Lim, H.-J., Yoo, S.-H., 2014. Train travel passengers' willingness to pay to offset their CO2 emissions in Korea. Renewable Sustain. Energy Rev. 32, 526–531.
Longo, A., Hoyos, D., Markandya, A., 2012. Willingness to pay for ancillary benefits of climate change mitigation. Environ. Resource Econ. 51, 119–140.
Lu, J.-L., Shon, Z., 2012. Exploring airline passengers' willingness to pay for carbon offsets. Transp. Res. Part D: Transp. Environ. 17 (2), 124–128.
MacKerron, G., Egerton, C., Gaskell, C., Parpia, A., Mourato, S., 2009. Willingness to pay for carbon offset certification and co-benefits among (high-) flying young adults in the UK. Energy Policy 37 (4), 1372–1381.
Manski, C., 1977. The structure of random utility models. Theory Decis. 8 (3), 229.
Mao, X., Yang, S., Liu, Q., Tu, J., Jaccard, M., 2012. Achieving CO2 emission reduction and the co-benefits of local air pollution abatement in the transportation sector of China. Environ. Sci. Policy 21, 1–13.
Mariel, P., Hoyos, D., Meyerhoff, J., Czajkowski, M., Dekker, T., Glenk, K., 2021. Environmental Valuation with Discrete Choice Experiments: Guidance on Design, Implementation and Data Analysis. Springer Nature.
Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P., 2022. Global Warming of 1.5 C: IPCC Special Report on Impacts of Global Warming of 1.5 C above Pre-Industrial Levels in Context of Strengthening Response to Climate change, Sustainable Development, and Efforts to Eradicate Poverty. Cambridge University Press.
McFadden, D., & others. (1973). Conditional logit analysis of qualitative choice behavior.
Newell, P., 2012. The political economy of carbon markets: the CDM and other stories. Climate Policy 12 (1), 135–139.
Page, E., 2013. The ethics of emissions trading. Wiley Interdiscip. Rev. Clim. Change 4 (4), 233–243.
Page, B.I., Shapiro, R.Y., 1983. Effects of public opinion on policy. Am. Polit. Sci. Rev. 77 (1), 175–190.
Pandey, D., Agrawal, M., Pandey, J., 2011. Carbon footprint: current methods of estimation. Environ. Monit. Assess. 178, 135–160.
Perch-Nielsen, S., Sesartic, A., Stucki, M., 2010. The greenhouse gas intensity of the tourism sector: the case of Switzerland. Environ. Sci. Policy 13 (2), 131–140.
Poe, G.L., Giraud, K.L., Loomis, J.B., 2005. Computational methods for measuring the difference of empirical distributions. Am. J. Agric. Econ. 87 (2), 353–365.
Raffaelli, R., Franch, M., Menapace, L., Cerroni, S., 2022. Are tourists willing to pay for decarbonizing tourism? Two applications of indirect questioning in discrete choice experiments. J. Environ. Plann. Manage. 65 (7), 1240–1260.
Rico, A., Martínez-Blanco, J., Montlleó, M., Rodríguez, G., Tavares, N., Arias, A., Oliver-Solà, J., 2019. Carbon footprint of tourism in Barcelona. Tourism Manag. 70, 491–504.
Rodríguez-Entrena, M., Espinosa-Goded, M., Barreiro-Hurlé, J., 2014. The role of ancillary benefits on the value of agricultural soils carbon sequestration programmes: evidence from a latent class approach to Andalusian olive groves. Ecol. Econ. 99, 63–73.
Rotaris, L., Giansoldati, M., Scorrano, M., 2020. Are air travellers willing to pay for reducing or offsetting carbon emissions? Evidence from Italy. Transp. Res. Part A: Policy Pract. 142, 71–84.
Rübbelke, D., 2002. International Climate Policy to Combat Global Warming: An Analysis of the Ancillary Benefits of Reducing Carbon Emissions. Edward Elgar Publishing.
Salvia, M., Reckien, D., Pietrapertosa, F., Eckersley, P., Spyridaki, N.-A., Krook-Riekkola, A., 2021. Will climate mitigation ambitions lead to carbon neutrality? An analysis of the local-level plans of 327 cities in the EU. Renew. Sustain. Energy Rev. 135, 110253.
Scarpa, R., Rose, J., 2008. Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why. Austral. J. Agric. Resource Econ. 52 (3), 253–282.
Ščasný, M., Zvěřinová, I., Czajkowski, M., Kyselá, E., Zagórska, K., 2017. Public acceptability of climate change mitigation policies: a discrete choice experiment. Climate Policy 17 (sup1), S111–S130.
Schneider, L., 2009. Assessing the additionality of CDM projects: practical experiences and lessons learned. Climate Policy 9 (3), 242–254.
Smith, K., Chafe, Z., Woodward, A., Campbell-Lendrum, D., Chadee, D., Honda, Y., 2015. Human health: impacts, adaptation, and co-benefits. Climate Change 2014 Impacts, Adaptation and Vulnerability: Part A: Global and Sectoral Aspects, pp. 709–754.
Tatsutani, M., & Pizer, W. (2008). Managing costs in a US greenhouse gas trading program: a workshop summary.
Thiene, M., Scarpa, R., 2009. Deriving and testing efficient estimates of WTP distributions in destination choice models. Environ. Resour. Econ. 44 (3), 379–395. https://doi.org/10.1007/s10640-009-9291-7. Retrieved from.
Torres, A., MacMillan, D., Skutsch, M., Lovett, J., 2015. 'Yes-in-my-backyard': spatial differences in the valuation of forest services and local co-benefits for carbon markets in México. Ecol. Econ. 109, 130–141.
Train, K., Weeks, M., 2005. Discrete Choice Models in Preference Space and Willingness-To-Pay Space. Springer.
UNWTO, 2019. Transport-related CO2 Emissions of the Tourism Sector: modelling Results. UNWTO.
Vogt-Schilb, A., Hallegatte, S., 2014. Marginal abatement cost curves and the optimal timing of mitigation measures. Energy Policy 66, 645–653.
West, J., Smith, S., Silva, R., Naik, V., Zhang, Y., Adelman, Z., Lamarque, J.-F., 2013. Co-benefits of mitigating global greenhouse gas emissions for future air quality and human health. Nat. Clim. Chang 3 (10), 885–889.
Wiedmann, T., Minx, J., 2008. A definition of `carbon footprint. Ecol. Econ. Res. Trends 1 (2008), 1–11.
Wiseman, J., Edwards, T., Luckins, K., 2013. Post carbon pathways: a meta-analysis of 18 large-scale post carbon economy transition strategies. Environ. Innov. Soc. 8, 76–93.
Xu, B., Ahmad, S., Charles, V., Xuan, J., 2022. Sustainable commercial aviation: what determines air travellers' willingness to pay more for sustainable aviation fuel? J. Clean. Prod. 374, 133990.

[10] The table reports the significance level at which the null hypothesis of equivalence between the WTP distributions for each attribute was rejected.

Yang, Y., Solgaard, H., 2015. Exploring residential energy consumers' willingness to accept and pay to offset their CO2 emission. Int. J. Energy Sect. Manage.
Zahedi, S., Batista-Foguet, J., van Wunnik, L., 2019. Exploring the public's willingness to reduce air pollution and greenhouse gas emissions from private road transport in Catalonia. Sci. Total Environ. 646, 850–861.
Zerbini, C., Vergura, D., 2022. Online Shopping and Sustainability. Willingness to Pay a Contribution to Offset Environmental Pollution. Manag. Sustain.: Perspect. Retail. Serv. 93–110.