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SUSTAINABLE TRAVEL WITH CARBON OFFSETTING
– A STUDY OF REVEALED AND STATED
PREFERENCES

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School of Hotel and Tourism Management

Sustainable Travel with Carbon Offsetting – A Study of
Revealed and Stated Preferences

Hongrun Wu

A thesis submitted in partial fulfilment of the requirements for
the degree of Doctor of Philosophy

July 2025

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Abstract

A promising approach to decarbonizing tourism is to empower tourists to support climate mitigation efforts through the purchase of voluntary carbon offset products. Developing travel-related offsets requires a comprehensive understanding of both the voluntary offset market and tourists' preferences and decision-making behaviors.

First, this thesis conceptualizes Travel Carbon Offsets (TCO) by examining the history, mechanism, and characteristics of voluntary offsets. Based on this foundation, a discrete choice experiment (DCE) was conducted to collect individuals' stated preferences (SPs) for TCO, exploring tourists' willingness to choose TCO and the factors influencing their preferences. Results indicate that tourists are generally willing to engage with TCO, with preferences shaped by offset- and travel-related attributes such as project type, cost, green trust, and socio-demographics.

While SP data provide insights into attribute trade-offs and preferences for novel products, a key limitation is the potential gap between stated intentions and real-world behavior (Louviere et al., 2000). To mitigate these concerns, the second study of this thesis, following the data enrichment paradigm, examines discrepancies and consistencies within and across SP and revealed preference (RP). By developing and comparing combined models, this study identifies differences in scale, individual- and alternative-specific heterogeneities, and state dependence. It also suggests that a partial data enrichment strategy—where preference homogeneity holds only for a subset of attributes—can more effectively harmonize SP and RP than a full enrichment approach.

SP and RP analyses, grounded in the random utility theory (McFadden, 1974), are classified as predictive choice models, which focus on quantifying and forecasting choices rather than

examining the underlying psychological processes that explain how and why people make particular choices. To address this gap, the third study conducts qualitative interviews with tourists, both with and without prior offsetting experience. Through thematic analysis, four interrelated themes emerge—awareness and knowledge, motivations and attitudes, project attribute preferences, and trust and credibility. These themes are explored through the integration of psychological, process-oriented perspectives with the economic, structure-oriented framework, providing deeper insights into the process behind utility maximization in carbon offset choices.

This triangulated thesis, comprising three complementary studies, makes three key contributions. First, it broadens the scholarly discourse on tourism and carbon offsetting by introducing the possibility of industrywide TCO, moving beyond the predominant focus on carbon offsets for flights. Second, this thesis employs a data enrichment approach to integrate and compare SP and RP data, deepening the interpretation of SP results and offering an updated approach for future research on tourism and carbon offsets. Lastly, by integrating behavioral and predictive approaches, this thesis bridges the gap between these traditionally distinct paradigms, enriching choice research within both the psychological and economic domains. The findings contribute valuable knowledge to academic and practical domains by clarifying tourists' real preferences and decision-making processes regarding carbon offsetting, and bringing them closer to accurately valuing carbon offsetting behavior, which can guide the development of decarbonization products in tourism.

Publications arising from the thesis

The Study 1 “Are tourists willing to pay for travel carbon offset?” has been published in the *Journal of Sustainable Tourism*, and the Study 2 “Stated vs. revealed preferences for travel carbon offset” has been published in the *Journal of Travel & Tourism Marketing*.

- **Wu, H.,** Zhang, H., & Song, H. (2024). Are Chinese willing to pay for travel carbon offset products? *Journal of Sustainable Tourism*, 33(7), 1281–1302.
<https://doi.org/10.1080/09669582.2024.2336493>
- **Wu, H.,** Zhang, H., & Song, H. (2025). Tourists’ choice for carbon offset: Revealed preference vs. stated preference. *Journal of Travel & Tourism Marketing*, 42(7), 994–1013. <https://doi.org/10.1080/10548408.2025.2470327>

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Chapter 1 Introduction

1.1 Research Background

The United Nations Secretary-General recently declared that “the era of global warming has ended” and that “the era of global boiling has arrived.”(United Nations, 2023). Representing about 8.8% of global carbon emissions, tourism’s environmental impact is considerable (Sun et al., 2024). Between 2009 and 2019, its carbon footprint grew from 3.9 to 5.2 billion tonnes of CO₂ equivalent in total. The primary sources of this increase were transportation, shopping, accommodation, and food within the tourism sector (Lenzen et al., 2018). Carbon dioxide emissions from tourism-related transport amounted to 982 million tonnes worldwide in 2005. They are expected to reach 1,998 million tonnes in 2030, approximately 25% higher than the corresponding figure for 2016 (1,597 million tonnes) if current mitigation measures continue and announced commitments are adhered to (United Nations World Tourism Organization & International Transport Forum [UNWTO & ITF], 2019).

Carbon emissions resulting in climate change may have direct negative impacts on tourism activities (e.g., extreme weather events; Hübner & Gössling, 2012; Lam et al., 2018) or indirect impacts (e.g., changes in snow conditions; Pröbstl-Haider & Haider, 2014), jeopardizing long-term sustainability in tourism-dependent regions. Given the interconnected relationship between climate change and tourism, the sector cannot remain exempt from the global mandate to achieve net-zero emissions by 2050, as stipulated in the Paris Agreement. Addressing and mitigating the carbon emissions from large-scale tourism activities is imperative.

Among the range of decarbonization strategies discussed in tourism research—such as energy efficiency, mobility shifts, and carbon taxation and emissions trading—carbon offsetting

occupies a distinct role. It is one of the few mechanisms that allows tourists to take direct responsibility for their emissions, complementing avoidance and reduction measures by addressing residual impacts. Despite this potential, offsetting remains underexplored in tourism research, especially beyond the aviation sector.

According to the carbon management hierarchy (Institute of Environmental Management & Assessment [IEMA], 2020), priority should be given to avoiding, reducing, or replacing carbon emissions. In the case of tourism, however, travel is often irreplaceable due to its unique experiential and cultural value. As a result, even when avoidance and reduction strategies are implemented, residual emissions remain. The Davos Declaration (World Tourism Organization & United Nations Environment Programme [UNWTO & UNEP], 2008) underscores that responsibility for mitigating greenhouse gas emissions is shared among governments, international organizations, industry, destinations, and tourists. In line with this call, tourists—who are direct contributors to travel-related emissions—are expected to take account of the climatic, economic, social, and environmental consequences of their choices and to minimize their carbon footprint, including through offsetting unavoidable emissions.

Carbon offsets, “an equivalent in part or in whole to the associated emissions by financing a reduction in emissions elsewhere” (International Air Transport Association [IATA], 2020), allow individuals to assume responsibility for their carbon footprint by supporting emission reduction projects.

Carbon offsets exist in two forms—compliance offsetting and voluntary offsetting. Compliance offset is mandatory and typically enforced by regulations or international agreements. Entities subject to compliance offset requirements must meet specific emission reduction targets set by authorities to adhere to legal obligations and environmental regulations.

In contrast, voluntary carbon offsetting refers to a proactive initiative undertaken by individuals or organizations to counterbalance their greenhouse gas emissions through investments in projects that reduce or absorb an equivalent volume of carbon dioxide (CO₂). It is driven by a personal or corporate commitment to sustainability (Lovell et al., 2009; McNish, 2012). In 2023, the global volume of voluntary carbon offsets issued was approximately 4.1 billion metric tonnes, compared to 980 million tonnes of retired offsets (carbon credits permanently removed to prevent the double-counting of emissions reductions within the carbon market) (Procton, 2024). This market has prompted project developers to reduce carbon emissions through technological innovations (Hamrick & Gallant, 2018). The voluntary carbon offset allows individual tourists to assume accountability for their carbon emissions through investments in emission-reduction projects.

Although individual offset purchases may appear small, tourists' voluntary contributions can play an important role in advancing decarbonization. First, when multiplied across large numbers of travelers, modest contributions accumulate into meaningful aggregate impacts, showing the potential of voluntary action to complement institutional and industry-level initiatives (Gössling et al., 2007). Second, engagement in offsetting can increase climate awareness: by converting abstract emissions into tangible units such as tonnes of CO₂ or monetary costs, offsetting helps make environmental consequences more visible for tourists. The visible participation in offsetting can reinforce pro-environmental norms in tourism, as visible mechanisms of compensation signal that low-carbon choices are socially expected and valued. In this way, voluntary offsetting not only directly contributes to emission mitigation but also, indirectly, fosters broader low-carbon travel norms, supporting longer-term behavioral change.

1.2 Problem Statement and Research Objectives

Voluntary carbon offsets can be a way for the tourism industry to participate in carbon-neutrality strategies and achieve sustainable development. However, tourists have largely been excluded from engaging in decarbonization activities or carbon markets due to a lack of accessible, trusted offset products. Only a tiny fraction of airlines have introduced an offset element into their sales (IATA, 2022), and uptake among passengers remains low, with only 10% of air travelers choosing to purchase offsets (Ritchie et al., 2021). Limited sales in offset tourism may also be attributed to a psychological distance between tourists and offset products (Higham et al., 2019). Given these limited practices, academic discussions about carbon offsets and tourism have focused on the application of carbon offsetting in aviation (Choi et al., 2018; Choi & Ritchie, 2014; Eijgelaar, 2011; Guix et al., 2022; Ritchie et al., 2021; Smith & Rodger, 2009; Zhang et al., 2019), but advancing carbon offset mechanisms within tourism requires coordinated action and collaboration across the entire industry. Developing effective travel carbon offset initiatives requires a nuanced understanding of voluntary carbon offsets and tourists' preferences and choices.

Therefore, this study first proposed a narrative of voluntary carbon offset for individual tourists (named TCO) based on a comprehensive understanding of its history, mechanisms, and characteristics. Based on this narrative, a DCE was designed to collect individuals' stated preferences for travel carbon offset (TCO) to explore whether tourists are likely to choose TCO and what factors influence their preferences and choices.

Stated preference (SP) data offers meaningful insights into how individuals evaluate trade-offs between attributes and offers evidence on preferences for emerging product features. SP methods are commonly utilized in research focused on carbon offsetting in air travel. However,

a widely acknowledged limitation of SP-based decision-making is the potential discrepancy between stated preferences and actual behavior (Louviere et al., 2000).

In the study of consumer choice behavior, a common method for validating SP results is to compare them with revealed preference (RP) data, which reflect actual market transactions (Hensher et al., 2015). However, the voluntary offset market is still emerging, with disorganized supply and minimal standardization limiting access to reliable RP transaction data. Furthermore, the limited variability inherent in RP data can hinder the accurate estimation of attribute-level effects.

To overcome these limitations, a combined RP and SP data approach, named data enrichment, has been proposed. The method leverages the complementary strengths of RP and SP data, effectively mitigating the weaknesses inherent in each source to improve the efficiency of choice model estimation, bias correction, and attribute identification (Ben-Akiva & Morikawa, 1991). Although data enrichment has been widely applied in domains such as transportation and health economics, it has not yet been adopted in tourism research or in the study of carbon offsetting, leaving a clear gap that this thesis seeks to address.

To more accurately capture tourists' actual preferences and choices regarding travel carbon offsets, this study adopts a data enrichment approach to explore both heterogeneity and potential homogeneity within and across data sources. By developing and comparing integrated models that combine RP and SP data, the analysis estimates key differences, including scale discrepancies between the two data types, individual- and alternative-specific heterogeneity, and state dependence effects linking SP and RP responses.

Stated and revealed preference analysis, grounded in Random Utility Maximization (RUM) theory (McFadden, 1974), is classified as predictive choice modeling. In fact, research on choice behavior can be classified into two main approaches: predictive choice models and

behavioral choice analysis (Ben-Akiva et al., 2002). Predictive models aim to identify regularities in choice behavior, which can then be used to measure and predict choices. This approach emphasizes the systematic and consistent elements of decision-making that can be quantified and forecasted. In contrast, behavioral choice analysis focuses on deconstructing the choice process, exploring its irregularities and individual characteristics. These two approaches differ primarily in their research objectives—prediction (economics) versus understanding and explanation (psychology). Despite these differences, there has been significant cross-pollination between economics and psychology, resulting in overlap between the two approaches. Each perspective has benefited from the insights of the other. However, little attention has been paid to integrating these approaches or to conceptualizing their interactions. Thus, this study aims to merge the psychological, process-oriented perspective with the economic, structure-oriented framework of RUM to attain greater insight into the mechanisms underlying utility maximization in carbon offset choices. More specifically, the thesis will include additional interviews with tourists, both with and without prior offsetting experience, to explore how and why preferences are formed and the interactions between economic and psychological frameworks.

This thesis advances the following primary research objectives:

- RO1 (Framework): Develop a decision-making framework for travel carbon offsets that integrates the psychological, process-oriented perspective with the economic, structure-oriented RUM framework.
- RO2 (Determinants & Adoption): Articulate an industry-wide TCO narrative (synthesizing offset- and travel-related attributes) and quantify the determinants of tourists' adoption/choice and willingness to pay (WTP) using SP data.

- RO3 (Data enrichment): Integrate and compare SP and RP evidence and identify the heterogeneities or homogeneity within and across SP and RP.
- RO4 (Mechanisms). Explain why and how tourists make offset choices by unpacking the process behind economic utility maximization in carbon offset decisions.

More specifically, to achieve these objectives, the thesis investigates the following research questions:

- RQ1 (RO2, RO1): Are tourists willing to pay for travel carbon offset products?
- RQ2 (RO2, RO1): What are the factors that influence tourists' choices of TCO?
- RQ3 (RO3): Do discrepancies exist between stated and revealed preferences for offsets?
- RQ4 (RO3): Where do these discrepancies occur, and what are their sources?
- RQ5 (RO3): Can stated and revealed preference data be combined in the context of offset choices?
- RQ6 (RO4, RO1): Why do tourists prefer certain attributes of carbon offset options?
- RQ7 (RO4, RO1): How do tourists make decisions when choosing carbon offset products?

1.3 Research Contributions

This thesis adopts a triangulated research design comprising three interrelated studies that collectively advance theoretical understanding, methodological innovation, and practical application in the field of travel carbon offsetting.

1.3.1 Theoretical Contributions

This thesis advances the theoretical understanding of carbon-offsetting behavior in tourism in several ways.

First, it synthesises behavioral and economic theories to propose an integrated decision-making framework that bridges process-oriented psychology with structure-oriented random-utility modeling. The framework links awareness and knowledge, motivations and attitudes, and trust and credibility to the economic representation of preferences (utility evaluation), yielding a more holistic account of sustainable consumer choice. In tandem with a reconsideration of discrete-choice foundations through an environmental-economics lens (e.g., indirect use value), the thesis justifies the application of discrete choice models to offsets and clarifies how ethical and environmental motives can be coherently expressed as willingness-to-pay for environmental characteristics.

Second, it extends the conceptual domain of tourism offsets by introducing an industry-wide TCO product that moves beyond a flight-only focus. By incorporating both offset-specific and travel-service attributes alongside a latent psychological construct (green trust), the thesis broadens how pro-environmental decisions are theorized in tourism.

Third, it sharpens theory on preference transportability across elicitation contexts by providing the first direct SP–RP comparison and combination for offsets. The results reveal both consistencies and inconsistencies between SP and RP and lead to a better understanding of offset decision-making.

1.3.2 Methodological Contributions

This thesis also contributes methodologically by demonstrating how different approaches can complement one another in studying complex decision behaviors.

In Study 1, green trust is incorporated as a latent variable within a mixed-logit Hybrid Choice Model (HCM), demonstrating how HCMs can be tailored to tourism offset research. Study 2 develops a partial data enrichment strategy that combines SP and self-reported RP data to enhance model realism and robustness. It explicitly accounts for preference heterogeneity, state dependence, and differences in data scale, offering methodological insights for future offset studies. Study 3 contributes qualitative depth by applying thematic analysis to uncover the cognitive and emotional mechanisms underpinning offset decisions.

Collectively, these methods demonstrate how triangulation can reduce bias, reveal heterogeneity, and connect interpretability (why) with predictive performance (what) in tourism behavior research.

1.3.3 Practical Contributions

This thesis presents key practical implications relevant to carbon offset providers, tourism operators, and policy decision-makers.

Study 2 guides the interpretation and use of SP findings in market settings by indicating where SP–RP alignment is strong (price, contribution) and where real-world presentation and credibility matter (type, location, certification).

Study 3 highlights how information delivery, product design, and credibility affect offset engagement, offering actionable insights for improving communication, trust-building, and personalization in offset programs.

By aligning credible product design (attributes, certification, provider reputation) with effective communication (clear tonnage, pricing, touchpoint), the thesis outlines actionable levers for higher offset engagement without undermining abatement priorities.

1.4 Thesis Structure

The structure of the remaining chapters is outlined below. Chapter 2 situates TCO within sustainable travel behavior, reviews offset narratives and choice theory, and presents the conceptual framework. Chapter 3 discusses the research design, methodologies, and data used in the studies. Chapter 4 includes the results and discussion for each study, followed by a cumulative conclusion in Chapter 5.

Chapter 2 Literature Review

2.1 Travel Carbon Offsets

Situating this study requires an initial examination of the wider context of sustainable travel behavior and the emergence of carbon offsetting within tourism. Section 2.1 reviews key concepts related to sustainable travel, introduces the development and mechanisms of voluntary carbon offsets, and frames carbon offsetting as a relevant pro-environmental action within tourism decarbonization efforts.

2.1.1 Sustainable Travel Behavior

While tourism significantly contributes to economic development and cultural exchange, it is equally important to acknowledge and address the negative impacts it entails. In particular, tourists are increasingly acclimated to unsustainable modes with large carbon footprints and harming the ecology (Gössling, 2002). Owing to the repercussions of tourist activities on the environment, there is a growing call for promoting sustainable travel practices.

Sustainability has become a prevalent development paradigm across various economic sectors, including tourism (Eusébio et al., 2014; Kastenholz et al., 2018). Within tourism, sustainability encompasses environmental, socio-cultural, and economic dimensions. Under the scope of tourism and sustainability, existing literature covers both supply-side and demand-side perspectives (Dolnicar, 2010; Dolnicar & Leisch, 2008).

The supply-side approach focuses on the measures and strategies adopted by tourism enterprises to provide more sustainable tourism products, frequently neglecting the influence of tourist behavior at the destination (Dolnicar, 2010; López-Sánchez & Pulido-Fernández, 2016). In contrast, demand-side strategies have become increasingly important, offering a

crucial addition to sustainable tourism management, which has long been shaped by supply-side measures (Barr et al., 2010; Dolnicar, 2010; Dolnicar & Leisch, 2008; López-Sánchez & Pulido-Fernández, 2016). Encouraging tourists to adopt environmentally friendly, socio-culturally respectful, and economically sustainable practices is key to leveraging tourism as a driver of economic and social development while preserving valuable natural and cultural assets.

Li et al. (2024) note that research on sustainable tourist behavior spans environmental, social, and economic aspects. This thesis focuses specifically on the environmental dimension of sustainable travel behavior, with particular emphasis on decarbonization. The concept of sustainable travel behavior in the environmental context is often simplified to pro-environmental behavior, portraying sustainable tourists as narrowly defined as green travelers. The term pro-environmental behavior is commonly used interchangeably with environmentally responsible, environmentally friendly, or environmental conservation behavior, encompassing a spectrum of actions dedicated to safeguarding the environment. Pro-environmental behavior encompasses actions that either minimize environmental harm caused by individual activities or contribute positively to it (Steg & Vlek, 2009), such as litter cleanup, energy conservation, volunteering for conservation projects and other sustainable behaviors that actively contribute to environmental protection and conservation endeavors, emphasizing choices and activities that support the welfare and preservation of the natural world (Dolnicar & Leisch, 2008; Seeler et al., 2021).

Tourists possess a range of behaviors at their disposal that can contribute to mitigating the adverse environmental effects of tourism, such as opting for sustainable tourism providers, visiting destinations committed to sustainability, or endorsing government sustainable regulations (Becken & Simmons, 2002; Gössling et al., 2011; Juvan & Dolnicar, 2017).

In the context of tourism decarbonization, tourists can reduce emissions by opting for shorter flights, choosing sustainable modes of transportation, and refraining from energy-intensive activities such as purchasing imported food (Becken & Simmons, 2002; Gössling et al., 2011). Besides these emission-reduction actions, tourists can financially support carbon offsets to remedy their carbon emissions (Becken, 2004).

Research on sustainable tourist behavior has frequently drawn on theoretical models, introduced from other discipline, such as the Theory of Planned Behavior (TPB), the Norm Activation Model (NAM), and the Value–Belief–Norm (VBN) framework. These perspectives highlight how cognitive evaluations, social and moral obligations, and underlying value systems shape individuals’ choices. They provide a foundation for this study by linking antecedents—such as awareness, norms, and values—to pro-environmental behaviors, including carbon offsetting. A detailed discussion of these theories is presented in Section 2.2.

Together, these theories and studies of sustainable travel behavior demonstrate that a wide range of factors influence sustainable tourist behavior. Li et al. (2024), for example, demonstrate that over one hundred different factors have been linked, directly or indirectly, to tourists’ sustainable actions. This diversity illustrates that no single pathway explains all forms of sustainable behavior. Instead, different behaviors often emerge from distinct constellations of psychological, social, and contextual drivers, which may lead to different outcomes. The distinct types of sustainable behavior may exhibit variations in their precursors and outcomes (Song & Soopramanien, 2019; Stern, 2000). Consequently, the psychological and empirical significance of distinguishing and classifying among different types of sustainable behavior is underscored (Miao & Wei, 2016). Li et al. (2024) further emphasize that different forms of sustainable tourist behavior are shaped by unique sets of antecedents and consequences, highlighting the importance of analyzing carbon offsetting as a specific case rather than

assuming findings from other behaviors apply universally. Their review also notes that research into similar antecedents or barriers has produced inconsistent results, often due to methodological differences. These inconsistencies reinforce the value of adopting a triangulated research design to enhance the robustness and validity of findings, an approach pursued in this thesis.

2.1.2 Voluntary Carbon Offset

Carbon offset can be broadly defined as a mechanism in which an individual or firm contributes to a project designed to extract atmospheric CO₂ or reduce CO₂ emissions on behalf of individuals or institutions. It encompasses various projects, such as forestry initiatives, wind energy projects, and the supply of cleaner cookstoves to developing regions. The term “offset” is employed to denote that such contributions serve to neutralize, either partially or fully, the carbon emissions generated by the offsetting entity or individual.

The concept of carbon offset, first introduced through the creation of the Clean Development Mechanism (CDM), can be viewed as an effort to expand the conventional tradable property rights framework of cap-and-trade into the context of the Kyoto Protocol (in Article 12) (United Nations Framework Convention on Climate Change [UNFCCC], 1997), which established the first international framework for carbon trading including two forms of carbon commodities: carbon allowances and offset credits.

The idea of cap-and-trade involved a public-sector agency responsible for coordinating a pollution-control system and establishing a system-wide “cap” on emissions. Subsequently, the agency could issue tradable emissions permits (“allowances”) equal to the overall cap and distribute them among participating entities.

In the late 1970s, the Environmental Protection Agency (EPA) operationalized the cap-and-trade concept through regulatory actions under the Clean Air Act. The initial cap-and-trade initiatives did not incorporate offset programs akin to those employed in contemporary carbon cap-and-trade programs. Nevertheless, they did lay the groundwork for the concepts that would later transform into the current understanding of carbon offsetting (McNish, 2012).

The term “offset” may have originated with the EPA’s “offset rule” in 1976. This regulation allowed new pollution sources in “nonattainment areas” to emit pollutants as long as voluntary cuts in emissions from another source within the same area offset the new releases. Over the subsequent decade, various international voluntary forest projects focused on funding initiatives to establish carbon sinks also began to be referred to as offset projects.

The apparent success of cap-and-trade in the United States during the 1990s elevated market-based ideas, leading policymakers to consider these approaches to address the greenhouse gas issue. At the Kyoto Protocol meeting in 1997, negotiators added offsetting to the “cap-and-trade” system at the last minute, prompting one commentator to nickname the CDM the “Kyoto Surprise.”, which currently is understood as the birth of carbon offset (/offset credits).

Carbon offset exists in two forms—compliance offsetting and voluntary offsetting. Despite distinctions between these offset types, they share a common origin dating back to the 1990s and are interconnected in several ways. Notably, many companies now offer compliance and voluntary offsets (Hyams & Fawcett, 2013).

Compliance carbon offsetting originated as a limited-scale experimental concept established during the Kyoto Protocol negotiations. Its primary purpose was to provide developed nations with flexibility in fulfilling their legally mandated carbon reduction commitments. The primary rationales supporting compliance offsetting included the belief that it would be economically

efficient for achieving global carbon reductions, facilitate fund transfers from wealthier to poorer countries, and contribute to technology transfer and development in poorer countries.

Compliance carbon offsets serve as the cornerstone of two key mitigation mechanisms established under the Kyoto Protocol's global climate framework. The Joint Implementation mechanism enables industrialized nations to acquire carbon credits (which function as offsets) through emission-reduction initiatives implemented in other developed countries or economies in transition. Similarly, under the CDM, developed countries can obtain offsets, but in this case, credits are secured by financing projects in developing nations.

Beyond the regulatory setting, there is a global trend towards voluntary efforts to reduce carbon emissions. Voluntary carbon offsets differ in that they are acquired by organizations and individuals who voluntarily choose to neutralize their emissions for reasons other than external mandates. A growing number of entities—from corporations to private citizens—are proactively investing in voluntary carbon offsets. In 2023, the global volume of voluntary carbon offsets issued was approximately 4.1 billion tonnes, compared to 980 million tonnes of retired offsets (Procton, 2024). This market has prompted project developers to reduce carbon emissions through technological innovations (Hamrick & Gallant, 2018).

This study will focus on the voluntary carbon offsets acquired by individuals, which allows individual tourists to assume responsibility for their carbon emissions through investment in emission-reduction initiatives. The research underscores the critical role of individuals as consumers of carbon offsets in reducing emissions in tourism.

Most voluntary carbon offset projects follow either the Gold Standard or the Verified Carbon Standard. Once a project meets the specified criteria, the certifying body issues carbon offsets equivalent to the verified emissions reductions. These offsets can be sold directly by project developers to end users, who may claim the associated reductions after formally retiring the

credits. Alternatively, offsets may be sold to intermediaries—such as brokers or retailers—who either resell them to final buyers or facilitate transactions in exchange for a service fee (Hamrick & Gallant, 2018). While standards may vary in terms of permissible project activities, locations, and regulatory compliance, they all share common requirements for offsets. First, reductions must be real, meaning they demonstrate additionality by achieving emissions cuts that would not have occurred under a business-as-usual scenario. Second, they must be measurable, requiring rigorous quantification through standardized methodologies. Third, all reductions must be verifiable and undergo impartial third-party auditing to confirm their validity.

Project developers can utilize diverse activities to generate carbon credits, ranging from the installation of renewable energy systems—such as wind turbines and solar panels—to afforestation and reforestation initiatives that capture and sequester atmospheric carbon. The diversity in offset production methods sets the various project types apart. **Figure 2.1** illustrates the transaction volumes in the global voluntary carbon offset market in 2022 and 2023, categorized by project type (Procton, 2024).

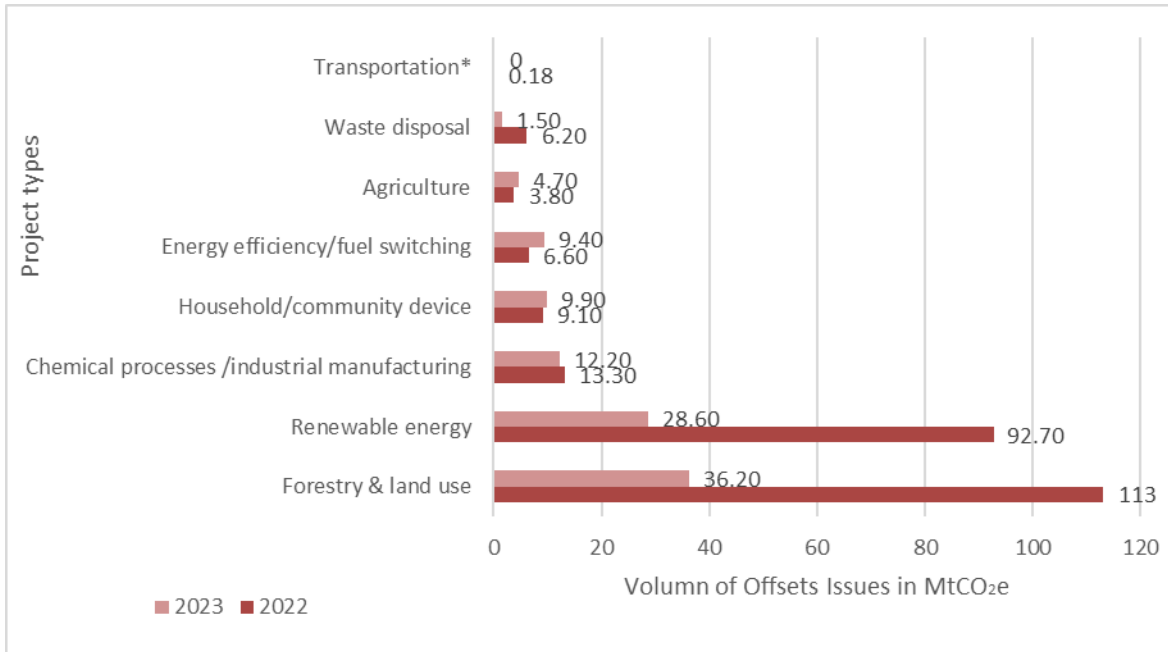


Figure 2.1 Volume of offsets issued in MtCO_{2e} from 2022 to 2023

Reforestation, environmental conservation, renewable energy, community initiatives, and waste-for-energy are prominent (Chapman, 2020; Raffaelli et al., 2022).

Reforestation and conservation have gained widespread popularity as offsetting initiatives. Credits are derived from carbon stored by new trees or maintained through forest protection efforts. These projects span the globe, ranging from forest establishment in the United Kingdom to mangrove restoration in Madagascar and rewilding initiatives in Brazil's rainforests. Although forestry-based offsets may not be the most cost-effective offsetting option, they are often selected for co-benefits beyond the carbon credits they provide. Forestry offsetting does involve some ambiguity. Historically, quantifying the carbon reductions achieved through forestry projects has been challenging. However, technological advancements and sustainable reforestation methods have significantly improved the ability to calculate and verify the benefits.

Offsets in renewable energy contribute to establishing or maintaining primarily solar, wind, or hydro sites globally. By investing in these initiatives, an individual contributes to expanding

the share of renewable energy in the grid, fostering job creation, decreasing dependence on fossil fuels, and supporting the overall global expansion of the renewable energy sector. For instance, consider the Bokhol Plant in Senegal, which stands as one of the largest projects in West Africa. This initiative provides renewable energy access to 160,000 people, resulting in substantial annual savings of \$5 million for the government and generating employment opportunities in the region. Moreover, revenues from carbon credit sales often flow back into local community development initiatives.

Community projects frequently implement energy-efficient technologies in underserved regions worldwide, offering benefits beyond carbon credits. Such projects contribute to the overall sustainability of entire regions and empower communities, enabling them to lift themselves out of poverty. Consequently, projects initially driven by philanthropy can now yield direct benefits for organizations, including carbon credits. An illustrative example is Ethiopia's female-led Water, Sanitation, and Hygiene initiative, which secures access to clean water by repairing and maintaining boreholes. This intervention reduces carbon emissions by eliminating the need for families to burn firewood for water boiling, thereby protecting local forests and mitigating indoor smoke pollution. Beyond the environmental benefits, the project is overseen by female-led committees, which provide employment opportunities for local women.

Waste-to-energy projects typically involve capturing methane and converting it into electrical power, achieved by extracting gas from landfills or processing human and agricultural waste in less urbanized areas. Similar to the impact of efficient stoves or clean water, waste-to-energy projects can positively influence communities. For instance, a Vietnam project educates residents on constructing and managing biogas digesters. These devices convert waste into cost-effective, clean, and sustainable energy, thereby minimizing methane emissions into the

atmosphere. Moreover, the initiative safeguards local forests that would otherwise be depleted by firewood collection.

Voluntary carbon projects are operational in 83 countries globally, allowing flexible trading between buyers and sellers within the same country or across borders. According to Hamrick & Gallant (2018), some nations, such as the United Kingdom and South Korea, have managed their markets domestically, promoting the purchase of locally produced offsets by businesses and individuals. From April 2005 to April 2018, 2,008 projects issued offsets, predominantly in Asia (51%) and North America (18%). Latin America, the Caribbean, Europe, and Africa each account for 11%, while Oceania has the fewest projects at 1%. In terms of offset issuance, Asia and North America lead with 39%, followed by North America at 26%, Africa at 13%, Latin America and the Caribbean at 12%, Europe at 9%, and Oceania at 1% again. Five countries—India, China, the United States, Turkey, and Brazil—collectively hosted 72% of all voluntary carbon offset initiatives during this period.

Issuance and retirement volumes serve as valuable supply-and-demand indicators in the voluntary carbon market. Issuances signify the number of offsets generated and available for trade, while retirements denote offsets that have been claimed and are no longer available for resale. Since gaining momentum in the late 2000s, the voluntary carbon market has witnessed substantial growth in both offset issuances and retirements. In 2017, these activities reached historic peaks, with issuances totaling 62.7 MtCO_{2e} and retirements amounting to 42.8 MtCO_{2e} (Hamrick & Gallant, 2018). However, issuances (supply) tend to exceed retirements (demand), partly due to historical imbalances between supply and demand and a time lag between their occurrence. In the 2020s, issued credits began to decline. In 2023, credit issuances were down by 93 MtCO_{2e} compared to 2022, while retirements rose by 2.6 MtCO_{2e}. This suggests that the surplus of carbon credits is diminishing, although it remains significant (Procton, 2024). In

addition, according to Molly et al. (2011), individuals accounted for only a minor share of voluntary carbon offset purchases, with most credits being bought by organizations, predominantly corporations. Limited uptake may stem from barriers in both access and perception—that is, physical and psychological distance between consumers and offset products (IATA, 2022; Ritchie et al., 2021). Identifying the determinants of offset choice is therefore crucial, as these factors can serve as design levers to reduce inaccessibility and close psychological gaps. Accordingly, analyzing travelers' preferences helps develop better products and tailor communication, marketing, and incentive programmes to increase adoption.

2.1.3 Travel Carbon Offset (TCO)

From an individual tourist's standpoint, carbon emissions are a byproduct of every travel activity. While air travel, especially flying, is the primary contributor to emissions in tourism, various other aspects of travel also generate CO₂. Activities such as boat tours, train services, and the use of hotel air conditioning all require energy, contributing to carbon emissions. Furthermore, the often-overlooked contribution of food waste to greenhouse gas emissions represents a significant concern within the travel sector. Culinary experiences, including eating local food and dining in restaurants, also contribute to the overall carbon footprint of travel.

Various measures can be taken to mitigate tourists' carbon footprint, such as choosing direct flights and selecting hotels powered by renewable energy. Despite adopting sustainable travel practices, some emissions will unavoidably persist. In such cases, carbon offsetting emerges as an option to address emissions that cannot be reduced entirely.

While the history mentioned above and the operation of offset may appear complex and daunting, the underlying concept is relatively straightforward. Tourists can counterbalance their travel carbon footprint by purchasing offset credits. An individual tourist can take two steps to offset their carbon emissions (KaitlynBra, 2020).

The first is calculating the carbon footprint. For tourists seeking to offset travel-related emissions, this requires estimating the emissions generated throughout their journey. Calculating the exact carbon footprint can be complex due to multiple emission sources, so it's often simplified by focusing on the major contributors. Tools such as online carbon footprint calculators are commonly used to estimate emissions from various travel activities, including commercial flights, car rentals, road trips, cruises, yachting, dive liveboards, and private jet charters. Apart from separate calculations by tourists, tourism businesses can aggregate emissions and package offsets to facilitate tourists' offsetting.

The next step is purchasing offsets from a trustworthy provider. Tourists can easily compensate for their CO₂ emissions by purchasing carbon offsets that support environmental projects elsewhere in the world. For every metric ton of CO₂ generated, an equivalent amount is neutralized through these initiatives. Carbon offsetting involves funding projects dedicated to reducing greenhouse gases, and it is generally an inexpensive option. For example, offsetting the emissions from a ten-hour flight via Cool Effect costs only around \$28 (American Airlines, 2022). However, the price per metric ton of CO₂ can vary significantly depending on factors such as project type and location.

When offsetting footprints, it is also essential to ascertain the efficacy of the carbon offset projects they endorse—ensuring that a reputable provider is chosen and that the project has certifications under an internationally recognized standard. In addition, tourism companies can also purchase offsets to mitigate carbon emissions from their consumers and corresponding business operations.

Individual tourists' investment in carbon offsets will help fund projects that reduce carbon emissions. These projects achieve their goals by either extracting CO₂ already present in the atmosphere or by preventing additional emissions. Beyond carbon mitigation, offset projects

have sustainable co-benefits, including supporting local communities and protecting biodiversity.

Offset as an Impure Public Good

Voluntary carbon offset can be regarded as a kind of impure public good, which embodies features of both private and public goods, creating a distinctive hybrid nature (Conte & Kotchen, 2009). This dual identity underscores the nuanced role of voluntary carbon offsets in concurrently addressing individual and collective environmental concerns.

On the public goods front, the environmental benefits of emissions reduction achieved through voluntary offsets exhibit non-excludable and non-rivalrous attributes (Maloney, 2022). These benefits extend beyond the purchaser and contribute to global environmental well-being. The offsets' global impact, reducing emissions on a broader scale, further aligns with the characteristics of public goods. Adherence to certification standards like the Verified Carbon Standard or the Gold Standard also ensures transparency and credibility, contributing to the public good. According to traditional economic theory, the volume of voluntary offset consumption is unexpectedly high because individuals might not be motivated to purchase offsets if they can enjoy improved environmental quality without doing so. This apparent contradiction is mitigated in imperfect public goods, where both public and private benefits are conferred, thereby diminishing the challenge of free riding (Maloney, 2022; Mason & Charles, 2011).

Purchasing carbon offsets contributes to the fight against global climate change while also providing notable personal benefits. When individuals invest in offsets, they often gain a profound sense of satisfaction and purpose—knowing they have taken meaningful action against climate change. This psychological boost, known as the “warm glow” effect, can motivate greater contributions to environmental protection than traditional market incentives

would predict. Furthermore, voluntary carbon offset purchases are closely linked to alleviating feelings of guilt (Kotchen, 2009a; Maloney, 2022). According to Kotchen (2009b), purchasing carbon offsets is frequently likened to the historical practice of buying indulgences from the church as a form of moral absolution.

Offset as a Novel Sustainable Product

Voluntary travel carbon offsets could also be regarded as sustainable products, enabling individuals, organizations, and businesses to take responsibility for their carbon emissions (Lovell et al., 2009). Through financing initiatives that mitigate or sequester greenhouse gas emissions, these offsets contribute to overall reductions in carbon footprints. The funds generated from the purchase of carbon offsets support sustainable initiatives, including renewable energy projects, afforestation, and energy-efficiency improvements (Procton, 2024). The positive environmental impact extends beyond carbon reduction, encompassing biodiversity conservation, ecosystem restoration, and community development.

However, voluntary carbon offsets differ from traditional sustainable products (e.g., fair trade goods and local organic foods) in several ways (Eijgelaar, 2011; Hyams & Fawcett, 2013; Lovell et al., 2009).

Firstly, voluntary carbon offset is an intangible product- the purchase represents reductions in greenhouse gas emissions in the atmosphere. Consequently, consumers do not receive a physical product, except for perhaps a certificate. Secondly, and related to this point, purchasing carbon offsets does not yield immediate tangible benefits for consumers (i.e., indirect use value), unlike products such as organic food, which offer recognized advantages in taste and health (Heal et al., 2004; Seyfang, 2007). A third distinguishing characteristic is the voluntary carbon market's limited regulatory oversight. Unlike fair trade or organic certification systems, which operate within well-defined governance structures and

standardized labeling regimes, voluntary carbon offsets currently operate without universally adopted international standards or authoritative eco-certifications. This regulatory gap creates fundamental differences in market structure and consumer assurance mechanisms between carbon offsets and other ethical consumption products. The absence of stringent regulation in voluntary carbon markets lowers barriers to entry, thereby fostering increased innovation, efficiency, and the participation of smaller-scale initiatives (Maloney, 2022), the foundation allowing diverse offset products with multiple “co-benefits.” However, the uncommon intangibility of carbon offsets indicates the pivotal role of narratives in shaping how consumers comprehend and engage with this product.

2.1.4 Evolving Narratives of Travel Carbon Offset

The acquisition of travel-related carbon offsets is emerging as a distinctive consumption practice within the intricate landscape of voluntary carbon offsets, characterized by diverse narratives. According to Lovell et al. (2009), diverse narratives are essential for the production and consumption of voluntary offsets. Such narratives serve as vital discursive mechanisms through which offset schemes have been strategically developed, institutionally legitimized, and effectively communicated to corporate actors and individual consumers alike. In addition, because a product is intangible, complex, and novel, voluntary offsets must be presented clearly and understandably to potential consumers. The existing narratives of the carbon offset market could be categorized into three forms (Lovell et al., 2009): “quick fix for planet,” “global-local connections,” and “avoiding the unavoidable.” This study builds on this literature but moves beyond a simple translation to tourism. Specifically, we (1) situate TCO as a compensatory, add-on, credence-based action within sustainable travel behavior (distinct from avoid, reduce or replace), and (2) identify travel-specific mechanisms—checkout timing (before, during and after travel), platform intermediation (airlines/ online travel agencies/hotels as gatekeepers),

credence risk and certification, and origin–destination relationality (national symbolism, climate justice)—that reconfigure how narratives operate in practice.

Quick Fix for Travel Carbon Footprint

The primary narrative in the carbon offset market centers on the urgency of addressing climate change as a planetary crisis, emphasizing the need for immediate action.

Organizations like the CarbonNeutral Company leverage scientific assessments—including landmark reports like the Stern Review on climate economics and Intergovernmental Panel on Climate Change assessment reports—to validate and amplify the urgency of climate-related risks. Within this narrative, voluntary offsets are positioned as both credible and time-sensitive solutions, offering consumers direct agency to act now rather than relying on gradual shifts in institutional policies or personal habits. The efficiency of offsetting, with its quick response, low transaction costs, and economic effectiveness, is emphasized. The narrative positions voluntary offsetting as a crucial component of effective climate policy, given its speed and cost-effectiveness. However, the narrative’s efficiency relies on future accounting practices and loosely regulated standards in the voluntary market (Hyams & Fawcett, 2013).

In the tourism context, the “benefit” of quick responses makes such “quick fix” solutions dominant in the industry decarbonization, especially in the aviation industry. To make a real impact, the entire industry must work together to create effective carbon offset narratives. In aviation in particular, offsets are offered as an optional add-on at the point of ticket purchase, positioning them as a rapid and relatively painless way to neutralize emissions. The appeal of speed and cost-effectiveness resonates strongly with travelers seeking to mitigate their carbon footprint without altering their travel plans. Yet the travel-specific expressions of this narrative are not merely rhetorical: it is shaped by the design of checkout flows, the limited attention of tourists, and the role of certification as a critical trust signal. Despite the appeal of the narrative,

ethical dilemmas arising from everyday activities and significant life events (e.g., travel) are brought to the forefront, requiring consideration and deliberation (Dhanda & Hartman, 2011; Hyams & Fawcett, 2013). The credibility of the “quick fix” therefore depends not only on climate urgency but also on the institutional scaffolding of the travel industry, which underlies consumer trust and determines whether offsets function as meaningful action or an educational tool.

Origin-Destination Connections

The second narrative in the carbon offset market shifts the emphasis from temporal climate urgency to geographical dimensions of mitigation, emphasizing the interconnectedness of the global community. It argues that emissions reductions can happen globally without physical barriers, as atmospheric gases mix universally.

The narrative suggests that particular advantages can be gained by positioning emission reduction in the Global South, where costs are lower, and technology transfer or innovation is possible. This economic argument aligns with the concept of comparative advantage, arguing that investments in developing countries could yield greater environmental benefits. The narrative connects the global and the local by highlighting the human dimension of carbon offsetting while underscoring ancillary sustainability benefits, such as biodiversity conservation and poverty alleviation. Offset companies boost marketability by linking buyers to specific environmental projects in the Global South.

This narrative borrows from sustainable development and fair trade narratives, framing carbon offsets as ethical and sustainable products. The emphasis on tangible benefits, such as poverty alleviation and rainforest preservation, adds legitimacy and dispels doubts about the positive impact of offsetting. The narrative also allows consumers to choose projects that resonate with

their personal values, fostering a sense of identification and emotional engagement with the offsetting initiative (Bryant & Goodman, 2004).

Inspired by the idea of “global-local connections,” the narratives of travel carbon offset could build connections between tourists and destinations. Offsetting in this domain is not only about reducing emissions somewhere in the world but also about linking the traveler’s journey to a specific place, whether at the point of departure, the destination, or through symbolic national and cultural affiliations. Offset schemes marketed through this narrative often emphasize co-benefits such as biodiversity conservation, cultural heritage, or local livelihoods, thereby resonating with travelers’ values and enhancing the sense of personal engagement. Importantly, this narrative reconfigures global-local relations as origin-destination ties specific to tourism: travelers frequently prefer projects framed as domestic or destination-based, perceiving them as fairer, more transparent, or more emotionally resonant. This narrative embeds offsetting within broader debates on national symbolism and climate justice.

The Last Step in Tourism Decarbonization

The third narrative framework diverges from globalized climate discourses, instead centering on the pragmatic realities of persistent emissions. This narrative appeals to reason, presenting offsetting as an essential compensatory mechanism for residual emissions that remain after implementing energy efficiency measures and transitioning to cleaner energy sources (Lovell et al., 2009). It targets environmentally literate consumers who incorporate offsets into a broader strategy of carbon-reduction practices, emphasizing self-control and the governance of individual consumption. Unlike the “origin-destination” narrative, it focuses on the consumer rather than the production of offsets.

This narrative deviates from conventional ethical consumption concepts, as it doesn’t center on political ecology issues or shortening the production-consumption chain. Instead, it

emphasizes how Northern consumers can comprehensively adapt their behavior to address climate change. The offset purchase becomes the culmination of a carbon assessment, calculation, measurement, and audit process, allowing consumers to quantify their impact. The narrative operationalizes “energy hierarchy” as a strategic planning tool (IEMA, 2020) (see **Figure 2.2**), advocating a sequential approach: (1) avoid energy consumption, (2) reduce energy consumption or transition to renewable sources, and (3) only then utilize carbon offsets as a last resort.

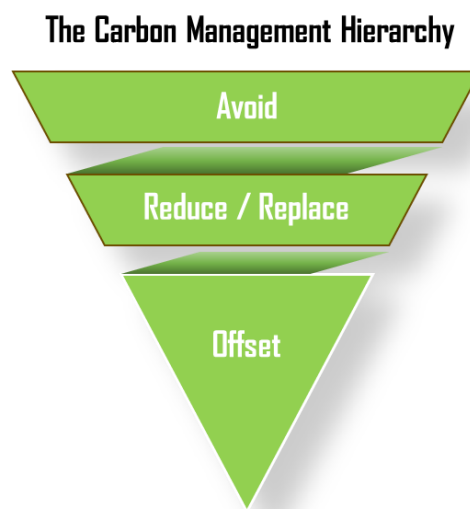


Figure 2.2 Carbon management hierarchy

Considering the “avoiding the unavoidable” principle, this study calls for co-creating narratives from the demand, supply, and governance sides. It suggests that tourism should reduce travel emissions before offsetting, and that all other narratives of travel carbon offset should treat themselves as part of the decarbonization system.

This thesis provides a narrative of carbon offset in a tourism setting, namely travel carbon offset, a form of voluntary carbon offset product that combines the characteristics of both travel and voluntary carbon offset, where tourists can compensate their travel carbon emissions by contributing to carbon offset projects. It is not merely a replication of existing offset narratives, but a reconfigured practice shaped by the temporal and geographic characteristics of tourism.

Context-specific mechanisms, such as checkout timing, platform intermediation, certification signals, and origin-destination relationality, reshape established discourses and generate new insights into the intersection of economic preferences and behavioral processes. These narratives lay the foundation for the analyses conducted in Studies 1–3.

2.1.5 Trust Issue Behind Travel Carbon Offset

“As a hypothesis regarding future behavior, a hypothesis certain enough to serve as a basis for practical conduct, confidence is intermediate between knowledge and ignorance. The person who knows completely need not trust.”

(Simmel, 1950, P.318)

Tourists decide under pronounced information asymmetry because offsets generate indirect value, and the underlying processes are both intangible and complex. The process linking the tourist, offset provider, and project to the ultimate reduction of atmospheric CO₂ involves several layers of delegation and technical verification that are not directly observable. This structure situates offsetting between the knowable and the unknowable, thereby creating an inherent need for trust. The effectiveness of carbon offsets in mitigating climate change has been a topic of ongoing debate since its inception (Hyams & Fawcett, 2013; Watt, 2021). The public’s skepticism and hesitance towards the credibility, effectiveness, and integrity of carbon offset measures have increased, resembling a series of greenwashing events, such as a lawsuit against Dutch airline KLM in 2022 (Thomas, 2022). This lack of trust has posed major challenges to the implementation and overall success of various offset initiatives (McNish, 2012; Watt, 2021), prompting the need for research on trust in tourism decarbonization.

Diverse disciplinary perspectives have contributed to the discourse surrounding trust. Differences in disciplinary perspectives evident in conventional approaches to the concept of

trust indicate the presence of inherent conflicts and divergent assumptions (Fichman, 1997) and involve different levels (individual, firm, and institutional).

Economists typically view trust as either calculative, following the ideas of Williamson (1993), or institutional, as emphasized by North (1990). Psychologists, following the work of Rotter (1967) and Tyler (2006), generally assess trust by examining the attributes of trustors and trustees and delving into various internal cognitions arising from personal characteristics. Sociologists offer a distinct approach, analyzing trust either as an emergent property of social relationships (Granovetter, 1985) or as a product of institutionalized expectations and norms (Zucker, 1986).

From a multidisciplinary perspective, Rousseau et al. (1998) investigated the shared understanding of trust across disciplines and groups and found that trust constitutes a psychological condition encapsulating the psychological state that manifests at individual, interpersonal, and organizational levels. There is a “meso” concept of trust: “the intention to accept vulnerability based on positive expectations of the intentions or behaviors of another” (p. 395). Trust derives from beliefs in trustees’ integrity, benevolence, and ability (Ganesan, 1994; Schurr & Ozanne, 1985).

In their examination of eco-conscious consumption, Chen (2010) conceptualized green trust as a consumer’s confident dependence on an environmentally positioned product, service, or brand. This psychological disposition emerges from the perceived environmental competence (ability), ethical orientation (benevolence), and overall reliability (credibility) of the offering’s ecological claims and performance. Green trust, which indicates a consumer’s confidence in a product or service provider’s environmental claims and actions, plays a pivotal role in shaping individuals’ decisions about their carbon offset choices.

Certification schemes such as the Gold Standard and the Verified Carbon Standard function as institutionalized trust signals by translating technical information into recognizable assurances of quality. Transparency initiatives, third-party verification, and post-purchase feedback further strengthen perceived credibility. However, inconsistencies in certification quality and the proliferation of exaggerated claims heighten tourists' perceptions of greenwashing risk (Chen et al., 2019). The coexistence of intangible benefits and unverifiable outcomes makes trust a decisive factor determining whether tourists accept the legitimacy of offsets as effective climate actions.

Empirical evidence consistently demonstrates the role of trust in shaping pro-environmental intentions and behaviors (Charness & Rabin, 2002; Ranaweera & Prabhu, 2003; Sung et al., 2021). Businesses have overstated or even fabricated the environmental performance of their green products, leading to customer distrust of the green market (Chen et al., 2019; Kalafatis et al., 1999). Chen (2010) pointed out that green trust influenced customers' purchase decisions for green products. Tourism research has consistently indicated that green trust positively influences people's pro-environmental behavior and intentions (Chen & Chang, 2012; Chuah et al., 2022). In a study on greenwashing in hotels, Chen et al. (2019) demonstrated that when hotel guests trust a property's green credentials, they are more likely to return, participate in eco-friendly practices during their stay, and recommend the hotel to others. Similarly, Schwirplies et al. (2019) found that people who view carbon offsets as effective climate solutions show greater willingness to purchase them.

In addition, trust in a company/institution is viewed as a fundamental requirement for cultivating enduring relationships (Chaudhuri & Holbrook, 2001; Denton et al., 2020; Reichheld & Scheffer, 2000). Trust stands out as a pivotal factor influencing customers'

inclination to engage in a prolonged and mutually beneficial business relationship with a company/institution (Ganesan, 1994; Schurr & Ozanne, 1985).

2.2 Choice and Pro-Environmental Behavior

While the previous sections focused on the context and characteristics of travel carbon offsets, understanding tourists' offsetting behavior requires a deeper exploration of decision-making theories. The following section reviews theoretical frameworks related to choice behavior and pro-environmental behavior, providing the conceptual foundation for analyzing tourists' carbon offset decisions.

2.2.1 Choice Behavioral Theories

Virtually every action undertaken by humans encompasses a decision, whether consciously or subconsciously, even including the decision not to make a choice (Hensher et al., 2015). Ongoing scientific investigations across diverse disciplines have continuously explored the reasons and mechanisms behind human decision-making since the inception of our curiosity about why and how we make particular choices.

The decision-making literature can be divided into process-oriented behavioral choice analysis and structure-oriented predictive choice models (Abelson & Levi, 1985). The process-oriented perspective considers the (pro-environmental) decision-making as a dynamic and evolving process, exemplified by behavioral approaches (Ajzen, 1991; Schwartz, 1977; Stern, 2000) and the choice-set approach (Brisoux & Laroche, 1981; Haines et al., 1970; Narayana & Markin, 1975). This perspective emphasizes understanding the intricacies of how decisions about products/services unfold. They specifically delve into the characteristics of various stages within the consumption choice process, highlighting the cognitive and behavioral processes involved in decision-making. It recognizes that decision processes may deviate from strict

rationality and can be influenced by psychological factors, social norms, and contextual cues (McCabe et al., 2016; Pearce & Packer, 2013; Qiu, 2018; Sirakaya & Woodside, 2005; Smallman & Moore, 2010). Process-oriented models often incorporate insights from psychology. The choice-set approach recognizes the selective consideration of alternatives in decision-making, shedding light on how individuals navigate and narrow down their options within the constraints of information processing and cognitive limitations.

A variety of studies have centered on process-oriented methods to examine the psychological drivers of pro-environmental behavior, informing environmental communication strategies through established theoretical frameworks, such as the TPB (Ajzen, 1991), the NAM theory (Schwartz, 1977), the VBN theory (Stern, 2000), and the Goal Framing Theory (GFT; Lindenberg & Steg, 2007). Beyond the decision model, behavior change frameworks that emphasize the change process through stage-based models have gained considerable attention. Notable examples include the Transtheoretical Model (TTM; Prochaska & DiClemente, 1983) and the Stage Model of Self-Regulated Behavioral Change (SSBC; Bamberg, 2013), both of which have been widely popular (Kurusu, 2015).

In contrast to studies under process-oriented frameworks, a separate body of literature views choice as a static issue and adopts a structure-oriented approach (Lancaster, 1966). Disregarding the decision-making process itself, these studies emphasize regularities in choice behavior, employing quantitative models that are predictive in nature. They center on a decision's structure or components, scrutinize the trade-offs among influencing factors, and assess the value attributed to each alternative.

Lancaster's Characteristics of Consumer Goods Framework (Lancaster, 1966), introduced in the field of microeconomics, conceptualizes consumer goods based on their inherent characteristics. This framework categorizes goods according to specific attributes, providing

insights into consumer preferences and behavior. Goods are defined by their attributes or characteristics, representing the features consumers seek when making purchasing decisions. Lancaster introduced the concept of a “consumption vector,” reflecting the bundle of attributes a consumer values in a good. Consumer preferences are driven not by goods per se, but by their underlying attributes, with utility being generated through these attribute combinations. This foundational work, combined with the RUM, established the basis for discrete-choice modeling by shifting the analytical focus from whole products to their constituent features.

The review of choice behavioral theories thus provides the scaffolding for research on travel carbon offsets. Process-oriented models elucidate how psychological and contextual factors motivate offset decisions, whereas structure-oriented models capture the attribute trade-offs embedded in those decisions. Although these traditions offer distinct yet complementary insights, systematic integration remains limited.

Ben-Akiva et al. (2002) advanced this integration by proposing an expanded discrete—choice framework—now commonly termed the hybrid choice model. The HCM enables the incorporation of latent psychological constructs—such as attitudes, perceptions, and trust—into a utility-based framework, thereby linking unobservable behavioral factors with observable choices. In doing so, it acknowledges the incomplete overlap between behavioral (process) and predictive (structure) approaches to choice analysis (see **Figure 2.3**). While HCMs successfully embed cognitive elements within a RUM framework, they do not fully reproduce the sequential and experiential dynamics emphasized by process-oriented theories.

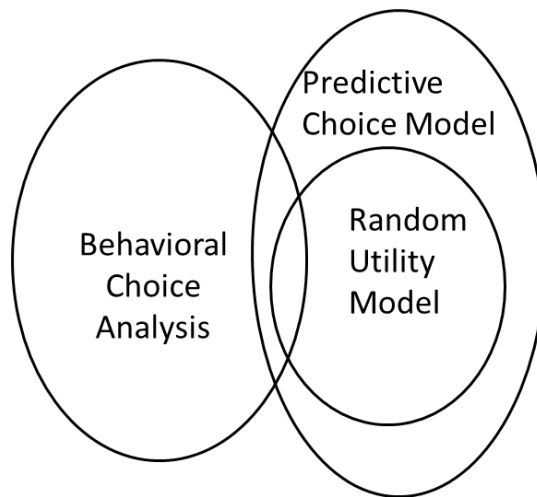


Figure 2.3 Domains of choice research

2.2.2 Pro-Environmental Behavior Theories

Extant research has systematically examined the psychological drivers or barriers of pro-environmental behavior through process-based frameworks that inform environmental communication. Decarbonization foregrounds the environmental dimension of sustainable travel; engaging this literature sharpens the conceptual basis for understanding carbon-offset decisions. Building on these foundations, this section primarily informs the present thesis—especially Study 3—by guiding the design of interviews, thematic coding, and the interpretation of motives, attitudes, norms, and other mechanisms underlying offset choices.

TPB (Ajzen, 1991) is the theoretical framework that is most frequently employed in research on environmental psychological decision-making. According to the TPB, human behavior is primarily derived from three cognitive antecedents: attitude, subjective norm, and perceived behavioral control. Attitude refers to an individual's positive or negative evaluation of performing a particular behavior. Subjective norm involves the perceived social expectations or pressures regarding whether one should engage in the behavior. Perceived behavioral control refers to a person's belief in their ability to perform a behavior, taking into account internal and

external factors that may facilitate or hinder it. The TPB suggests that these three components collectively shape an individual's behavioral intention, which serves as the most immediate predictor of actual behavior. According to a poll of Swedish air travelers, Gössling et al. (2009) reported that opinions regarding offsetting projects among travelers were divided between those who saw it as a chance to launch an offsetting product and those who did not. Wu et al. (2023) investigated 1002 visitors to a protected mountain in China and discovered that visitors' low-carbon attitudes and behaviors are related.

NAM (Schwartz & Howard, 1984), another well-liked theory in environmental psychology, was initially developed to explain altruistic behavior, such as assisting those in need. The theory was originally designed to explain behavior in morally relevant contexts rather than all behavioral types, thereby distinguishing it fundamentally from the TPB. Despite this specific scope, it has been widely adopted in environmental psychology due to its superior capacity to account for moral motivations in ecological decision-making. The framework posits dual determinants of behavior: (1) internalized personal norms and (2) contextual situational factors. Personal norms are internalized values or beliefs that individuals hold about what is right and wrong. These norms can be influenced by personal experiences, cultural or religious background, and socialization. The theory posits that individuals are driven to align their actions with internalized personal norms due to an underlying sense of moral compulsion—a psychological imperative stemming from perceived ethical responsibilities. Situational factors refer to the contextual cues or social norms that can influence behavior. For example, if an individual observes others engaging in a particular action, they may be more inclined to follow suit. The NAM proposes that situational factors can activate an individual's personal norms, thereby increasing the likelihood of engaging in a specific behavior. For example, Teng et al. (2015) distributed a questionnaire to residents from Taiwan. They found altruism positively

influenced their intention to stay at a green hotel. Wang et al. (2022) also identified a positive relationship between altruistic values and the intention to stay at green hotels.

Stern's VBN theory (2000) builds upon and extends the NAM theory by formalizing the relationships among key variables and linking the activation of personal norms to deeper value orientations. The theory proposes that an individual's behavior is shaped by three factors: personal values, beliefs about the consequences of their actions, and social norms. Personal values serve as internal guiding principles that help individuals determine what they consider important and worthwhile. According to the VBN framework, people are more likely to engage in behaviors that align with their core values. Beliefs about the consequences of actions refer to individuals' perceptions about the outcomes of their behavior. For example, if an individual believes that their behavior can positively impact the environment, they may be more predisposed to make eco-friendly choices. The VBN theory suggests that individuals demonstrate a greater propensity to adopt actions perceived as instrumentally effective in achieving valued consequences. Social norms are the shared expectations or standards of behavior within a community. The VBN theory suggests that individuals are more inclined to engage in actions that align with these norms. The theory proposes that these three factors interact to influence behavior. While values and beliefs drive an individual's motivation to act, social norms establish the social framework within which such behavior occurs. Together, these factors encourage individuals to act in ways that are consistent with both their internal motivations and external social expectations.

GFT explains how the way goals are presented can influence people's motivation and behavior. The theory suggests that how a goal is framed or presented to individuals can influence their motivation to pursue it and how they go about achieving it (Klößner, 2015). In goal-framing theory, the primary factor influencing behavior is the activated goal. Goals are expected to

guide attention, shape accessible knowledge and attitude structures, and determine which behavioral alternatives are considered during decision-making. Goal-framing theory also assumes that people have multiple goals at once and that these goals are arranged in a hierarchy. Goals that are less salient at a given moment exert little or no influence on information processing or behavior, while dominant goals guide decisions. These goals may also conflict with one another. For example, a dilemma may arise when an individual wants to attend a conference but also aims to minimize their environmental impact. The objective of attending a distant conference conflicts directly with low-carbon transportation choices - while aviation enables timely participation, its carbon intensity violates environmental commitments, and surface transportation's climate benefits preclude practical attendance. Numerous other factors, including clues about the situation, the presence of other individuals, and what they do, determine which objective is prioritized or activated in a specific circumstance. An individual typically strives to act in accordance with what is perceived as appropriate within the currently activated goal frame, regardless of which goal holds the highest overall priority. The cognitive representations activated by the relevant goal frame shape the perception of appropriate behavior. According to Lindenberg and Steg (2007), there are three overarching goal frames: the hedonic, gain, and normative goal frames. The hedonic goal frame involves considerations such as seeking pleasure, minimizing effort, and avoiding discomfort or negative emotions. The gain goal frame is primarily concerned with acquiring or preserving personal resources, including time, money, and status. The normative goal frame activates the "right thing" and other goals. For instance, by experimenting with UK residents, Hafner et al. (2019) conducted an experimental study and found that the provision of normative information significantly increased the likelihood of pro-environmental choices.

While the above theories primarily focus on how individuals make pro-environmental decisions, a parallel stream of research emphasizes behavior change over time through stage-

based models. These models conceptualize behavior change as a progressive process involving multiple phases.

The TTM was developed by Prochaska and DiClemente (1983) to conceptualize behavior change as a temporal and staged process. It proposes that individuals move through six sequential stages: pre-contemplation, contemplation, preparation, action, maintenance, and termination. Each stage reflects a qualitatively distinct mindset regarding behavior change, ranging from no intention to act (pre-contemplation) to complete commitment and habit formation (termination). Central to TTM is the notion that different psychological processes dominate at different stages. Early stages involve cognitive and emotional strategies, such as raising awareness and self-evaluation, while later stages rely more on behavioral processes, such as reinforcement management and stimulus control. Howell (2014) demonstrated that the model can be applied beyond clinical settings by evaluating how climate change documentaries can foster mitigation behaviors. Despite its widespread application, critiques of TTM note that its stage definitions may sometimes blur, and real-world behaviors may follow a more continuous rather than discrete path of change. Nevertheless, the TTM remains influential for its recognition that interventions must be stage-matched, providing different types of support depending on individuals' readiness for change.

To address the limitations of TTM, particularly in environmental behavior contexts, Bamberg (2013) introduced the SSBC. The SSBC integrates principles from Heckhausen and Gollwitzer's (1987) Model of Action Phases and draws on elements of the TPB and the NAM, offering a more dynamic, self-regulatory perspective on behavior change. The model delineates four successive stages. In the predecisional stage, individuals recognize a problematic behavior and form a goal intention to reduce its negative consequences. In the pre-actional stage, individuals develop a specific behavioral intention to adopt an alternative action. The actional

stage involves the implementation of alternative behavior, which requires planning and coping with situational barriers. Finally, in the post-actional stage, the focus shifts to maintaining the new behavior and managing the risks of relapse. Each stage is characterized by distinct psychological tasks and drivers, such as moral norms influencing the pre-decisional stage and perceived behavioral control shaping the pre-actional stage. Empirical evaluations of the SSBC suggest that interventions tailored to an individual's stage are more effective than non-tailored approaches in promoting sustainable behaviors, such as reducing car use and meat consumption. The SSBC advances previous frameworks by explicitly addressing longitudinal change processes and highlighting the centrality of self-regulation skills throughout the behavior change trajectory.

In contrast to stage-based frameworks, the Capability, Opportunity, Motivation–Behavior (COM-B) model developed by Michie et al. (2011) conceptualizes behavior change as a function of the dynamic interaction between three essential components: capability, opportunity, and motivation. According to the COM-B model developed by Michie et al. (2011), behavior is the result of an interaction between three key components: individuals must have the necessary physical and mental abilities, access to environmental and social conditions that allow the behavior, and sufficient motivation, which includes both deliberate decision-making and instinctive emotional responses. Unlike models that describe behavior change as a sequence of stages, the COM-B model views behavior as emerging from the ongoing balance and interplay of these three factors. Capability and opportunity shape motivation, and all three components, in turn, are affected by the outcomes of past behaviors. This systemic perspective is designed not only to diagnose why a particular behavior occurs or fails to occur but also to guide the selection of intervention strategies. The COM-B model serves as the foundation of a behavior change wheel framework, linking behavioral analysis to practical intervention functions, such as education, persuasion, incentivization, and environmental restructuring. Its

strength lies in its structured approach to intervention design, ensuring that behavior change strategies systematically target deficits in capability, opportunity, or motivation depending on the behavioral diagnosis.

Together, these three models offer a comprehensive theoretical foundation for analyzing behavior change processes. The TTM emphasizes the progressive stages of readiness and provides guidance on tailoring interventions based on individuals' positions in the change process. The SSBC focuses on the self-regulatory mechanisms and psychological tasks that facilitate advancement toward sustainable behavior. The COM-B model introduces a dynamic systems perspective, highlighting the necessary conditions for behavior to occur and offering a direct, structured pathway from behavioral diagnosis to intervention design. Understanding and integrating these theoretical perspectives is critical for developing effective strategies to foster pro-environmental behaviors, including those related to carbon offset consumption.

2.2.3 Discrete Choice Modeling

People are inherent traders, making decisions by consciously or unconsciously evaluating options and choosing an action, which is referred to as a choice outcome. While the decision maker might perceive the observed outcome as straightforward, the analyst seeking to interpret this outcome using observed data will inevitably face informational limitations that prevent a fully comprehensive explanation (Hensher et al., 2015).

This thesis requires a conceptual framework that focuses on identifying the fundamental factors shaping a tourist's decision-making regarding carbon offsetting. Accordingly, Studies 1 and 2 will incorporate economics and the aforementioned structure-oriented decision-making framework, starting with the point that an individual's choices are primarily determined by their preferences for specific alternatives, whether goods or services. Subject to existing constraints, individuals' preferences for alternative offsets shape their purchasing decisions.

The sum of these individual choices represents the total demand for TCO within the market. Rather than relying on aggregated demand analysis, discrete choice models—which operate at the disaggregate (individual) level—can provide deeper insights into tourists’ TCO preferences and decision-making behavior.

Since choices are discrete, conventional continuous-outcome models (e.g., linear regression) are not applicable. Prior to the 1960s, economists mainly used consumer theory as a conceptual tool to examine the properties of different market structures and the implications of economic policies. When empirical applications were pursued, the focus was often on aggregate-level data (McFadden, 2001). The observed data on choices provide insights into the individual’s preferences across a discrete set of alternatives presented in a discrete categorical format. These preferences reflect underlying latent utilities—continuous, unobserved variables that quantify the strength of preferences. While observed choices reveal only relative preferences among available alternatives, the latent utility framework theoretically permits regression-based analysis if these utilities were directly measurable.

Alternative methods are necessary when available information reveals only relative preferences through discrete choice outcomes (Hensher et al., 2015). The exploration of these concepts dates back to Thurstone’s (1927) study of psychophysical discrimination, in which he introduced the “law of comparative judgment.” This law posits that each alternative is interpreted as comprising a deterministic “stimulus” component combined with a normally distributed random error. The likelihood of choosing a particular alternative depends on the comparative strength of these “stimuli” across all options. This foundational idea, first proposed by Thurstone (1927), is now recognized as the binomial probit model.

Building on Thurstone’s work, Marschak (1959) introduced the term “utility” to describe what Thurstone had called “stimuli” and formulated a RUM model within the economic literature.

The utility serves as a measure of a consumer's satisfaction with a product, indicating that satisfaction is determined by the utility a consumer perceives from the combination of product attributes. The RUM characterizes choice as a discrete event, treating the utility associated with each option as a random variable that reflects both observed and unobserved influences. The RUM assumes that individuals make decisions by selecting the option that maximizes their utility, which is influenced by both observable and unobservable factors. That is, people tend to choose what they prefer, and any deviations from this pattern are attributed to random, unobserved factors.

Within the domain of predictive choice models, the RUM is the fundamental framework for the discrete choice models. Luce (1959) introduced the independence from irrelevant alternatives (IIA) axiom in psychology. This assumption holds that the probability of choosing a given alternative remains unchanged by the inclusion or exclusion of irrelevant options. In other words, the relative preference between two alternatives should not be influenced by the presence of a third, unchosen option. This property simplifies the estimation of multinomial choice probabilities from binary-choice data. Building on the work of Marschak (1959) and Luce (1959), McFadden (1974) developed a conditional logit model, now widely known as the multinomial logit (MNL) model.

Studies on discrete choice models spanning from the 1970s to 2010 are characterized by significant advancements in the MNL model (**Equation (3.6)** in Chapter 3), primarily led by Dan McFadden (Hensher et al., 2015; McFadden, 2001). Methodological contributions from McFadden's projects included advances in choice-based sampling, simulation techniques, and statistical procedures for the specification and testing of the nested logit (NL) model.

The NL model was developed to overcome the limitations of the IIA condition by explicitly addressing dissimilarity within the RUM framework. The NL model accommodated

differential variance in unobserved influences across the alternatives in the set, addressing concerns about decision trees.

Between the mid-1970s and 2010, significant advancements were made in the theoretical development, computational methods, and empirical implementation of closed-form discrete choice models, particularly the MNL and NL models. Morikawa's methodological innovation enabled the consistent integration of discrete-choice datasets via scale-parameter estimation, preserving RUM theoretical consistency. His approach strategically employed the nested logit formulation as a computational device to identify and calibrate scale differences across pooled data sources.

Challenges remained, leading to breakthroughs such as simulated moments and the exploration of more complex choice models, including random-parameter logit and error-components logit. These models capture various forms of unobserved preference heterogeneity. Despite these advancements, traditional discrete choice models remained largely structural, focusing on observable trade-offs but omitting the unobservable cognitive or affective processes underlying choice. Responding to this gap, hybrid choice models—which integrate discrete choice models with latent variable frameworks—were developed to better align economic approaches with behavioral theories (Ben-Akiva et al., 2002; Hess & Daly, 2014). By incorporating unobserved psychological constructs—such as attitudes, perceptions, and decision-making protocols—hybrid models offer a more holistic representation of individual choice behavior. Building on this synthesis, the current thesis employs a hybrid choice framework in Studies 1 to quantify tourists' attribute preferences and to examine how unobservable psychological factors—derived from pro-environmental behavior theories—shape offsetting behavior.

2.2.4 Determinants of Travel Carbon Offset Choice

Stern (2000) categorized pro-environmental behavior into two spheres: private behaviors, encompassing habits, consumer choices, and resource recycling, and public behaviors, including endorsing environmental policies and encouraging others to engage in eco-friendly activities. Purchasing carbon offsets can be regarded as a kind of pro-environmental consumer choice.

Consumer choices are influenced by both external and internal factors (Bangsa & Schlegelmilch, 2020). The external factors include alternative-specific factors and contextual factors (Wu et al., 2023). In the context of offsetting consumption, alternative-specific factors include product attributes such as mitigation amounts, offset providers, project types, locations, and prices. Contextual factors include trip-specific factors and social and political situations. Internal factors are defined as factors that differ from external factors and refer to offsetter-specific factors, including personal psychological factors such as low-carbon attitudes and motivations, climate change knowledge and perceptions, and objective demographic characteristics, such as age, gender, and income.

Table 2.1 summarises the main factors influencing offset consumption choices in previous studies on assessing individuals' preferences and values for voluntary carbon offset in tourism.

Table 2.1 Key influences on voluntary carbon offset decisions in tourism

Study (year)	Factors		Methods (Models)	Sample	Setting
	<div style="display: flex; justify-content: space-between;"> External factors Internal factors </div>				
	Product attributes	Contextual factors	Psychological factors	Socio-demographic	s and other

(Brouwer et al., 2008)	Price	/	Awareness; Perceived responsibility; Perceived consumer effectiveness	/	CV	Travelers at Dutch airport	Airline
(Gössling et al., 2009)	/	/	Attitude; Emotion; Environmental knowledge; Offset knowledge;	/	Survey study	Travelers at Swedish airport	Airline
(MacKerlon et al., 2009)	Certification; Offset provider; Price; Project type	/	Environmental knowledge/concern; Offset knowledge/concern; Co-benefits	Income ; Gender ; Marital status	DCE	UK residents	Airline
(Mair, 2011)	/	/	Attitude	Age; Gender ; Region of residence	CV	Australia and UK offsetters	Airline
(Lu & Shon, 2012)	/	Travel-specific characteristics	Perceived consumer effectiveness; Offset knowledge	Age	CV	Taiwanese air travelers	Airline
(Chen, 2013)	/	/	Attitude; Subjective norms; Emotions	/	Survey study	Taiwanese air travelers	Airline

(Blasch & Farsi, 2014)	Certification; Offset contributions; Offset provider; Price; Project location; Project type	Consumption context as attributes	Social norms; ascription of responsibility	Age; Gender; Income	DCE	Swiss residents	Four consumption contexts
(Choi & Ritchie, 2014)	Offset contributions; Price; Project location; Project type; Airline measures	/	Attitudes; Perceived consumer effectiveness; Social norms;	Age; Income; Gender; Marital status	DCE	University students/staff	Airline
(Lim & Yoo, 2014)	/	/	Knowledge; Value	Gender; Education; Income; Age	CV	Residents of Seoul, Incheon, and Gyeonggi	Railways
(McLennan et al., 2014)	/	/	/	Age; Region of residence	Secondary data	Australia inbound tourists	Airline
(Kim et al., 2016)	/	/	Attitudes; Subjective norms; Perceived behavioral control; Emotions; Offset knowledge	/	Survey study	US residents	Airline
(Araghi et al., 2016)	Offset contribution; Price	/	Attitudes	Age; Education level; Gender	DCE	Australian air travelers	Airline

(Segerstedt & Grote, 2016)		Trip purpose;	Offset knowledge	Age; Education level; Gender; Income; tourist-specific factors	Survey study	German travelers	Airline
(Babakhanian et al., 2017)		Activation	Attention; Attitude; Awareness	/	Lab experiment	University students/staff	Airline
(Lu & Wang, 2018)		Communication media	Attitude; Environmental knowledge	Trip purpose, gender, age, travel experience	Survey study	Taiwanese air travelers	Airline
(Choi et al., 2018)	Legal effects; Offset contributions; Offset provider; Price; Project type	Flight comparisons	Attitudes; Perceived consumer effectiveness;	Age; Education level; Income; Gender; State	DCE	Australian residents	Airline

(Schwirp lies et al., 2019)	Offset contributions; Offset from provider; Price; Project location	Contexts varied with the model of transportati on; Framing effects	Attitudes; Beliefs	Age; Educati on level; Gender ; Income ; Offset experie nce	DCE	German residents	Different transporta tion context
(Ritchie et al., 2020)	/	/	Attitudes; Belief; Perceived consumer effectiveness; Social norms; Policy knowledge	/	Panel survey	Australia n residents	Airline
(Rotaris et al., 2020)	Offset contributions; Price; Project type	/	Environmental awareness	Educati on level; Gender ; Employ ment status; Travel habits	DCE	Italian air travelers	Airline
(Ritchie et al., 2021)	Admin cost; Certification; Offset contributions; Offset from provider; Price; Project location; Project transparency; Project type		Attitude; Altruism;	Age; Employ ment status; Househ old type; Travel experie nce; Offset	DCE	Australia n residents	Airline

Note: CV: contingent valuation; DCE: discrete choice experiment; LCM: latent class model; MML: multinomial logit model; MXL: mixed multinomial logit model.

The adoption of the Kyoto Protocol by the United Nations Framework Convention on Climate Change (UNFCCC) in 1997, alongside the subsequent development of the carbon market, has spurred a substantial body of tourism research on voluntary carbon offsetting. The initial focus of these studies was primarily the potential of carbon offsets (Dhanda & Hartman, 2011; Eijgelaar, 2011; Hyams & Fawcett, 2013; Watt, 2021) and the factors that influence the choice of carbon offsets (Brouwer et al., 2008; Choi et al., 2018; Choi & Ritchie, 2014; Gössling et al., 2007, 2009; Lim & Yoo, 2014; Lu & Shon, 2012; Mair, 2011; Ritchie et al., 2021; Rotaris et al., 2020; Schwirplies et al., 2019). Survey studies (e.g., Brouwer et al., 2008; Mair, 2011) indicate substantial latent demand, yet consumers' uptake remains limited in practice. The factors in **Table 2.1** can also be mapped onto two barrier buckets: some primarily address inaccessibility (e.g., choice architecture, certification), while others target psychological gaps (e.g., perceived effectiveness), and several operate on both.

Empirical work also shows how these determinants function as offset levers. For example, Choi and Ritchie (2014) included carbon emissions, the types of offset projects, airline measures, and price in a DCE, which indicated significant relationships between these attributes and travelers' preference for products to offset flying. Rotaris et al. (2020) investigated 1,228 Italian air travelers using a DCE and found that the type of offset project and the quantity of CO₂ reduced via offsets were important factors influencing the travelers' choice to offset their carbon emissions from flying. Rotaris et al. (2020) also conducted an online survey in a DCE among 998 Australians. They found that air travelers preferred to purchase domestic air carbon offsets that were accredited, administered by a non-profit organization, and contributed more to carbon reduction. Schwirplies et al. (2019) examined carbon offsets for different travel

modes (e.g., plane and bus) using a DCE with 1,000 individuals from Germany and found that compensation locations, project types, contributions from providers, and the cost of carbon offsets significantly influenced tourists' decisions to offset their CO₂ emissions.

In addition, researchers have also explored ways to improve communication with tourists and boost their offsetting behavior or choices (Babakhani et al., 2017; Denton et al., 2020; Guix et al., 2022; Segerstedt & Grote, 2016; Zhang et al., 2019).

These previous studies inform the attribute and level design of Studies 1 and 2 and guide the thematic probing and coding scheme in Study 3. Despite the breadth of existing work, several gaps remain in understanding the determinants of offset choice. First, most research examining the drivers of tourists' offsetting behavior has predominantly focused on air transport contexts, with limited attention to offsets embedded in broader travel or accommodation products. This narrow focus restricts the generalizability of findings to more diverse travel scenarios and neglects destination-based offset opportunities.

Second, within the internal or psychological domain, existing research on carbon offset behavior has largely focused on attitudes, social norms, and perceived behavioral control—factors widely investigated in general pro-environmental behavior literature—while overlooking other latent psychological mechanisms that may influence offset decisions. While some have included measures of perceived consumer effectiveness (Choi et al., 2018; Choi & Ritchie, 2014; Ritchie et al., 2021; Schwirplies et al., 2019), none have explicitly examined tourists' trust toward offset products. Among the psychological mechanisms shaping offset decisions, trust—particularly green trust—has received minimal empirical attention, despite being central to the functioning of offset markets.

As discussed in Section 2.1.5, offset transactions involve a complex, opaque chain linking payments to verified emission reductions, creating a persistent information asymmetry between tourists and project outcomes. This opacity renders trust indispensable for decision-making yet difficult to observe directly. Although several studies (Blasch & Farsi, 2014; MacKerron et al., 2009; Ritchie et al., 2021) have incorporated credibility cues such as certification standards or provider reputation, these variables capture only the surface elements of trust signals. Such cues are typically modeled as discrete product attributes rather than as antecedents of a latent belief system that shapes whether tourists perceive offsets as credible and effective climate actions. The absence of a formal trust construct in most choice modeling studies thus leaves a conceptual gap between information cues and behavioral response, limiting understanding of how tourists translate institutional assurances into WTP.

2.3 Data Enrichment

SP and RP data constitute the two principal types of response data employed in the analysis of choice behavior (Hensher et al., 2015). RP data involves real-market choices, where consumers make actual selections. In contrast, SP data involves situations where consumers make choices based on hypothetical scenarios. Each of them has its strengths and weaknesses (Train, 2009).

2.3.1 Revealed Preference (RP) Data

The RP data revealed the world as it is. RP data can be gathered from actual market choices through several collection approaches, such as direct observation in a market or electronic means like scanners in shopping centers. Regardless of the method, the analyst needs to decide how to collect data on both the attribute levels of alternatives and the socioeconomic characteristics of the individuals making decisions within the market. Attribute levels can be obtained by measuring actual attributes or asking decision-makers about their perceptions. Regarding socioeconomic characteristics, observation may provide basic information (like

gender and age range), while a survey could offer more valuable insights. Despite challenges in collection, RP data has advantages and disadvantages that analysts should weigh before using. (Hensher et al., 2005; Louviere et al., 2000).

Since RP data are derived from real-life choices—and overall demand for a product or service reflects the actual frequency with which it is chosen in the marketplace—collecting RP data from a representative sample theoretically allows us to reconstruct the true market shares of all goods and services. RP data essentially mirrors the market “equilibrium.” Furthermore, by analyzing actual market data, we can observe the decisions made by individuals within the actual constraints they face, including environmental and technological constraints within the market itself and personal constraints such as budget constraints. Additionally, RP data provide enhanced reliability (consistent measurement across administrations) and face validity (authentic behavioral capture).

On the other hand, the inherent “real-world” characteristics limit the RP on existing alternatives and attributes in current markets. This will not pose an issue if the market being studied maintains a steady equilibrium with no potential for new entrants and no room for innovations. The new entrants, whether in the form of new companies or new products/brands, introduce new alternatives to the market, potentially influencing choice behavior through increased competition. Similarly, the introduction by existing competitors or new market entrants may lead to the emergence of new attribute levels—or entirely novel attributes—that can influence consumer choice behavior. Consequently, additional data collection becomes necessary to develop new models if new entrants emerge or innovations are introduced. Therefore, RP data offers limited, if any, advantages for those seeking to forecast market responses to alternatives or innovations that have not yet been introduced. Given the substantial investment required for research and development, along with the high probability of product failure, relying on post-

launch market equilibrium offers limited strategic value to analysts seeking to inform pre-market decision-making.

Secondly, practical experience indicates that many markets exhibit restricted variation in the attribute levels necessary for effective modeling. In such cases, choice models are unable to identify the effects of price or other attributes, as parameter estimation in statistical models depends on the degree of variation within each attribute rather than their absolute values. As a result, when an explanatory variable displays minimal variability, its corresponding parameter cannot be reliably estimated.

Furthermore, collecting data directly from the market—such as through scanner panel data or from individuals engaged in market transactions—often leads to a lack of information about the alternatives that were not chosen. For example, when surveying decision-makers, the focus is typically limited to the attributes and attribute levels of the selected options, with little to no insight into the unchosen alternatives. If decision-makers have not encountered or experienced non-chosen alternatives, they may lack the necessary information about the attribute levels associated with those unselected options. Consequently, data collection is limited to information on the chosen alternatives.

In addition, previous studies (Heilig et al., 2017; Hensher et al., 2005; Lin et al., 2018) also indicated that a notable portion of markets exhibit significant correlations among attributes, creating challenges for estimation models. For instance, in some cases, goods or services of perceived “higher” quality are associated with higher prices.

The voluntary carbon offset market remains in a nascent and rapidly evolving phase, characterized by fragmented supply and the absence of consistent standardization, which limits the availability of comprehensive revealed transaction data. This study will collect RP data through tourists’ self-reports of their offset experience.

2.3.2 Stated Preference (SP) Data

“We have seen that RP data offer a number of advantages to the analyst as well as a number of disadvantages. If life were kind, then the alternative paradigm, that of SP data, would offer only advantages, thus making the choice of data paradigm to employ easy. Unfortunately, life is not so kind.”

(Hensher et al., 2005, P. 96)

The SP data revealed the world as it could be. SP data, collected in a controlled experimental environment, offers several advantages compared to RP data derived from natural markets. They allow for exploring preferences for attributes and options that are not yet available in the market. The choice set is predetermined, minimizing the risk of multicollinearity among attributes. Additionally, the range of attribute values can be expanded (Morikawa et al., 2002).

Despite these strengths, the hypothetical nature of SP data comes with its weaknesses. The trustworthiness of information obtained under hypothetical conditions renders SP data invalid for model estimation. If the cognitive processes underlying hypothetical decisions differ significantly from those in real-world contexts, the resulting data may be subject to bias and considerable random error. Various decision-making heuristics may emerge in SP settings. For example, respondents may focus exclusively on the most salient attribute of an alternative—a phenomenon described by the prominence hypothesis. Alternatively, responses may reflect inertia or justification of current behaviors. In some cases, individuals may treat the survey as a means of expressing support for a particular outcome, such as overstating usage of a proposed transportation system to encourage its implementation. Additionally, the reliability of SP data is contingent on the questionnaire’s quality or the experiment’s settings (Ben-Akiva et al., 2002).

2.3.3 The Mechanics of Data Enrichment

SP methods are commonly applied in research examining carbon offset choices (Brouwer et al., 2008; Choi et al., 2018; Choi & Ritchie, 2014; Gössling et al., 2009; Lu & Shon, 2012; Ritchie et al., 2021; Rotaris et al., 2020; Schwirplies et al., 2019). SP data yields valuable insights into how consumers navigate trade-offs among product attributes and reveals preferences for new or hypothetical features not yet available in the market. However, the SP results of offset share the same criticism of SP disadvantages: stated preferences may not always predict actual behavior (Louviere et al., 2000). In consumer choice behavior, a typical approach to assessing the validity of SP results involves jointly using RP data, namely, data enrichment (Hensher et al., 2015). This section will introduce this approach.

Given that each data type possesses distinct advantages and limitations, there is a strong rationale for integrating the two to capitalize on their respective strengths while addressing their shortcomings. One such approach, known as data enrichment, combines RP and SP data within a single model. This method was initially proposed by Morikawa (1989), who demonstrated that incorporating SP data could reveal parameters that RP data alone failed to identify, thereby improving the overall efficiency of model estimates.

Early contributors to this field include Ben-Akiva et al. (1992), Bradley and Daly (1994), Hensher and Bradley (1993), and Hensher (1998). A recurring theme in this line of work is treating RP data as the benchmark, with SP data serving a complementary role by addressing limitations inherent in RP observations. This perspective, known as the “data enrichment paradigm,” is depicted in **Figure 2.4** (adapted from Louviere et al., 2000), which implies the analyst’s objective as developing a model capable of accurately forecasting future real-market behavior.

RP data are typically collected to reflect current market equilibrium and the trade-offs consumers make among attributes. However, RP data often lack sufficient variation in key attributes, limiting the analyst's ability to estimate preference parameters. To address this, SP data are gathered—either from the same individuals or from a different sample—with a focus on capturing trade-off information that RP data cannot provide. Importantly, the SP data used in this integration need only pertain to attribute trade-offs and do not require that alternatives, attributes, or attribute levels perfectly match those in the RP dataset.

By combining two data sources, analysts can estimate parameters that would be otherwise unidentifiable due to missing attributes or limited attribute variation in a single dataset. The appeal lies in including non-existent alternatives and in manipulating attributes and levels that are not currently experienced through an SP choice experiment. In instances where a specific alternative appears only in the RP data, even if the data are ill-conditioned, the analyst must rely on RP to estimate the associated preference function. Conversely, when an alternative exists solely in the SP data, the model depends on SP information to estimate preferences, including SP-specific alternative-specific constants (ASCs), which become necessary in the absence of an RP counterpart. The data enrichment framework directly informs Study 2, which combines stated-preference data from a discrete-choice experiment with revealed-preference data on tourists' self-reported offset behaviors.

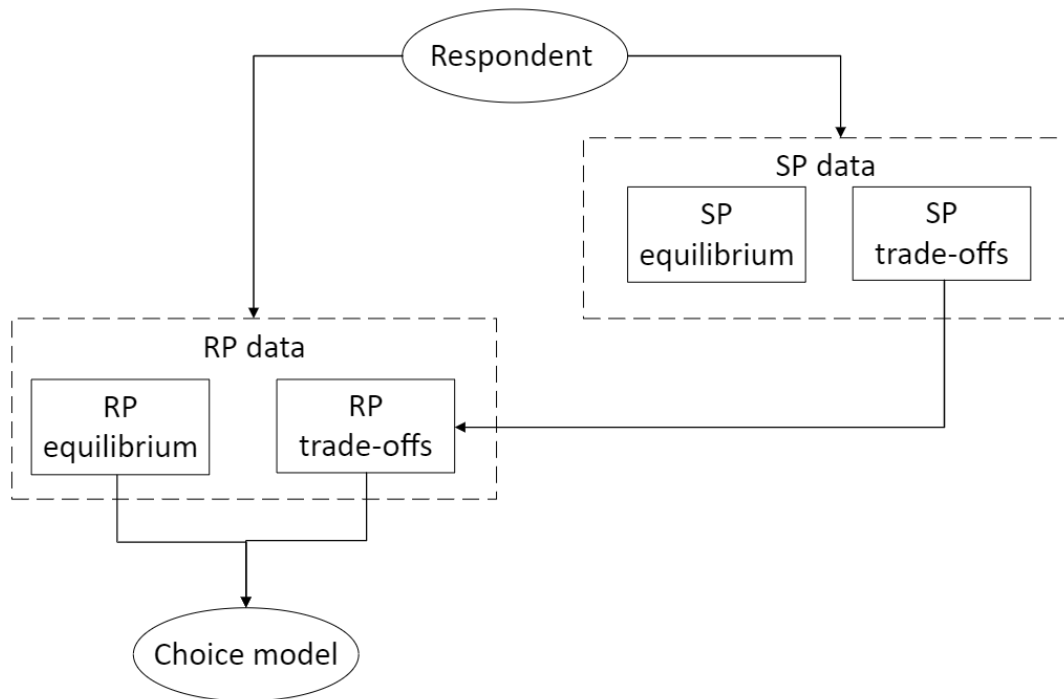


Figure 2.4 Data enrichment paradigm

2.4 Conceptual Framework of Travel Carbon Offsetting

The preceding review highlights the coexistence of two dominant approaches to studying carbon offsetting: process-oriented behavioral analyses and structure-oriented predictive modeling. Rarely have these been considered together, which limits understanding of both the mechanisms underlying offset decisions and their quantitative implications. To conceptually address this fragmentation, this thesis develops an integrative framework of travel carbon offsetting, shown in **Figure 2.5**. The framework synthesises the factors influencing TCO choices, the behavioral process through which decisions unfold, and the structural modeling perspective that links attributes and latent variables to observable outcomes.

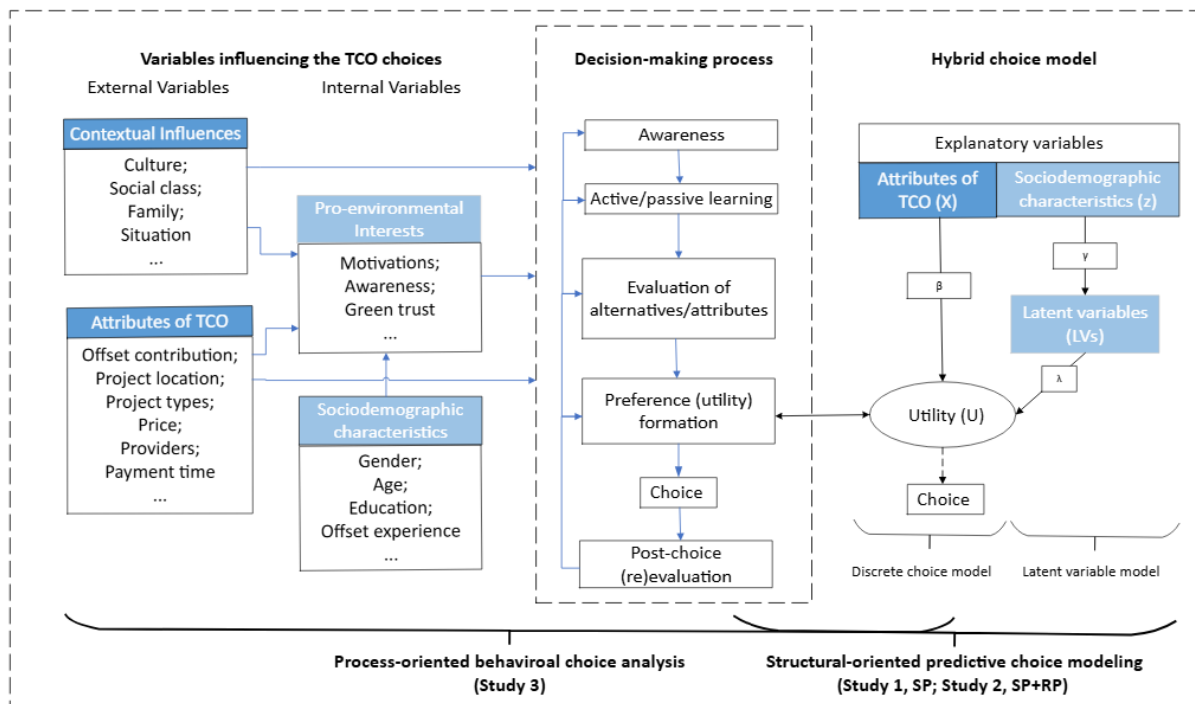


Figure 2.5 Framework of decision-making on TCO

A range of external and internal influences shapes offsetting decisions. External variables include contextual influences such as culture, social class, family, and situational factors, as well as the attributes of TCO products themselves. These attributes comprise the contribution level, project type and location, provider reputation, certification, price, and payment timing, which together define the options available to consumers. Internal variables capture the decision-maker’s characteristics and orientations, including pro-environmental interests—motivations, awareness, and green trust—alongside sociodemographic characteristics such as gender, age, education, and prior offsetting experience.

Drawing on behavioral theories of consumer decision-making, the framework conceptualises TCO adoption as a staged process that begins with awareness, shaped by both passive exposure through travel providers and active information seeking. Travelers then proceed to evaluate offsetting attributes and alternatives, forming preferences that lead to a choice decision. A subsequent stage of post-choice reflection may occur, during which consumers reassess their

decision in light of perceived effectiveness or satisfaction. The formulation of utility/preferences can be translated into choice modeling.

The framework also incorporated the hybrid choice model's structural orientation. In this structure, TCO attributes and sociodemographic variables enter the utility function directly, while latent constructs such as environmental motivations, awareness, and trust influence utility indirectly. Structural parameters specify the relationships among these observed and unobserved variables, enabling the capture of both revealed trade-offs and underlying psychological constructs. The hybrid model, therefore, combines discrete choice modeling with latent variable analysis, allowing for a more comprehensive representation of offsetting decisions.

By bringing together behavioral process pathways with structural modeling, the framework offers a conceptual bridge between process-oriented and predictive approaches. This framework also guided the methodological design. Studies 1 and 2 employ predictive choice models based on stated and revealed preferences, and Study 3 explores behavioral processes through qualitative analysis. The framework positions them within a single architecture.

2.5 Research Gaps

This chapter presents a review of the existing literature on tourism, choice behavior theory, preference data types, and data enrichment methods. From the review, several research gaps become apparent.

First, previous research on carbon offsets within the tourism sector has predominantly focused on offsets associated with air travel due to the limited adoption of offset practices and existing barriers between tourists and offsets (Choi et al., 2018; Choi & Ritchie, 2014; Eijgelaar, 2011; Guix et al., 2022; Ritchie et al., 2021; Smith & Rodger, 2009; Zhang et al., 2019). However, it

is essential to acknowledge that other components of tourism—such as accommodation, shopping, dining, and related services—also generate significant carbon emissions (Lenzen et al., 2018). Therefore, addressing the issue of carbon offset mechanisms in tourism requires collective effort and cooperation across the entire industry. Furthermore, given that offsets are credence goods whose outcomes cannot be directly verified, trust in certification, providers, and governance is crucial for their legitimacy and adoption. Limited attention has been paid to this dimension in existing research. This thesis seeks to bridge this research gap by introducing a novel concept of an industrywide TCO that integrates both offset-related and travel-related attributes and incorporates latent trust-related variables, thereby expanding the scope and clarifying the mechanisms of offsetting in tourism.

Second, SP methods have been widely applied in research on carbon offset choices. SP data are particularly valuable for uncovering consumer trade-offs among product attributes and for eliciting preferences regarding carbon offsetting. However, a well-recognized limitation of SP approaches is that stated preferences do not always align with actual behavior, raising concerns about their predictive validity (Louviere et al., 2000). Building on prior efforts to integrate RP and SP data in other domains, this study aims to develop a combined model that utilizes both RP and SP data to examine travel carbon offset choices. It compares models based on RP, SP, and integrated RP–SP data to evaluate consistency and identify potential biases across data sources. By incorporating both real-world behavior and stated intentions, the study enhances the robustness and validity of its findings. This comparative approach offers deeper insights into discrepancies between stated preferences and actual behavior, fostering a more accurate and nuanced understanding of consumer decision-making in the context of travel carbon offsetting.

Finally, there remains a limited integration between behavioral and predictive approaches to analyzing choice. Behavioral studies highlight psychological mechanisms such as awareness, motivations, and moral reasoning, while predictive models quantify attribute trade-offs under the RUM framework. Each perspective could benefit from the insights of the other, yet little attention has been given to connecting them or conceptualizing their interaction. To address this gap at a conceptual level, this thesis develops an integrative framework that positions behavioral processes and predictive choice models within a shared architecture. Applied across the thesis—through predictive modeling in Studies 1 and 2 and qualitative exploration in Study 3—the framework enables the findings to be interpreted together. It provides a foundation for future empirical integration. In doing so, the thesis unpacks the process behind economic utility maximization in offset choices, combining psychological insights with structure-oriented modeling.

Building on the preceding review, this thesis draws from theories of choice behavior, pro-environmental behavior, and discrete choice modeling to develop a conceptual framework for analyzing tourists' carbon offset decisions. Theories such as the TPB, NAM, and VBN illuminate the psychological and moral factors driving sustainable behavior. At the same time, the discrete choice modeling tradition grounded in RUM provides a quantitative framework for modeling individual preferences. Furthermore, recognizing the intangible and uncertain nature of carbon offsets, the role of green trust emerges as a critical latent factor influencing offset choices. This thesis conducts a comprehensive triangulation analysis by integrating insights from behavioral and predictive approaches and addressing identified research gaps—including the broader scope of offsetting in tourism beyond air travel, the underexplored influence of trust, and the integration of revealed- and stated-preference data. The following chapters present this analysis, outlining how both product attributes and psychological constructs shape tourists' choices for travel carbon offsets.

Chapter 3 Methodology

3.1 Research Philosophy and Structure

This research will adopt the triangulation method to enhance the credibility and validity of the findings (see **Figure 3.1**). Credibility—referring to the perceived trustworthiness of a study—and validity—relating to the extent to which the research accurately captures or assesses the intended concepts—are fundamental components of rigorous research (Bashir et al., 2008). Triangulation helps overcome inherent biases associated with using a single method or observer by integrating theories, methods, or observers in a research study. Additionally, it serves as an endeavor to delve into and elucidate complex human behavior, providing a more comprehensive and balanced explanation through the utilization of diverse methods. This approach supports the validation of data and is applicable across both quantitative and qualitative research designs (Noble & Heale, 2019).

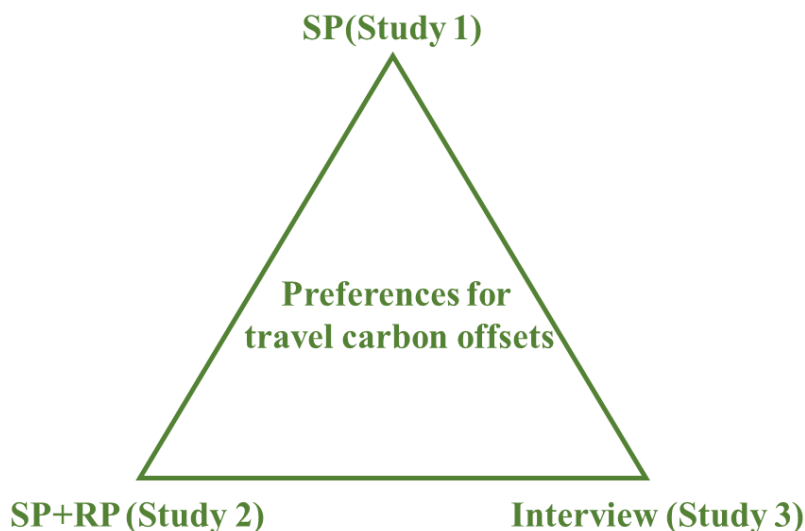


Figure 3.1 Triangulation of thesis

Triangulation enhances research by providing diverse datasets that illuminate a phenomenon's various facets. It plays a crucial role in challenging suppositions, allowing a hypothesis to be

invalidated by one dataset if contradicted by another. Additionally, it helps confirm hypotheses when multiple sets of findings align. Ultimately, triangulation aids in the interpretation of study results (White, 2002). The core idea is that using multiple methods that yield consistent results enhances the credibility of research findings. Denzin (2009) identifies four types of triangulation: (1) data triangulation, which considers variations across time, space, and participants; (2) investigator triangulation, which involves multiple researchers contributing to the study; (3) theory triangulation, which entails interpreting phenomena through different theoretical lenses; and (4) methodological triangulation, which supports the use of varied data collection methods, such as interviews and observations.

This research adopts data triangulation and methodological triangulation. **Figure 3.1** shows three studies pointing in the same direction: tourists’ preferences for travel carbon offset. **Table 3.1** depicts the three studies’ objectives, methods, and data sources. This thesis includes two quantitative studies and one qualitative study. Study 1 uses SP data to find determinants of TCO adoption and WTP. Study 2 further collects RP data and identifies heterogeneities in preferences within/between RP and SP data sources by comparing different models using RP and SP data. Study 3 employs semi-structured interviews and thematic analysis to explain and contextualize the patterns observed in Studies 1 and 2, clarifying the underlying process behind RUM. Taken together, the three studies aim to deliver a behaviorally credible and mechanism-aware account of tourists’ TCO decisions.

Table 3.1 Mapping the three studies: research objectives, methods, and data

Research objectives	Method	Data
---------------------	--------	------

Study1: Quantitative 1	Offset as a solution for tourism decarbonization <ul style="list-style-type: none"> • Are tourists willing to pay for travel carbon offset products? • What are the factors that influence tourists' choices of TCO? 	Discrete choice experiment; Hybrid choice model	SP data (Survey)
Study2: Quantitative 2	Stated vs. revealed preferences for travel carbon offset <ul style="list-style-type: none"> • Do discrepancies exist between stated and revealed preferences for offsets? • Where do these discrepancies occur, and what are their sources? • Can stated and revealed preference data be combined in the context of offset choices? 	Discrete choice modeling: MNL; Random parameter/effect logit model;	SR & RP data (Survey)
Study 3: Qualitative 1	Opening the Box: Process Behind Economic Preferences for Carbon Offsetting <ul style="list-style-type: none"> • Why do tourists prefer certain attributes of carbon offset options? • How do tourists make decisions when choosing carbon offset products? 	Thematic analysis	Semi-structured and In-depth interviews

3.2 Random Utility Maximization (RUM) and Multinomial Logit (MNL) Model

The details of the RUM framework are as follows.

Let G denotes the global set of all possible alternatives, and let S represents the set of attribute vectors capturing the characteristics of decision makers. Consequently, an individual randomly selected from the population, for example, through a simple random sampling method, will possess an attribute vector $s \in S$ and will encounter a subset of available alternatives C within G . Therefore, the actual choice made by this individual, characterized by particular attribute levels s and alternatives C across the sampled population, where the term “multinomial”

reflects the presence of multiple possible outcomes. The probability of selecting a particular alternative $x \in C$, conditional on the decision maker's socioeconomic context and available options, is expressed as: $P(x|s, C) \forall x \in C$. The vector s represents consumption services or attributes, underscoring that the alternative is defined with a set of attributes.

For operationalizing the previous condition, it is necessary to formulate an individual behavior rule (IBR) mapping each vector of observed attributes s and a given set of potential alternatives A to a specific chosen alternative within C . The probability of an individual randomly chosen from the population opting for alternative x , given the observed attribute vector s and the set of alternatives C , can be defined as the likelihood that a specific behavioral rule—governing decision-making under these conditions—results in the selection of x :

$$P(x|s, C) = P\{IBR \in SIBR | IBR(s, C) = x\} \quad (3.1)$$

where SIBR refers to the set of individual behavior rules. Then, it becomes essential to relate the selection probabilities and the principle of utility maximization. The utility of the i th alternative out of J alternatives for the q th individual (U_{iq}), is typically decomposed into two components: a deterministic component (V_{iq}) referring to “observed utility”, and a stochastic error term (ε_{iq}) capturing unobserved idiosyncrasies of individual tastes:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \quad (3.2)$$

$$V_{iq} = \sum_{k=1}^K \beta_{ik} S_{ikq} \quad (3.3)$$

where β s refer to utility parameters, presumed to remain constant across individuals in the initial assumption. Utility parameters can either vary randomly across sampled individuals (random parameters) or be expressed as functions of contextual variables—such as an

individual's socioeconomic characteristics or the type of data under analysis, such as RP versus SP.

The utility maximization principle posits that an individual q will choose alternative i from their available choice set iff:

$$U_{iq} > U_{jq} \text{ all } j \neq i \in C \quad (3.4)$$

Combining and rearranging **Equations (3.2) and (3.4)**, we obtained $(V_{iq} - V_{jq}) > (\varepsilon_{jq} - \varepsilon_{iq})$. The analyst cannot directly observe $(\varepsilon_{jq} - \varepsilon_{iq})$, so it is impossible to determine whether definitively $(V_{iq} - V_{jq})$ is greater than $(\varepsilon_{jq} - \varepsilon_{iq})$. The analyst can only make probabilistic statements about choice outcomes, meaning that the likelihood of each alternative being chosen is expressed in terms of probability. The analyst can calculate the probability of $(\varepsilon_{jq} - \varepsilon_{iq})$ will be less than $(V_{iq} - V_{jq})$ through imparting an operational flavor to **Equation (3.1)**, namely a random utility model:

$$\begin{aligned} P_{iq} &\equiv P(x_i | s, C) = P[\text{IBR}_\varepsilon \in \text{SIBR} | \text{IBR}_\varepsilon(s, C) = x_i] \\ &= P(x_{iq} | s_q, C) = P\{[\varepsilon(s, x_j) - \varepsilon(s, x_i)] < V(s, x_i) - V(s, x_j)\} \text{ for all } j \neq i \end{aligned} \quad (3.5)$$

The IIA axiom asserts that the probability of choosing alternative I from the choice set C , denoted as $P(I | C)$, equals the probability of selecting an alternative from a larger choice set G , $P(I | G)$, divided by the probability of choosing the subset C from G . That is, $P(I | C) = P(I | G) / P(C | G)$ for all $I \in C \subseteq G$. This implies that $P(I | C)$ represents a conditional probability based on the larger choice set G . A key implication of the IIA property is that the relative odds of choosing between any two alternatives I and j remain unchanged regardless of the presence or absence of other alternatives in the choice set, as long as both I and j are included.

The closed-form MNL interprets the probability of individual q selecting alternative i as:

$$P_{iq} = \exp(V_{iq}) / \sum_{j=1}^J \exp(V_{jq}) \quad (3.6)$$

3.3 Research Design

3.3.1 Study 1: Are Tourists Willing to Pay for Travel Carbon Offset?

3.3.1.1 Survey Design

We adopted a DCE method to explore the respondents' preferences for TCO attributes. We designed the DCE based on a hypothetical scenario in which tourists were asked to choose from possible TCO options comprising six attributes. Based on previous literature and relevant practices, we chose these attributes and levels by integrating the characteristics of carbon offsetting into tourism products.

Table 3.2 presents the attributes and their corresponding levels. The first attribute, CO₂ offsetting contribution, represents the potential reduction in a tourist's carbon emissions that can be achieved through TCO. The emissions can be offset partially (50%) or entirely (100%) based on the amount of CO₂ emissions from a trip. To achieve this reduction in carbon emissions, individuals can contribute to various types of carbon offset projects. We included four main types of carbon offset projects (i.e., reforestation, environmental conservation, renewable energy, and waste-for-energy; Chapman, 2020; Raffaelli et al., 2022) implemented in specific locations. In the tourism context, source countries or regions and destinations are the most relevant project locations for tourists who want to offset their carbon emissions. We included these location choices in our TCO framework, following Choi and Ritchie (2014). We also included other developing countries as potential project locations because most reforestation offset projects are in these countries (Wissner et al., 2022), and we considered the

potential impact of offsetting projects on sustainable development in these developing countries beyond carbon mitigation. To account for the unique product characteristics of both tourism and carbon offsetting, we included offset organizations as the direct providers and airlines, travel agents, and hotels as possible middlemen, identified by the attribute “provider”. We also considered the responsibility of these providers and their potential contributions to reducing carbon emissions by incorporating their additional offset quantity in the TCO product. To accommodate tourists’ payment preferences for TCO, we included three main payment options: paying before departure, on-site, or after travel. Additionally, we established four levels for the monetary attribute (¥5, ¥20, ¥35, and ¥50/100 kg) that reflect the range of carbon prices in carbon markets across China and Europe (The State Council, 2022; Ember, 2022). All attributes of the TCO products other than these six were assumed to be identical in this experiment.

Table 3.2 Attributes and attribute levels of TCO products

Attribute	Description	Levels
CO ₂ offsetting contribution	You have the option to offset either 50% or the full 100% of the carbon emissions generated by your travel.	50% 100%
Project location	The projects may be implemented in your home country, your overseas destination, or a developing country.	Domestic; Overseas destination; Other developing countries
Project type	Reforestation and conservation projects absorb CO ₂ through afforestation and forest protection; Renewable energy projects include building solar, wind, or hydro sites; Community projects help to introduce energy-efficient technologies to undeveloped communities;	Reforestation and conservation; Renewable energy; Community project; Waste-to-energy

	Waste-to-energy projects capture carbon and convert it into electricity.	
Offset product provider	You can choose to buy the carbon offset product through middlemen, including airlines, hotels, and online travel agencies, or buy it directly from the companies/organizations implementing carbon offset projects.	Airline as the middleman; Hotel as the middleman; Online travel agency as the middleman; Directly provided by a carbon offset company/organization
Contribution from product provider	The amount by which the product provider increases the amount of CO ₂ offset	0% (0 kg) 50% increase 100% increase
Payment time	When you pay for the carbon offsets	Before departure; On-site; After travel
Carbon offset price	The price you need to pay to offset 100 kg of carbon emissions	¥ 5/100 kg ¥20/100 kg ¥35/100 kg ¥50/100 kg

The survey included four sections. The first section gathered information on respondents' previous travel experiences. In the second section, a DCE was conducted by involving the respondents in a hypothetical scenario in which they had booked a trip through an online travel agency in light of their responses to the first section and found a "low-carbon travel" collection on the website in which they could choose to purchase a carbon offset product to mitigate the emissions of their upcoming travel. Respondents were given eight choice sets and asked to select one option among two carbon offset options ("A" and "B") and one opt-out option

(“None”) for each choice set. **Figure 3.2** illustrates an example of a choice set presented to respondents.

	Option A	Option B	None of them
CO2 offsetting contribution	Offsetting 880kg carbon emissions	Offsetting 440kg carbon emissions	/
Project location	Domestic	Overseas destination	/
Project types	Reforestation and conservation	Renewable energy	/
Offset product providers	Hotel as the middleman	Online travel agency as the middleman	/
Contribution from product providers	Offsetting 880kg carbon emissions	Offsetting 0kg carbon emissions	/
Payment time	On-site	After travel	/
Carbon offset price	¥ 176	¥ 154	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> None

Figure 3.2 Choice set sample of Study 1

To examine the influence of the latent variable on respondents’ carbon offset choices, a 7-point Likert scale was employed to measure their level of green trust (Chen et al., 2019; Sung et al., 2021). In the final section, we collected information on the respondents’ gender, age, educational attainment, annual income, current occupation, and marital status.

3.3.1.2 Data Collection

An online survey was randomly distributed to Chinese residents through a professional market research firm. Before the main survey, a pilot test involving 150 participants was carried out to refine the D-efficient design and confirm that the survey was realistic and understandable to the respondents. A D-efficient design for minimum D-error was generated using Ngene, with two blocks, each of which included eight choice sets.

The main survey was then distributed to 1,571 respondents in January 2023, but more than half of them did not finish or failed to pass the screening questions (e.g., respondents who had not

traveled abroad for leisure purposes in the last five years, who would not like to travel overseas in the upcoming year, and who did not understand carbon offsetting after it was described). Finally, 900 useful responses (57.29%), including 7,200 choice observations, were included in the data analysis.

The composition of the sample is detailed in **Table 3.3**. The respondents were spread across a broad demographic, with near gender parity (48.2% female). Nearly half (46.2%) were young or middle-aged adults (18-39 years), while 10.9% comprised seniors (60+ years). Education levels varied significantly, with 14.4% possessing master’s degrees or higher. Income distribution showed bipolar tendencies, with 23.5% reporting lower incomes (\leq ¥144K) and 24.2% higher incomes (\geq ¥420K). The sample included minimal unemployment (0.6%) and a substantial single population (11.8%).

Table 3.3 Demographic characteristics of the sample (N = 900)

Characteristic	Value	%
Gender	Female	48.2
	Male	51.2
	Other	0.6
Age	18–29	16.1
	30–39	30.1
	40–49	26.4
	50–59	16.4
	60 and above	10.9
	Educational attainment	Secondary education
Further education		6.7
Bachelor’s degree		74.1
Master’s degree		12.0
Doctoral degree		2.4
Annual household income	Below ¥36,000	3.4
	¥36,001–144,000	20.1
	¥144,001–300,000	32.4
	¥300,001–420,000	19.8
	¥420,001–660,000	13.2
	¥660,001–960,000	7.0
	¥960,001 and above	4.0
Occupation	Student	2.6
	Frontline employee (private or public sector)	6.8

	Junior manager/executive (private or public sector)	31.1
	Senior manager/executive (private or public sector)	30.7
	Educator/researcher	2.8
	Professional (e.g., doctor, lawyer, writer, journalist)	13.4
	Self-employed (including housewife/husband)	5.9
	Unemployed	0.6
	Retired	6.2
Marital status	Single	11.8
	Married with child(ren)	81.0
	Married with no children	6.0
	Separated	0.9
	Other	0.3

3.3.1.3 Model Specification: Hybrid Choice Model (HCM)

This study employs an HCM, which integrates a Discrete Choice Model (DCM), specifically a Mixed Logit (MXL), with a Latent Variable Model (LVM) to generate parameter estimates. Hybrid models have been extensively applied in previous research on mode choice, route choice (Atasoy et al., 2013; Kim et al., 2012; Prato et al., 2012; Temme et al., 2008), and contactless hospitality choice (Hao et al., 2021). An HCM can also be used to examine preference heterogeneity among tourists using individual psychological constructs. The methodological framework adopted in this study is illustrated in **Figure 3.3**.

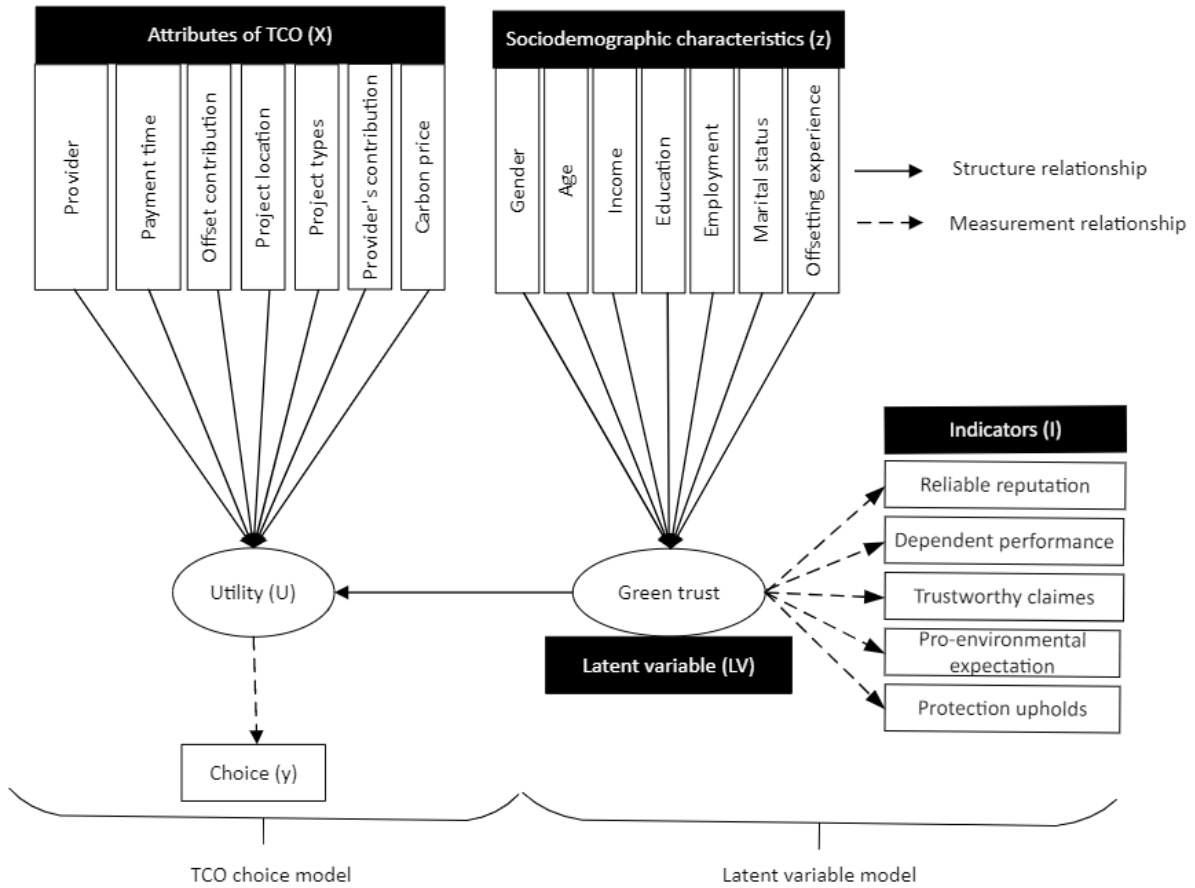


Figure 3.3 Methodological framework of Study 1

Discrete choice modeling is theoretically grounded in RUM (McFadden, 1974; **Equation (3.6)**) and the Lancaster characteristic framework, which posits that the utility derived from a good or service is determined by its attributes rather than the good itself (Lancaster, 1966). The structural component and measurement component of the discrete choice model used in this study are described below (Morley, 1992):

$$V_{i,q} = \begin{cases} \sum_{k=1}^K \beta_{q,k} X_{q,k}, & i = 1 \text{ or } 2 \\ ASC_q + \lambda^L LV_q, & i = 3 \end{cases} \quad (3.7)$$

$$y_{i,q} = \begin{cases} 1, & \text{if } U_{i,q} \geq U_{q,n} \forall n \in C_j \\ 0, & \text{otherwise} \end{cases} \quad (3.8)$$

where $U_{i,q}$ is the utility of tourist q choosing alternative i (i.e., TCO option); $V_{i,q}$ is the utility function's deterministic component; and $\varepsilon_{i,j}$ is an unobserved, independently and identically distributed (IID) extreme value error term. If tourist q chooses alternative $i = 1$ or $i = 2$, $X_{q,k}$ represents a vector of the six observed attributes describing the TCOs. $\beta_{q,k}$ denotes random parameters used to capture preference heterogeneity across tourists and are assumed to follow a normal distribution for TCO attributes. ASC_q is an alternative-specific constant representing tourists' preference for the opt-out option (alternative i). LV_q is the latent variable. λ^L denotes an individual's preference heterogeneity. $y_{i,q}$ takes the value of 1 if respondent q chooses alternative i and 0 otherwise. Finally, C_q is the choice set of individual i .

The latent variable (LV_q) indicating the underlying psychological characteristic of respondents (green trust) is normally distributed. The structural equation and measurement equation of the LV component are described as follows:

$$LV_q = \gamma z_q + \eta_q \quad (3.9)$$

$$I_{g,q} = \begin{cases} 1 & \varphi_{g0} \leq \theta_g LV_q < \varphi_{g1} \\ 2 & \varphi_{g1} \leq \theta_g LV_q < \varphi_{g2} \\ \vdots & \vdots \\ S & \varphi_{g(S-1)} \leq \theta_{qg} LV_q < \varphi_{gS} \end{cases} \quad (3.10)$$

where z_q denotes a vector representing the sociodemographic characteristics (i.e., gender, age, and employment status) and carbon offset experience variable for individual q ; γ represents the parameter vector estimating the influence of these variables on the latent variable LV_q ; η_i denotes a random disturbance assumed to follow a standard normal distribution; $I_{g,q}$ captures the observed response to indicator question g of the latent variable; φ_{gS} is the parameter linking the latent variable to the responses on a 7-point Likert scale ($S=7$); and θ_g represents the scale parameter associated with the attitudinal indicators.

The model parameters were estimated using maximum simulated likelihood methods, incorporating numerical simulation techniques to evaluate the complex integrals in the likelihood function. The choice probability conditional on the carbon offset attributes is expressed as follows:

$$P_y(y_q | X_{q,k}, LV_q; \beta_{q,k}, \lambda^L) = \frac{\exp(U_{i,q})}{\sum_{k \in C_n} \exp(U_{q,k})} \quad (3.11)$$

The probability of predicting the vector of indicators is given by the following ordered logit model (Hess & Palma, 2019):

$$P_{I_{g,q}}(I_{g,q} | LV_q; \varphi, \theta) = \sum_{s=1}^S (I_{g,q} = s) \left[\frac{\exp(\varphi_{gs} - \theta_g LV_q)}{1 + \exp(\varphi_{gs} - \theta_g LV_q)} - \frac{\exp(\varphi_{g,s-1} - \theta_g LV_q)}{1 + \exp(\varphi_{g,s-1} - \theta_g LV_q)} \right] \quad (3.12)$$

The joint likelihood function, which combines the probability of the observed choices with that of the latent indicators, is formulated as follows:

$$LL_i(y_q, I_{g,q} | X_{q,k}; \beta_{q,k}, \lambda^L, \eta, \varphi, \theta) = \int_{\eta} \int_{\beta} P_y(y_q | X_{q,k}, LV_q; \beta_{q,k}, \lambda^L) P_{I_{g,q}}(I_{g,q} | LV_q; \varphi, \theta) f_{\beta}(\beta_{q,k}) f_{\eta}(\eta_q) d\beta d\eta \quad (3.13)$$

WTP indicates the substitution effects between non-monetary and monetary attributes (Choi, 2020; Masiero et al., 2015; Sriarkarin & Lee, 2018). It is calculated as the ratio of the average coefficient of a given attribute l (β_l) to the price coefficient (β_p), which is described by the equation below:

$$WTP = \frac{MU_l}{MU_p} = -\frac{\beta_l}{\beta_p} \quad (3.14)$$

3.3.2 Study 2: Stated vs. Revealed Preferences for Travel Carbon Offset

3.3.2.1 Survey Design and Data Collection

We collected RP and SP data through questionnaire surveys. The survey comprised four distinct sections. The initial section focused on capturing respondents' past travel experiences. The second section collected RP data by inquiring about participants' past experiences with travel offsets. They were asked questions about various aspects, such as the platform they used to purchase their flight carbon offset products, the type of offset product they selected for their most recent trip, and the total carbon emissions offset by their purchases in tonnes. Additionally, they were asked to indicate the amount they paid to offset emissions for their last trip and to specify the locations of the offset projects associated with that trip. They were also asked to describe the types of carbon offset projects they engaged with and to identify the certification standards for the carbon offset products they purchased. The third section of the survey aimed to gather SP data via DCE. The participants were presented with a hypothetical scenario that required them to select one option from two carbon offset products or a "none of the above" option when booking a flight. Each participant was required to complete eight choice sets. The attributes of the offset options in each set were developed based on the literature and current carbon offsetting practices within the Chinese market. These attributes included CO₂ offset contributions, types and locations of offset projects, certification, and monetary value, as informed by carbon pricing in the aviation sector that affects Chinese travelers. A D-efficient experimental design was used and implemented with Ngene version 1.4 (ChoiceMetrics, 2024). **Table 3.4** summarizes the attributes and their levels, while **Figure 3.4** displays an example of a choice card. The final section gathered demographic details such as gender, education, age, occupation, income, and marital status.

Table 3.4 Attributes and levels of flying offset options

Alternatives	Offset by per trip (Option A) With the per-trip offset option, travelers have the choice to offset the carbon emissions generated by each individual flight they take. The offset amount is calculated based on the flying duration and the associated carbon footprint.	One-off offset (Option B) The one-off offset option involves offsetting a fixed amount of carbon emissions as a one-time contribution. Travelers have the option to offset a predetermined quantity of emissions without the need to calculate emissions for each trip.
Attributes	Description	
Carbon offsetting contribution	You can choose to offset the carbon emissions of your one-way or round trip.	You can choose to offset a certain amount of carbon emissions: 1 to 4 tonnes (equivalent to 1,000 to 4,000 kg).
Project location	The country/region in which the project for which you are purchasing carbon offsets is being developed could be: China Overseas destinations Other countries/regions	
Project types	Which types of projects can your purchased carbon offsets support? Afforestation and conservation projects: Planting new trees or preserving old ones to capture carbon. Renewable energy projects: wind power, photovoltaic, waste incineration, and other renewable energy initiatives. Community projects: Introducing energy-saving methods or technologies in underdeveloped communities.	
Certification	Does the offset project have certifications from a recognized standard?	
Carbon offset price	What is the cost of offsetting carbon emissions?	

Choice card 1	Offset by per trip	One-off offset	Neither of them
CO2 offsetting contribution	780 kg (one-way trip)	2000kg	/
Project location	Destination	Domestic	
Project type	Reforestation and conservation	Community project	/
Certification	Yes	No	/
Carbon offset price	¥ 47	¥ 40	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

Figure 3.4 Choice set sample of Study 2

The study data were gathered through surveys conducted with Chinese overseas travelers via the online platform Credamo. Before the main survey, a pilot study involving 79 participants was undertaken to gauge insights into the flight offset market in China, establish the filter criteria for the main survey, design a D-efficient experiment, and confirm the comprehensibility of the survey for participants. The main survey was conducted with 1,760 respondents between July and September 2024, with 27.5% (484) reporting previous offset experience. We screened out non-airline offsetters and “fake offsetters” (individuals who stated an airline as engaging in offsetting, but the airline did not offer such options). We asked offsetters to indicate the offset platform they used and to verify whether it provided offset products. If their stated platform did not offer such services, we deemed them fake offsetters. Ultimately, RP and SP data were obtained from 336 respondents, resulting in 554 RP observations and 2,688 SP observations. We also gathered an additional 2,592 SP observations from 324 non-offsetting travelers without previous offset experience. **Table 3.5** presents a summary of the demographic characteristics of the 660 respondents.

Table 3.5 Profile of the respondents (N=660)

Characteristic	Value	% (N = 660)
Gender	Female	58.2
	Male	41.8
Age	18–20	2.7
	21–30	49.5
	31–40	37.7
	41–50	5.6
	51–60	4.2
	above 60	0.2
Educational attainment	Secondary education	0.8
	Further education	4.8
	Bachelor’s degree	64.7
	Master’s degree	27.7
Occupation	Doctoral degree	2.0
	Frontline employee (private or public sector)	15.9
	Professional (e.g., doctor, lawyer, writer, journalist)	10.3

	Self-employed (including housewife/husband)	2.6
	Junior manager/executive (private or public sector)	30.6
	Student	13.0
	Educator/researcher	5.2
	Retired	0.5
	Senior manager/executive (private or public sector)	22.0
Marital status	Single	32.9
	Married with child(ren)	6.7
	Married with no children	59.1
	Separated	0.2
	Other	1.2
Average annual personal income	below ¥50,001	10.5
	¥ 50,001-100,000	20.6
	¥ 100,001-150,000	23.0
	¥ 150,001-200,000	14.7
	¥ 200,001-400,000	25.0
	¥ 400,001-600,000	4.8
	above ¥ 600,000	1.6

3.3.2.2 Addressing Scale Differences in Data Enrichment Based on MNL

Basic Model Specifications of Joint MNL

The preference data for the choice of carbon offsets when flying were derived from two sources: RP and SP. Both datasets encompass attribute vectors, some of which overlap. Utilizing the RUM framework, the choice mechanisms for these datasets, as indicated by utility functions, are displayed below:

$$\begin{cases} U_i^{\text{RP}} = \alpha_i^{\text{RP}} + \beta^{\text{RP}}X_i^{\text{RP}} + \omega Z_i + \varepsilon_i^{\text{RP}}, \forall i \in C^{\text{RP}} \\ U_i^{\text{SP}} = \alpha_i^{\text{SP}} + \beta^{\text{SP}}X_i^{\text{SP}} + \delta W_i + \varepsilon_i^{\text{SP}}, \forall i \in C^{\text{SP}} \end{cases} \quad (3.15)$$

where α represents alternative-specific constants, X_i^{RP} and X_i^{SP} denote common attributes with their respective utility parameters (β^{RP} and β^{SP}), Z and W are unique attributes characterized by utility parameters (ω and δ), and i represents an alternative within the choice sets C^{RP} or C^{SP} .

The RUM assumes that the q th individual will opt for the i th alternative i if:

$$\begin{cases} U_i^{\text{RP}} > U_j^{\text{RP}} \text{ all } j \neq i \in C^{\text{RP}} \\ U_i^{\text{SP}} > U_j^{\text{SP}} \text{ all } j \neq i \in C^{\text{SP}} \end{cases} \quad (3.16)$$

$$y_{iq} = \begin{cases} 1, \text{ if } U_i > U_j \text{ all } j \neq i \in C \\ 0, \text{ otherwise} \end{cases} \quad (3.17)$$

Assuming that the unobserved influences (ε) adhere to an IID Type 1 extreme value (EVI) distribution for each dataset, as characterized by scale factors λ^{RP} and λ^{SP} , the probability that the q th individual will opt for the i th alternative, P_i^{RP} and P_i^{SP} , can be specified as the following MNL models (Ben-Akiva and Lerman, 1985):

$$\begin{cases} P_i^{\text{RP}} = \frac{\exp [\lambda^{\text{RP}}(\alpha_i^{\text{RP}} + \beta^{\text{RP}}X_i^{\text{RP}} + \omega Z_i)]}{\sum_{j \in C^{\text{RP}}} \exp [\lambda^{\text{RP}}(\alpha_j^{\text{RP}} + \beta^{\text{RP}}X_j^{\text{RP}} + \omega Z_j)]}, \forall i \in C^{\text{RP}} \\ P_i^{\text{SP}} = \frac{\exp [\lambda^{\text{SP}}(\alpha_i^{\text{SP}} + \beta^{\text{SP}}X_i^{\text{SP}} + \delta W_i)]}{\sum_{j \in C^{\text{SP}}} \exp [\lambda^{\text{SP}}(\alpha_j^{\text{SP}} + \beta^{\text{SP}}X_j^{\text{SP}} + \delta W_j)]}, \forall i \in C^{\text{SP}} \end{cases} \quad (3.18)$$

One of the study's goals is to evaluate the equivalence of common parameters across SP and RP. The integration of these two datasets necessitates the assumption that the common attributes are governed by identical parameters across both sources, denoted as $\beta^{\text{RP}} = \beta^{\text{SP}} = \beta$. However, the presence of a scale factor complicates this assessment. The parameters estimated are inextricably linked to the scale factors specific to each dataset, as articulated in **Equation (3.18)**. Even with the imposition of equal parameter constraints, considering the scale factors remains essential, as detailed in the subsequent equations:

$$\begin{cases} P_i^{\text{RP}} = \frac{\exp [\lambda^{\text{RP}}(\alpha_i^{\text{RP}} + \beta X_i^{\text{RP}} + \omega Z_i)]}{\sum_{j \in C^{\text{RP}}} \exp [\lambda^{\text{RP}}(\alpha_j^{\text{RP}} + \beta X_j^{\text{RP}} + \omega Z_j)]}, \forall i \in C^{\text{RP}} \\ P_i^{\text{SP}} = \frac{\exp [\lambda^{\text{SP}}(\alpha_i^{\text{SP}} + \beta X_i^{\text{SP}} + \delta W_i)]}{\sum_{j \in C^{\text{SP}}} \exp [\lambda^{\text{SP}}(\alpha_j^{\text{SP}} + \beta X_j^{\text{SP}} + \delta W_j)]}, \forall i \in C^{\text{SP}} \end{cases} \quad (3.19)$$

These equations highlight that merging the two data sources to refine the estimation of β requires consideration of the scale factors. Data enrichment entails combining these choice data

sources while maintaining the equality of common attribute parameters. In contrast to **Equations (3.19)**, which incorporate adjustments for scale factors, the absence of superscripts for β in **Equations (3.18)** signifies this equality. Ultimately, the integrated dataset enables the estimation of $\psi = (\alpha^{RP}, \beta, \omega, \lambda^{RP}, \alpha^{SP}, \delta, \lambda^{SP})$.

Normalization is necessary due to the inherent identification problem associated with scale factors. Conventionally, the scale factor for the RP data is fixed at one ($\lambda^{RP} \equiv 1$), allowing the estimation of λ^{SP} as a comparative measure of the RP dataset. This can also be framed as estimating the variance of SP relative to that of RP, with ($\sigma^2_{RP} = \frac{\pi^2}{6}$).

Under the assumption of independent sampling between datasets, the joint log-likelihood function decomposes additively into separate multinomial log-likelihood components for the RP and SP data sources. The full parameter vector is jointly estimated through maximum likelihood (Hensher et al., 2015):

$$L(\psi) = \sum_{q \in RP} \sum_{i \in C_q^{RP}} y_{iq} \ln P_{iq}^{RP}(X_{iq}^{RP}, Z_{iq} | \alpha^{RP}, \beta, \omega, \lambda^{RP}) + \sum_{q \in SP} \sum_{i \in C_q^{SP}} y_{iq} \ln P_{iq}^{SP}(X_{iq}^{SP}, W_{iq} | \alpha^{SP}, \beta, \delta, \lambda^{SP}) \quad (3.20)$$

In **Equation (3.20)**, $y_{iq} = 1$ if individual q selects alternative i ; otherwise, $y_{iq} = 0$. To derive the maximum likelihood parameter estimates, **Equation (3.20)** must be maximized with respect to ψ .

Parameter Equity Test

Merging two separate datasets poses a challenge due to the interplay between the estimated parameters and their respective scaling factors. These scaling discrepancies must be resolved

before comparing the parameters. To resolve this challenge, we implement Swait and Louviere's (1993) parameter comparison test.

The procedure begins by estimating separate MNL models for the RP and SP datasets, as represented by **Equation (3.18)** for both RP and SP data. This step provides maximum likelihood (ML) estimates for $\lambda^{RP} \alpha^{RP}$, $\lambda^{RP} \beta^{RP}$, and $\lambda^{RP} \omega$ for RP data, and $\lambda^{SP} \alpha^{SP}$, $\lambda^{SP} \beta^{SP}$, and $\lambda^{SP} \delta$ for SP data, along with their respective log-likelihoods L^{RP} and L^{SP} . Note that the RP and SP models include K^{RP} and K^{SP} parameters.

Following this, an integrated MNL model is estimated using the combined dataset, as outlined in **Equations (3.19)**, to obtain the maximum likelihood estimates for α^{RP} , β , ω , α^{SP} , δ , λ^{SP} and the joint log-likelihood L^{Joint} . The integrated model estimates a total of

$K^{RP} + K^{SP} - |\beta| + 1$ parameters, where $|\cdot|$ represents the number of elements in the shared utility parameter vector. This formulation reflects the imposed constraint that the utility parameters from the RP and SP datasets are equal ($\beta^{RP} = \beta^{SP} = \beta$), along with the inclusion of one extra parameter to account for the relative scale difference in the SP data.

To assess whether the shared utility parameters are statistically equivalent, a chi-squared test is conducted using the following formula:

$$-2[L^{Joint} - (L^{SP} + L^{RP})] \quad (3.21)$$

This test statistic converges in distribution to $\chi^2(|\beta| - 1)$ under the null hypothesis, where the degrees of freedom reflect the number of parameter restrictions.

3.3.2.3 Estimating Unobserved Heterogeneities and the State Space Effect with MXL

The scale parameter inherently accounts for any variation present in the utility coefficients. To ascertain the presence of scale heterogeneity, we applied various MXL models that can accommodate different sources of variation. The MXL offers considerable flexibility and can

approximate any random utility model (McFadden & Train, 2000). It addresses the limitations of the traditional MNL model by capturing correlations among alternatives—reflecting unobserved preference heterogeneity—through error components. Additionally, it accounts for unobserved response heterogeneity by incorporating random parameters that allow individual-level variation in tastes (Train, 2009).

Mixed Logit Models

An MXL model can be utilized to represent error components, as it accommodates preference heterogeneity by allowing for correlated utilities across different alternatives. The utility function of the error component logit (ECL) model is articulated as follows:

$$U_{iq} = \alpha_{iq} + \beta X_{iq} + \mu_q E_{iq} + \varepsilon_{iq} \quad (3.22)$$

In **Equation (3.22)**, α signifies alternative-specific constants, X_{iq} represents attributes, and E_{iq} is the error component that, together with ε_{iq} , define the stochastic portion of utility. Thus, the unobserved stochastic utility component, denoted as η_{iq} , is composed of $\mu_q E_{iq} + \varepsilon_{iq}$, and this component may exhibit correlations across different alternatives, contingent upon the particular specifications of E_{iq} . Following Hess and Palma (2019), in this study, the use of an error component simply involves adding a random parameter E ($0, \sigma_{ec}$). That does not multiply an attribute in **Equation (3.22)**.

The probability that an individual q opts for alternative i from a set of J options in choice situation t is expressed as:

$$P_{iq} = \frac{\exp(\alpha_{iq} + \beta_q x_{iq,t})}{\sum_{j=1}^J \exp(\alpha_{jq} + \beta_q x_{jq,t})} \quad (3.23)$$

A random parameter logit (RPL) model extends β_q to include individual response heterogeneity:

$$\beta_{qk} = \beta_k + \sigma_k v_{qk} \quad (3.24)$$

where, β_k signifies the population, while σ_k quantifies the dispersion of the random coefficient distribution around its mean value. The term v_{qk} s reflects individual-specific, unobserved heterogeneity in response to attributes, acting as a random disturbance that contributes to overall heterogeneity.

State Dependence Specification

In addition to unobserved preference and response heterogeneity, we also consider the impact of past choices on stated choices, i.e., state dependence. Bhat and Castelar (2002) define state dependence as follows:

$$\varphi_q(1 - \delta_{qt,RP}) \quad (3.25)$$

Here, $\delta_{qt,RP}$ equals 1 if the observation is RP and 0 otherwise. φ_q refers to the parameter estimate of state dependence.

Overall, the utility function U_{iqt} , which accommodates unobserved preference and response heterogeneity in addition to state-dependence effects, is expressed as follows:

$$U_{iqt} = \alpha_{iq} + \beta_q X_{iqt} + \varphi_q \left[(1 - \delta_{qt,RP}) \times \left(\sum_s^{T_q} \delta_{qs,RP} Y_{iqs} \right) \right] + \mu_q E_{iqt} + \epsilon_{iqt} \quad (3.26)$$

where α_{iq} denotes alternative-specific constants for both RP and SP, β_q is the coefficient vector that varies across individuals but remains constant across alternatives and time, and the binary variable $\delta_{qt,RP}$ flags whether the choice occasion corresponds to a revealed preference choice. The term Y_{iqs} captures the binary selection of option i at occasion t , while T_q represents the total number of observed choice occasions for individual q . The individual-specific state-dependence effect, φ_q , influences how alternatives are valued by incorporating the influence of prior RP choices.

The unobserved utility components are jointly determined by the error components E_{iqt} and ϵ_{iqt} . The term $\mu_q E_{iqt}$ induces heteroscedasticity and correlation across these unobserved utilities, expressed as $\mu_q E_{iqt} = \sum_{m=1}^M d_{im} \mu_m E_{qm}$, where d_{im} is a binary variable indicating membership in nest m , and μ denotes a vector of random terms with a mean of zero. The error term ϵ_{iqt} is characterized by an IID EVI distribution. The scale parameter is specified as $\lambda_{qt} = [(1 - \delta_{qt,RP})\lambda] + \delta_{qt,RP}$, adjusting for the variance differences between RP and SP choice situations. For identification purposes, the RP scale is normalized to one, while λ is estimated for the SP scale.

Overall, the complete probability model can be represented as follows:

$$P_{iq} = \frac{\exp [\alpha_{iq} + \beta_q x_{iqt} + \varphi_q [(1 - \delta_{qt,RP}) \times (\sum_s^{Tq} \delta_{qs,RP} Y_{iqs})] + \mu_q E_{iqt}]}{\sum_{j=1}^{Jq} \exp [\alpha_{jq} + \beta_q x_{jqt} + \varphi_q [(1 - \delta_{qt,RP}) \times (\sum_s^{Tq} \delta_{qs,RP} Y_{jq_s})] + \mu_q E_{jqt}]} \quad (3.27)$$

Equation (3.27) is dependent on the stochastic terms v_q and error components E_q . To obtain unconditional choice probabilities, the process involves integrating out v_{qk} and E_{qm} from the conditional probabilities, expressed as $P_i = E_{v,E}[P(i|v_q, E_q)]$. This involves multiple integrals for which a direct analytical solution is not available, and necessitates the use of simulation methods, where repeated samples are drawn from the assumed populations and then averaged to approximate the result (Greene & Hensher, 2007; Train & Wilson, 2008). Model parameters are estimated by maximizing the simulated log-likelihood function.

$$\log L_s = \sum_{q=1}^N \log \frac{1}{R} \sum_{r=1}^R \prod_{t=1}^{Tq} \frac{\exp [\alpha_{iq} + \beta_{qr} x_{iqt} + \varphi_q [(1 - \delta_{qt,RP}) \times (\sum_s^{Tq} \delta_{qs,RP} Y_{iqs})] + \mu E_{iqt,r}]}{\sum_{j=1}^{Jq} \exp [\alpha_{jq} + \beta_{qr} x_{jqt} + \varphi_q [(1 - \delta_{qt,RP}) \times (\sum_s^{Tq} \delta_{qs,RP} Y_{jq_s})] + \mu E_{jqt,r}]} \quad (3.28)$$

In **Equation (3.28)**, R denotes the total number of replications. The r -th sample of βq is calculated as $\beta + \sigma_k v_{qr}$, where v_{qr} represents the r -th multivariate sampling for individual

q , and $E_{q,m,r}$ corresponds to the r -th univariate normal sampling of the intrinsic effect specific to that individual.

3.3.2.4 Summary of the Sources of Heterogeneity

Figure 3.5 shows the sources of heterogeneities in the joint models of this study, within/between SP and RP. They are individual-specific heterogeneity, alternative-specific heterogeneity, scale factors, and state dependence, which can be identified through different models. Each green box is a data source (SP or RP), framing the decision-making process depicted by RUM.

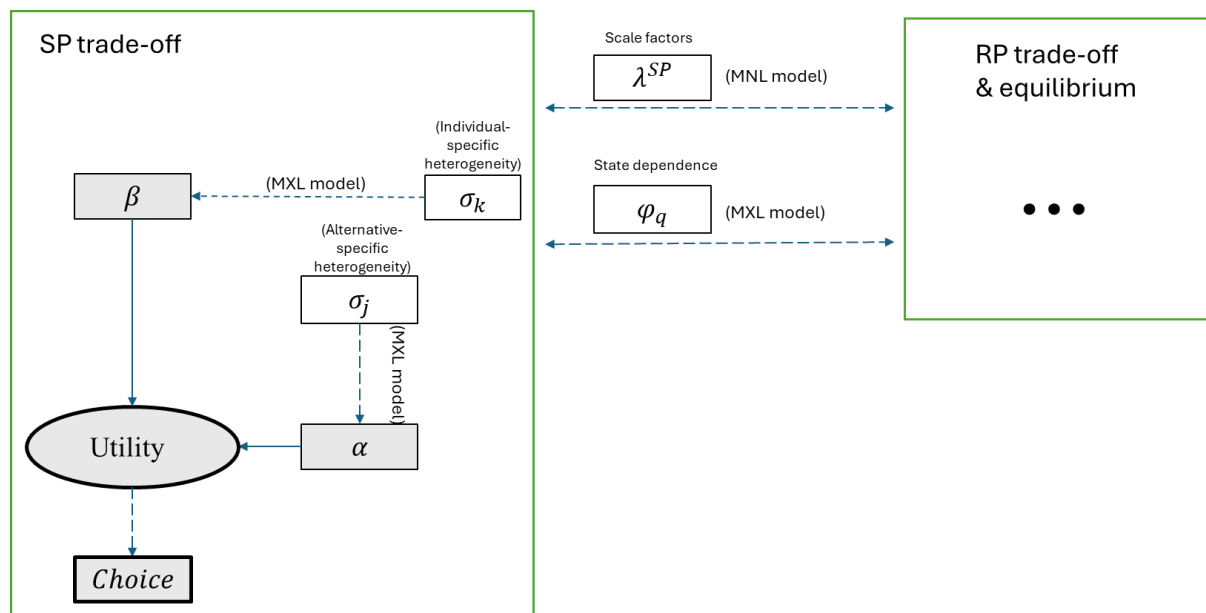


Figure 3.5 Sources of heterogeneity within/between SP and RP

3.3.3 Study 3: Opening the Box: Process Behind Economic Preferences for Carbon Offset

The third study adopted an inductive qualitative approach to address the aforementioned objectives: further verify and explain individuals' stated and revealed preferences of TCO, the results of which would be found in the first two studies. Harnessing semi-structured interviews,

tourists with and without carbon offset experience were invited to express their preferences and decision-making about travel carbon offset.

In conducting interviews for this study, a social constructivist approach guides the research process, emphasizing the significance of the researcher–participant relationship and aiming to deepen the understanding of their preferences for carbon offset. Social constructivism posits that knowledge is co-constructed through interactive and dialogical processes, acknowledging the active involvement of both the researcher and participants in co-constructing the understanding of the topic (Amineh & Asl, 2015). The relationship between the researcher and participants will be seen as a collaborative endeavor, acknowledging that individual perspectives, experiences, and preferences contribute to the construction of knowledge (Kim, 2014). Through interviews, the study seeks to uncover the diverse and contextually embedded aspects of participants’ preferences for carbon offset. This approach facilitates a more in-depth examination of tourists’ perspectives, considering the social, cultural, and contextual factors that influence their preferences. By adopting a social constructivist lens, the study aims to capture the richness and depth of tourists’ insights, providing a nuanced understanding of their preferences related to carbon offset.

3.3.3.1 Authors’ Position and Reflexivity

In conducting this research, it is essential to acknowledge the researcher’s positionality and engage in reflexive practices (Olmos-Vega et al., 2023; Robinson & Wilson, 2022; Whitaker & Atkinson, 2021). As the primary investigator, I bring a background in tourism economics, and my research experiences involve decision-making. I am aware of potential biases related to my economic mindset and utilitarianism. In addition, it is crucial to recognize that my position as an insider to the TCO preferences as an individual tourist and as a researcher may influence the research process. I am aware of potential biases in the data collection and analysis,

including my overemphasis on personal perspectives, difficulty in remaining objective, potential for confirmation bias, and influence on participant responses. To address these background and insider biases in a study on preferences for carbon offsetting, I maintained reflexivity and shared preliminary findings with my supervisor and colleagues with different backgrounds.

3.3.3.2 Data Collection

Semi-structured in-depth interviews were conducted with Chinese residents who had undertaken international air travel within the preceding three years. Participants were recruited through Credamo and Little Red Book between November 2024 and March 2025. Sampling was stratified purposively across offsetters and non-offsetters, with variation in age and gender. Each interview lasted 30-60 minutes, with data collection continuing until theoretical saturation was achieved - the point where no new thematic patterns emerged in the data (Fusch & Ness, 2015; Braun & Clarke, 2021). A total of 21 participants were interviewed, comprising a balanced distribution of offsetters (52.4%) and non-offsetters (47.6%). The sample was also gender-balanced, with 52.4% identifying as female and 47.6% as male. In terms of recruitment sources, 52.4% were recruited through Credamo and 47.6% through Little Red Book. The age distribution was as follows: 42.9% were aged 21–30, 38.1% were 31–40, 14.3% were 41–50, and 4.8% were 51–60. Regarding educational attainment, 47.6% held a bachelor’s degree, 47.6% held a master’s degree, and one participant (4.8%) held a doctoral degree. Marital status varied across the sample, with 57.1% being married and 42.9% single. In terms of annual income, 66.7% reported earning below ¥200,001, 14.3% earned between ¥200,001 and ¥400,000, 9.5% earned between ¥400,001 and ¥600,000, and 4.8% reported income above ¥600,000. A detailed breakdown by individual participants is provided in **Table 3.6**.

Table 3.6 Profile of the interviewees

	No.	Gender	Age	Marital status	Education	Annual income	Sources
Offsetter	O01	Female	21-30	Single	Master	above ¥ 600,000	Little Red Book
	O02	Female	21-30	Married	Bachelor	below ¥ 200,001	Little Red Book
	O03	Male	21-30	Single	Master	¥ 200,001-400,000	Little Red Book
	O04	Male	41-50	Married	Master	above ¥ 600,000	Little Red Book
	O05	Male	31-40	Married	Master	¥ 200,001-400,000	Credamo
	O06	Male	31-40	Married	Master	below ¥ 200,001	Credamo
	O07	Female	41-50	Married	Bachelor	below ¥ 200,001	Credamo
	O08	Male	31-40	Married	Bachelor	¥ 400,001-600,000	Credamo
	O09	Male	31-40	Single	Bachelor	below ¥ 200,001	Credamo
	O10	Male	41-50	Married	Bachelor	below ¥ 200,001	Credamo
	O11	Female	51-60	Married	Doctor	¥ 400,001-600,000	Credamo
Non-offsetter	N01	Female	21-30	Single	Bachelor	below ¥ 200,001	Little Red Book
	N02	Female	21-30	Single	Master	below ¥ 200,001	Little Red Book
	N03	Male	21-30	Single	Master	below ¥ 200,001	Little Red Book
	N04	Female	21-30	Single	Master	below ¥ 200,001	Little Red Book
	N05	Female	21-30	Single	Master	¥ 200,001-400,000	Little Red Book
	N06	Male	21-30	Single	Master	below ¥ 200,001	Little Red Book
	N07	Female	31-40	Married	Bachelor	below ¥ 200,001	Credamo
	N08	Female	31-40	Married	Bachelor	below ¥ 200,001	Credamo
	N09	Male	31-40	Married	Bachelor	below ¥ 200,001	Credamo
	N10	Female	31-40	Married	Bachelor	below ¥ 200,001	Credamo

Eleven interviewees who had previously purchased carbon offsets to mitigate travel-related carbon emissions were selected using purposive sampling. Informed by the results from Study

1 and Study 2, semi-structured interview questions were developed to gather basic information about their offsetting experiences and to explore the factors influencing their preferences and decision-making processes regarding offset consumption. The questions covered topics such as awareness and knowledge, motivations and barriers, preferences, and experiences related to travel carbon offsets.

Additionally, ten participants who had not purchased carbon offsets were interviewed to understand their awareness, perceptions, and potential barriers to engaging in carbon offsetting. Similar semi-structured questions were employed, focusing on their awareness and knowledge, motivations and barriers, preferences, and expectations concerning travel carbon offsets.

3.3.3.3 Data Analysis

Thematic analysis was the chosen method to interpret the data derived from interview transcripts, documents, and survey responses. This particular approach facilitates the systematic identification of potential themes by effectively organizing and thoroughly articulating complex patterns present within the existing data (Braun & Clarke, 2006). It is important to note that all original materials collected for this study, including documents in various languages such as Chinese, were diligently documented from the outset. Subsequently, these materials underwent a comprehensive process of synthesis for analytical induction (Brewer, 2000) and underwent a meticulous translation into English, ensuring the utmost preservation of their original meaning and contextual nuances.

Following the guidelines outlined by Berbekova et al. (2021), the researcher familiarised herself with the data and conducted a preliminary review. A combined deductive–inductive coding strategy was then applied manually, with NVivo 12 used to support data management and theme development. The inductive strand kept the analysis open to patterns not specified in advance. In contrast, the deductive strand drew on a seed codebook developed from Studies

1–2 and the relevant literature to anchor coding in established constructs. Codes were subsequently refined and categorised to improve the organisation and coherence of the analysis. To strengthen analytic validity, a second coder independently coded a subset of transcripts; the two coders compared interpretations and reconciled discrepancies through discussion and peer debrief, with a brief audit trail and code–recode check maintained.

The data analysis phase of the empirical study followed a structured, three-stage approach comprising open coding, axial coding, and selective coding, as outlined by Glaser and Strauss (2017). Open coding serves as the initial step to discern the principal categories that are firmly grounded in the TCO narrative and choice framework, as indicated in the literature review. Subsequently, during the axial coding phase, these primary categories identified during open coding were further dissected into subcategories, facilitating a more detailed and structured interpretation of the data. Lastly, through the process of selective coding, additional commonalities and distinctions among the subcategories identified during axial coding were meticulously delineated, further enriching the analysis. To ensure consistency and coherence, appropriate concept labels were assigned to these subcategories, taking into account their shared conceptual nature.

Chapter 4 Results and Discussion

4.1 Are Tourists Willing to Pay for Travel Carbon Offset?

4.1.1 Results

4.1.1.1 Choice Model Performance

The DCMs were estimated using the Apollo package (Hess & Palma, 2022) in R. **Table 4.1** compares the HCM's performance with that of the MNL and MXL models. Based on the evaluation metrics—including the choice components' likelihood, Akaike information criterion (AIC), and Bayes information criterion (BIC)—the HCM demonstrated superior performance, achieving the highest log-likelihood and indicating the best model fit.

Table 4.1 Performance of choice models

	MNL	MXL	HCM
Log-likelihood (choice)	-5,972.92	-5,261.96	-5,089.58
AIC (choice)	11,973.84	10,577.92	10,233.16
BIC (choice)	12,070.19	10,763.73	10,418.97

Note: AIC = Akaike information criterion; BIC = Bayesian information criterion; HCM = hybrid choice model; MNL = multinomial model; MXL = mixed multinomial logit model.

4.1.1.2 TCO Choice Model Results

As the choice component of the HCM outperformed the MNL and MXL, we focus on the HCM results (see **Table 4.2**) in this section.

The utility associated with the third alternative—namely, choosing not to offset travel emissions—is given by the constant, the result of which indicated that the respondents were more likely to purchase TCOs than to opt-out (-2.006 , $p < .01$). This study further explored

the determinants of tourists' TCO choice. A positive sign on the significant coefficient implies that the respondents preferred that attribute and were more likely to select a TCO product with that attribute, and vice versa. Significant positive coefficients of individuals' contributions to reducing carbon emissions imply that the respondents demonstrated a preference for TCO products that enabled them to offset a greater amount of carbon emissions (0.310, $p < .01$). The respondents' preferences for lowering carbon emissions were also reflected in the significant positive value of providers' contribution to decarbonization (0.256, $p < .01$). In contrast, the respondents did not prefer TCO products with a higher price (-0.012 , $p < .01$).

The attribute levels of the project location, project type, offset product provider, and payment time were coded as categorical variables with levels "Other developing countries," "Waste-to-energy," "Hotel," and "On-site," respectively, as the base (0) level in the utility **Equation (3.7)**. The respondents showed a significantly higher likelihood of selecting TCO products implemented in domestic regions (0.250, $p < .01$) or overseas destinations (0.229, $p < .01$). The higher preferences for domestic projects over overseas projects underscore the potential of China's voluntary offset market. These preferences align with the reopening of new project registrations within the China Certified Emission Reduction (CCER) framework in 2023 and the domestic climate obligations advocated by Carton et al. (2021). The respondents were also most supportive of reforestation and conservation offset projects (0.309, $p < .01$) and renewable energy (0.303, $p < .01$). The highest value for reforestation-related projects aligns with the conclusions drawn by Choi et al. (2018), MacKerron et al. (2009), Ritchie et al. (2021), and Rotaris et al. (2020). These previous studies also found that nature-based projects were preferred by tourists to human benefit-oriented projects or technology-based projects, suggesting a consistent preference for such initiatives across different investigations. Tourists' preferences for nature-based offset projects may be driven by their strong environmental concerns, the tangible impact these projects offer, the focus of the projects on environmental

conservation, tourists' emotional connection with nature, the projects' long-term sustainability, and the educational and awareness-raising opportunities these projects offer. The respondents preferred the situation in which they paid for TCO products before departure (0.122, $p < .01$) to the base-level situation in which they paid during their trip. This purchasing pattern could potentially be influenced by the booking practices commonly associated with online travel agencies. Interestingly, the respondents were less likely to select TCO products provided by airlines (-0.145 , $p < .01$), which may be related to the fact that airlines are major emitters of greenhouse gases (Graver et al., 2020). This suggests that the public may perceive airlines' involvement in offsetting carbon emissions as "greenwashing" because airlines appear to emphasize their public image over substantial carbon reductions (Hyams & Fawcett, 2013; Watt, 2021). The choice model results showed that offset- and travel-related attributes influenced tourists' choice of TCO. In addition, the standard deviations, which are estimated parameters (refer to **Equation (3.7)**), related to carbon offset contributions, domestic or overseas projects, offset product providers, contribution from providers, payment time, and price were significant ($p < .01$), indicating that the respondents exhibited diverse preferences regarding these attributes and their levels.

Table 4.2 Estimates of the travel carbon offset choice model

Variable	Coefficient	(SE)	Standard deviation	(SE)
Attribute				
Carbon offset contribution (tonnes)	0.310***	0.059	0.995***	0.068
Project location				
Other developing country	Base level			
Domestic	0.250***	0.0774	-0.642 ***	0.084
Overseas destination	0.229***	0.077	-0.258 ***	0.120

Project type				
Waste-to-energy	Base level			
Reforestation and conservation	0.309***	0.090	0.166	0.103
Renewable energy	0.303***	0.096	0.194	0.160
Community project	0.040	0.095	0.228	0.141
Offset product provider				
Hotel	Base level			
Airline	-0.145***	0.063	-0.273***	0.137
Online travel agency	-0.097	0.062	0.189**	0.114
Carbon offset company	-0.114	0.102	0.11190	0.211
Contribution from product provider (tonnes)				
	0.256***	0.047	0.358***	0.053
Payment time				
On-site	Base level			
Before departure	0.122***	0.048	0.304***	0.091
After travel	0.089	0.075	-0.313***	0.089
Price (¥)	-0.012***	0.002	-0.028***	0.001
Alternative specific constant (opt-out)				
	-2.796***	0.300		
Latent variable				
Green trust	-2.006***	0.147		

Note: *** and ** denote statistical significance at the 1% and 5% levels, respectively. SE = standard error.

4.1.1.3 LVM Results and Offsetters' Profiles

As shown in **Table 4.2**, green trust was negatively associated with the likelihood of selecting the opt-out option (-2.006, $p < .01$): as green trust increased, the respondents were less likely to choose the “would not offset my carbon emissions” option. Increasing green trust led to an

increased probability of selecting TCO options. This result aligns with Chen et al. (2019), indicating that green trust was positively related to the intention to engage in green practices and positive word-of-mouth. **Table 4.3** presents the measurement equation results from the LVM, where green trust in carbon offsets was positively correlated with perceptions of TCO products' reliability, dependability, trustworthiness, environmental concerns, and promise of environmental protection ($p < .01$).

Table 4.3 Measurement model estimates (latent variable)

Latent variable: Green trust	Mean	Coefficient	(SE)
The environmental reputation of this carbon offset product is generally reliable.	5.79	1.953***	0.143
The environmental performance of carbon offset products is generally dependable.	5.88	1.760***	0.129
The environmental claims made by carbon offset products are generally trustworthy.	5.89	1.902***	0.140
The environmental concerns of carbon offset products meet my pro-environmental expectations.	5.97	1.511***	0.114
The carbon offset product upholds its promise of environmental protection.	5.81	1.833***	0.132

Note: *** denotes statistical significance at the 1% level. SE = standard error.

The structural equations in the LVM (see **Table 4.4**) showed that gender, income level, marital status, employment status, and offset experience had statistically significant effects. Women were more likely than men to trust TCO products (0.271, $p < .01$), consistent with the results reported by Westin et al. (2020) from a Swedish sample. The respondents with prior carbon offsetting experience demonstrated greater trust in TCO products than people without offset experience (0.917, $p < .01$).

The low-income respondents (-0.288 , $p < .01$) were less likely to trust TCO products, in line with prior research indicating a positive association between income and pro-environmental behavior (Dolnicar, 2004, 2010; Schwirplies et al., 2019). Additionally, unemployed individuals were less likely than their employed counterparts to trust carbon offset products (-0.901 , $p < .01$), a finding that aligns with Rotaris et al. (2020). The single respondents (-0.588 , $p < .01$) were also less likely to trust carbon offset products. These socio-demographic characteristics and past experiences affected TCO choices via the latent variable.

Table 4.4 Structural model estimates (latent variable)

Variable	Green trust	
	Coefficient	(SE)
Gender (Male = 0)		
Female	0.271***	0.067
Age (40–59 = 0)		
Age (18–39 years)	0.012	0.074
Age (≥ 60 years)	0.205	0.149
Educational attainment (lower than bachelor's degree = 0)		
Education (high)	0.132	0.115

Income (¥144,001–420,000 = 0)		
Income (< ¥144,001)	−0.228***	0.083
Income (> ¥420,000)	−0.014	0.089
Marital status (not single = 0)		
Single	−0.588***	0.110
Occupation (not employed = 0)		
Unemployed	−0.901***	0.313
Carbon offset experience (no = 0)		
Yes	0.917***	0.078

Note: *** indicates significance at the 1% level. SE = standard error.

4.1.1.4 Economic Value of TCO

Table 4.5 shows the estimation results for WTP (i.e., marginal rates of price substitution, see **Equation (3.14)**) from the mean values of the attribute parameters in the choice model and their 95% confidence intervals. As expected, compared with offsetting carbon emissions, “no TCO” was less preferred by the respondents. On average, they were willing to pay ¥26.86 (\approx US\$5.95) per tonne of carbon emissions offset ($p < .01$). This was lower than the WTP reported for Australian (US\$19.27; Choi & Ritchie, 2014), Italian (US\$13.43–42.52; Rotaris et al., 2020), and German (US\$44.78; Schwirplies et al., 2019) samples. The observed lower WTP per tonne of carbon offset in the Chinese sample compared with the samples from other countries suggests potential variations in WTP across countries, influenced by factors such as income disparities (World Bank, 2023) and varying levels of environmental awareness (Babakhani et al., 2017; Carlsson et al., 2021). In addition, respondents, on average, expressed a WTP ¥22.13 per tonne of carbon emissions additionally offset by the provider ($p < .01$). Compared with projects located in other developing countries, the respondents were willing to pay an average of ¥21.65 for a domestic project ($p < .05$), which was ¥1.82 higher than their

WTP for a project at their destination ($p < .05$). Compared with the baseline project type (i.e., waste-to-energy), the respondents were willing to pay an average of ¥26.76 for reforestation and conservation projects ($p < .01$), which was slightly higher than their WTP for a renewable energy project ($p < .05$). Interestingly, the significant negative value of mean WTP (-12.43 , $p < .01$) implied that the respondents would be worse off with TCO products provided by the airline compared with the hotel as the provider. The respondents preferred to pay before departure, with a mean WTP estimate of ¥10.59 ($p < .05$) compared with on-site payments. We further compared the WTP estimates and only found significant differences in WTP between project types ($p < .01$).

Table 4.5 WTP values for non-monetary attributes

Attribute	WTP (¥)	(SE)	95% CI	
Carbon offset contribution (tonnes)	26.86***	5.74	15.61	38.11
Project location				
Other developing country	Base level			
Domestic	21.65**	8.74	4.52	38.78
Overseas destination	19.83**	8.37	3.42	36.25
Project type				
Waste-to-energy	Base level			
Reforestation and conservation	26.76***	10.24	6.69	46.82
Renewable energy	26.20**	10.64	5.33	47.07
Community project	3.45	8.52	-13.24	20.14
Offset product provider				
Hotel	Base level			
Airline	-12.43**	5.82	-23.84	-1.03
Online travel agency	-8.39	5.47	-19.13	2.34

Carbon offset company	-9.87	10.81	-31.06	11.32
Contribution from product provider (tonnes)	22.13***	4.01	14.27	29.99
Payment time				
On-site	Base level			
Before departure	10.59**	4.45	1.86	19.31
After travel	7.72	6.29	-4.61	20.06

Note: ***, **, and * denote statistical significance at the 10%, 5%, 1% levels, respectively. CI = confidence interval; SE = standard error; WTP = willingness to pay.

4.1.2 Discussion

After a 6-year break, the reintroduction of new project registrations within the CCER signals the revival of China's voluntary carbon market (Mao, 2023). This study aligns with policy objectives and ambitions for industry-wide offsetting, as it investigates the feasibility of an innovative voluntary offset product designed for individual tourists, encompassing their entire journey and the entire tourism industry. It is worth noting that carbon offsets should be adopted and developed cautiously to avoid "moral disengagement" from the harms associated with carbon footprints (Fankhauser et al., 2022). The underlying idea behind TCO and other travel offset products should be "avoiding the unavoidable" (Lovell et al., 2009). When tourism decarbonization is viewed as a systemic process, the principle of "avoiding the unavoidable" employs an "energy hierarchy" as a planning and decision-making framework—prioritizing reduction, then renewal or replacement, and finally offsetting. This principle suggests that the tourism industry should reduce travel emissions before offsetting and that all other narratives concerning travel carbon offsetting should be considered part of the decarbonization system. The industry should also engage knowledgeable and responsible consumers who view carbon offsets as part of a broader commitment to carbon-reduction practices, emphasizing self-control and the governance of individual consumption.

Using the HCM, this study employed the determinants of TCO choices. The findings indicate the following: (1) the respondents preferred to opt-in when they were provided with a TCO product and were willing to pay ¥108 (about \$15.88) for an optimal TCO product for a trip with a 1-tonne carbon footprint; (2) offset-related attributes (offset quantity, offset location, and project type) and travel-related attributes (product provider, contributions from the provider, and payment time) influenced the choice of a TCO product; and (3) the respondents' levels of green trust influenced their preferences concerning TCO products.

Interestingly, although we found a negative preference for airlines as offset providers, the majority of research in the tourism domain has predominantly centered on carbon offsets provided by airlines. Few studies have identified a negative inclination towards flying carbon offsets among specific traveler groups. Ritchie et al. (2021) found that frequent flyer members and business travelers were unlikely to engage in carbon offsetting, reflecting a dilemma for cosmopolitan travelers highlighted by Gössling (2002). Some recent contributions to tourism scholarship have recognized and addressed gaps between existing offsetting products and consumer preferences (Babakhani et al., 2017; Denton et al., 2020; Guix et al., 2022; Segerstedt & Grote, 2016; Zhang et al., 2019). Babakhani et al. (2017) highlighted that consumers' limited awareness of carbon offsetting diminishes its appeal. Guix et al. (2022) found that misleading messages hinder the accurate communication of products' pro-environmental characteristics and that airlines tend to deliver misleading communications about carbon offsetting. However, these studies on carbon offsets all focused on aviation. We expect that the findings of this paper will encourage tourism academics to rethink and reflect on their research directions and broaden their perspectives on carbon offsets, moving beyond the conventional focus on aviation.

In summary, the theoretical insights offered by this study are significant and warrant careful consideration. First, this study advances existing research on tourism and carbon offsetting,

which has thus far predominantly focused on flight-related offsets, sidelining other forms of offsetting. This study proposes the creation of innovative, industry-wide TCO products to offset emissions throughout individual tourists' travel processes. In addition, the discovery of the negative WTP for airlines as TCO product providers should prompt an exploration of this aversion and should pave the way for future research in the field of carbon offsets within the tourism industry. Second, we enhance the comprehension of tourists' offsetting decision-making processes by examining the influences of offset-related attributes (including offset quantity, offset location, and project type) and travel-related attributes (including product provider, contributions from the provider, and payment time) in conjunction with levels of green trust and social-demographic characteristics on TCO selection. The intricacy of offsetting choice behaviors was elucidated by considering the interplay of external determinants (TCO attributes) and internal factors, including psychological factors (green trust) and social demographics (Wang et al., 2022; Warburg et al., 2006) within the HCM framework. Moreover, the finding that green trust positively influences individuals' selection of TCO products enriches existing research on the drivers and barriers affecting consumer decisions regarding carbon offsetting (Babakhani et al., 2017; Denton et al., 2020; Guix et al., 2022; Segerstedt & Grote, 2016; Zhang et al., 2019). Third, this research enriches the body of knowledge concerning both estimating tourists' WTP for offsetting carbon emissions across their entire travel journey and providing economic values for each attribute or level. This contribution aims to initiate a broader discussion. For instance, the lower observed WTP per tonne of carbon offset in the Chinese sample compared with the WTP values in samples from other countries indicates that future research should delve into cross-country differences in WTP per tonne of carbon offset and explore the underlying causes of these differences. Finally, this study offers empirical support for applying HCM within tourism, as this methodology facilitates the amalgamation of TCO attributes, tourists' socio-economic characteristics, and latent variables

such as green trust using MXL–LVM in an HCM framework. These analyses and findings encourage the integration and refinement of discrete choice modeling techniques into research on psychological inclinations and consumer behavior within the field of tourism.

The study provides meaningful, practical insights that are highly relevant for various stakeholders in the tourism field. First, the respondents' preferences for TCO products underscore the importance of offering options that provide transparent travel emissions data along with accessible offsetting mechanisms. Second, the results regarding the importance of TCO product attributes provide tourism and offset practitioners with references to aid in the development of a more attractive TCO product. This product should contribute to reducing carbon emissions from both demand and supply sides by prioritizing domestic projects, investments in renewable energy, non-airline providers, and pre-departure payment options. Given the historically tepid adoption of carbon offset practices in tourism, businesses should merge carbon offsets and tourism-related attributes while exploring novel operating models. Lessons from real-world practices in tourism agencies, such as agency, merchant, and advertising business models, could be adapted to develop effective TCO products or services. It is worth noting that credibility is essential for businesses developing carbon offset products. It is crucial for businesses to ensure real and additional emissions reductions, avoid greenwashing, and comply with regulations. Credible offsets enhance environmental responsibility, reputation, and long-term viability, demonstrating a commitment to sustainability and ethical practices while mitigating risks and gaining market acceptance. Third, the positive links between green trust in carbon offsets and individuals' choices of TCO products and the negative preference for airlines as providers may prompt governments and offset practitioners to correct their potentially deceptive green image and build public trust in their carbon offsetting practices. The positive effect of green trust on consumers' behavioral intentions aligns with the findings of Sung et al. (2021). Reliable, transparent communication

channels and products should be built and delivered to consumers. Finally, considering that the mean WTP for net offset per tonne of CO₂ (¥26.86 ≈ US\$3.95) was lower than the current carbon price in China's carbon market (¥48 ≈ US\$7.06), Chinese practitioners of TCO should aim to strike a balance between benefits and costs while catering to market preferences, such as by integrating reforestation and conservation projects into the TCO framework to enhance offsetters' WTP. Beyond participants' WTP, however, carbon offset pricing also depends on the carbon market and regional regulations.

This study is subject to several limitations, which also open up directions for future research. First, while the HCM proves powerful, its computational demands and data-intensive nature pose challenges. In this study, we parsimoniously introduced a latent variable in the utility function. Further research could introduce latent variables in each continuous and categorical attribute level and explore different approaches to introducing more latent variables in an HCM. Furthermore, although the HCM outperformed other choice models in this study, future studies of tourism consumer behavior could compare the costs and benefits of different modeling techniques. In addition, the study did not thoroughly address potential modeling issues that may violate behavioral assumptions, such as scale heterogeneity and attribute non-attendance. Addressing these concerns and optimizing the experimental design to accommodate these factors is a promising future research avenue. Second, while this study identified the positive influence of green trust on offset preferences, further investigation could delve into how green trust influences offset preferences and how to build consumers' trust in the offset market. In addition, our measure of green trust adapted the Likert scale developed for other green products; there is clear value in developing and validating an offset-specific trust scale that reflects domain features (e.g., project verification, additionality, permanence, leakage). Furthermore, a significant disparity exists between attitudes and behaviors regarding TCO purchases. This gap can be attributed to social norms, a lack of motivation, knowledge, or information, free rider

concerns, and the perceived lack of credibility of offset initiatives (Denton et al., 2020; Higham et al., 2019). In addition to trust issues, future research should explore other barriers to and facilitators of individual engagement in travel carbon offsetting. Furthermore, the sample size employed in this study was relatively limited and may not fully capture the diversity of the broader population of potential Chinese outbound tourists. Potential sampling bias may have arisen due to the overrepresentation of highly educated and high-income individuals. This overrepresentation may have occurred because the respondents retained in the analysis were those who had traveled abroad for leisure purposes in the last 5 years, who would like to travel overseas in the coming year, and who could understand carbon offsetting after it was described to them. Fourth, the potential of the stated preference survey data in forecasting the potential influences of novel TCO products is accompanied by hypothetical bias arising from stated and actual choices in real-world situations. Future TCO studies should collaborate with tourism businesses to acquire real-world data for analysis. Finally, this study only explored the possibility of a hypothetical TCO product and its determinants. Further study is needed to determine how to operate such products in the tourism industry. Overall, this study advocates for a systematic approach to tourism decarbonization, emphasizing that tourists should prioritize reducing travel emissions before considering offsetting, treating offsetting as the final step to “avoid the unavoidable.” Such an approach necessitates collaborative efforts from various stakeholders within the industry. Future research and policy endeavors should focus on fostering multi-stakeholder cooperation to amplify the impact of individual initiatives across the tourism sector (Higham et al., 2019). In addition, the successful development of voluntary offsetting behavior among tourists highlights the need for studies on challenges such as the lack of motivation to purchase carbon offsets and the free rider issues, ensuring project credibility and regulations, and implementing effective communication strategies (Fankhauser et al., 2022).

4.2 Stated vs. Revealed Preferences for Travel Carbon Offset

4.2.1 Results

4.2.1.1 Comparing Stated and Revealed Preferences

For our analysis of the datasets comprising 5,280 SP and 554 RP observations, the MNL estimates for RP and SP are presented in the first two columns of **Table 4.6**, labeled “RP MNL” and “SP MNL.” The results reveal consistent trends and indicate similar preferences in both RP and SP contexts for carbon offsetting when flying.

They indicate that respondents tended to offset their flying emissions rather than abstain from offsetting ($p < 0.01$). The positive coefficients for individual contributions to carbon emission reduction suggest a preference for offsetting more emissions (0.102 in RP, $p < 0.1$; 0.089 in SP, $p < 0.01$). Conversely, respondents preferred lower prices (-0.006 in both RP and SP, $p < 0.01$). They also showed a preference for flying offset products based in domestic regions (3.419 in RP and 0.752 in SP, $p < 0.01$) and overseas destinations (3.241 in RP and 0.338 in SP, $p < 0.01$), compared with other countries or regions.

A notable difference between SP and RP emerged in travelers’ preferences for offset projects. In terms of RPs, participants favored reforestation and conservation projects (1.716, $p < 0.01$), followed by renewable energy projects (1.081, $p < 0.05$). In contrast, the preference for these projects in SPs was not significantly different from the baseline, while renewable energy projects were the most favored (0.155, $p < 0.01$). Travelers showed a significant preference for certified offsets in their SPs (0.091, $p < 0.05$), while certification in terms of RPs was insignificant.

Table 4.6 Estimates of RP, SP, and joint multinomial logit models

	RP MNL	SP MNL	Full Joint MNL	Partial Joint MNL
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Variable	Data	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
<i>Alternative specific constants</i>									
Offset by trip	RP	9.795***	1.235			15.582***	0.154	10.98***	1.237
Offset by trip	SP			1.190***	0.071	1.217***	0.330	1.142***	0.335
One-off offset	RP	9.917***	1.306			16.188***	0.403	11.123***	1.324
One-off offset	SP			1.109***	0.081	1.122***	0.303	1.059***	0.309
<i>Common attributes</i>									
Carbon offsetting contribution	SP&RP					0.110**	0.049	0.094**	0.046
	RP	0.102*	0.059						
	SP			0.089***	0.023				
Project locations									
Other developing country (Base level)									
Domestic-RPSP	SP&RP					0.815***	0.225		
Domestic-RP	RP	3.419***	0.754					3.423***	0.761
Domestic-SP	SP			0.752***	0.046			0.731***	0.217
Overseas destination-SPRP	SP&RP					0.367***	0.103		
Overseas destination-RP	RP	3.241***	0.877					3.25***	0.799
Overseas destination-SP	SP			0.338***	0.045			0.327***	0.099
Project types									
Community project (Base level)									
Reforestation and conservation-SPRP	SP&RP					0.069	0.046		
Reforestation and conservation-RP	RP	1.716***	0.465					1.708***	0.45
Reforestation and conservation-SP	SP							0.034	0.039
				0.033	0.045				
Renewable energy-SPRP	SP&RP					0.174***	0.062		
Renewable energy-RP	RP	1.081**	0.432					1.069***	0.413
Renewable energy-SP	SP			0.155***	0.049			0.151***	0.059
Certification	SP&RP					0.113**	0.061		
	RP	2.855	1.937					2.847	2.847
	SP			0.091**	0.036			0.09	0.09
Price (¥)	SP&RP					-0.006***	0.002	-0.006***	0.002
	RP	-	0.002						
	SP	0.006***		-	0.000				
				0.006***					
Scale parameter						0.939***	0.257	1.031***	0.305
Number of observations		554		5280		5834		5834	
Number of parameters excluding constants		7		7		8		13	
LL		-134.52		-4846.60		-5003.16		-4981.23	
BIC		325.9		9770.35		10082.12		10069.86	
Adj. Rho-squared vs observed shares		0.478		0.093		0.109		0.112	

*Note: Significance levels are denoted as ***, and **, representing significance at the 1%, and 5% levels, respectively. SE = standard error.

To further empirically compare the parameters between SP and RP, we followed the process of the parameter equality test proposed by Swait and Louviere (1993).

A comparison between the “RP MNL” and “SP MNL” models reveals a notable trend in which the estimates in the RP dataset are considerably higher than those in the SP dataset. To further validate these findings, we estimate a “full joint MNL” model, assuming coefficients of all attributes or levels are equal in SP and RP. This model imposes constraints on the parameter homogeneity of all offset attributes and levels across both SP and RP datasets, as presented in the third column of **Table 4.6**.

The null hypothesis, which posits common preference equality across data sources (i.e., as $\beta^{SP} = \beta^{RP}$), is evaluated using the parameter comparison approach. This involves calculating the statistic $-2[L^{Joint} - (L^{RP} + L^{SP})]$. In this analysis, the obtained chi-squared statistic is 44.08 with 6 degrees of freedom. This value indicates a rejection of the hypothesis of uniform parameters across SP and RP. This suggests that travelers’ preferences for carbon offsetting in hypothetical scenarios diverge from their actual behavior in real-life situations, underscoring the discrepancy between stated intentions and revealed actions.

Figure 4.1 illustrates the shared parameters estimated from the source-specific MNL models, highlighting that the scale parameters of the two datasets may differ. This difference suggests that the rejection of the hypothesis of equal parameters can be attributed to three specific parameters: domestic project, certification, and reforestation. When excluding these, the remaining coefficients follow a line with a positive slope passing through the origin, indicating a close relationship between choices in the SP and RP datasets. Of the three suspect parameters, the domestic project shows a higher correlation between SP and RP. This indicates that projects in a domestic location have a greater influence on the SP than in the RP setting, while the effects of certification and reforestation projects are less pronounced.

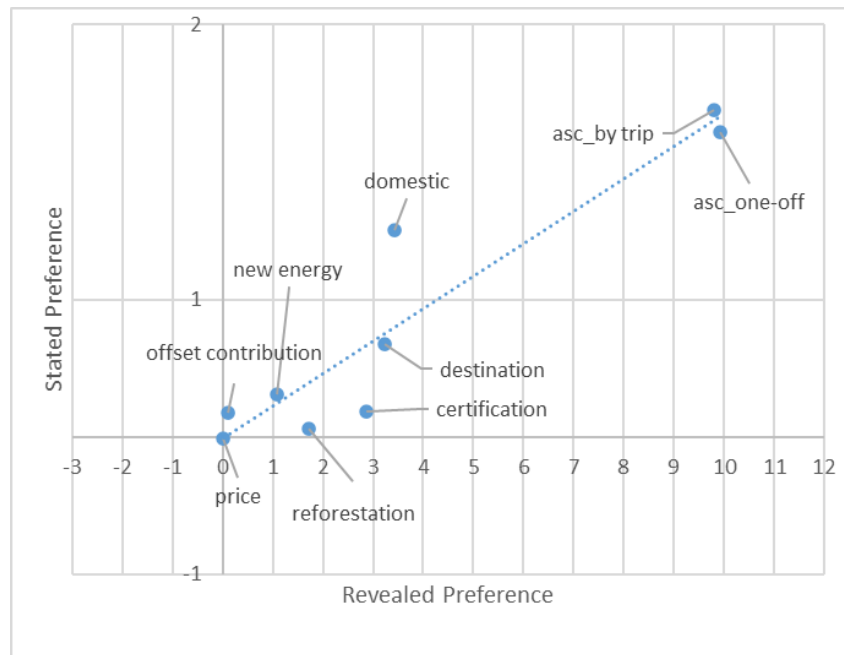


Figure 4.1 Plot of MNL attribute coefficients

We further allowed the three parameters to be dataset-specific (i.e., relaxing the parameter homogeneities of certification, project types, and locations between SP and RP) and developed a new joint model, as reflected in **Table 4.6**'s final column. The “domestic” project parameter corresponds to one of the two dummies (domestic and destination, compared with other countries/regions), representing a three-level qualitative attribute related to project locations, while the “reforestation” project corresponds to one of the two dummies (reforestation and new energy, compared with community project) that also represent a three-level qualitative attribute concerning project types. Although different levels of an attribute can have varying effects in each dataset, we believe it is more appropriate to regard the entire attribute as exhibiting heterogeneity rather than isolating specific levels. We therefore permitted five parameters to be dataset-specific: certification, domestic, destination, reforestation, and new energy projects.

The new combined model (partial joint MNL) yields a log-likelihood of -4981.23 with 13 estimated parameters, while the full data enrichment model reports a log-likelihood of -5003.16 with eight parameters. We further tested the equality of a subset of parameters under partial enrichment, yielding a test statistic of 0.22 (df=2), which is statistically insignificant at $\alpha = 0.05$

(critical value = 5.99). We upheld the partial data enrichment hypothesis, signifying that the offset contribution and price parameters are uniform. The partial joint MNL model reveals statistically significant differences in the scales of the SP and RP datasets, with a relative scale of 1.031 ($p < 0.1$). This suggests that the RP dataset has slightly greater unobserved heterogeneity overall than the SP dataset after specifying different data-related project locations, types, and certifications.

4.2.1.2 Unobserved Heterogeneity and State Dependence

As noted by Hess and Train (2017), if utility coefficients vary for reasons beyond scale heterogeneity, which is typically expected in real-world scenarios, then the estimated scale parameter will reflect at least some of that variation. Specifically, the estimated scale parameter accounts for any correlation present in the data that can be captured by this single parameter. A statistically significant scale parameter does not necessarily indicate the existence of substantial scale heterogeneity; rather, its significance may result from other sources of correlation that the scale parameter inadvertently captures. Therefore, we further explored unobserved heterogeneity and state dependence through various transformations of the MXL model, including ECL and RPL models.

The BIC is frequently employed to assess the fit of choice models. During maximum likelihood estimation, adding parameters can artificially improve the model's fit, increasing the risk of overfitting. The BIC addresses this by introducing a penalty term that grows with the number of estimated parameters and accounts for the variance of unobserved effects, thereby discouraging overly complex models. Therefore, a lower BIC indicates a more parsimonious model with a better balance between goodness of fit and model complexity. Consequently, the model with the lowest BIC is considered the most preferable (Hensher et al., 2015).

As shown in **Table 4.7**, the fit measurements reveal a significant improvement with the inclusion of correlations across choice sets; the BIC value drops from 10,071.92 in the MNL model to 8,230.86 in ECL Model 1, suggesting that accounting for the error component enhances model fit. Further improvements arise from incorporating unobserved response heterogeneity, with BIC values decreasing from 8,230.86 in Model 1 to 7,455.81 in Model 3 and from 8,091.86 in Model 2 to 7,278.88 in Model 4, indicating that this inclusion also improves model fit. Additionally, including state dependence leads to BIC reductions from 8,230.86 in Model 1 to 8,091.86 in Model 2 and from 7,455.81 in Model 3 to 7,278.88 in Model 4, confirming that accounting for state dependence enhances model fit. Overall, Model 4 is identified as the preferred model due to its lowest BIC value.

Table 4.7 Comparison of offset values and model performance

	Partial joint MNL	ECL (Model 1)	ECL with state dependence (Model 2)	RPL with error component (Model 3)	RPL with error component and state dependence (Model 4)
Number of observations	5834	5834	5834	5834	5834
Number of parameters excluding constants	12	14	15	15	17
Log-likelihood	-4985.42	-4037.39	-3963.55	-3645.53	-3548.39
BIC	10071.92	8230.86	8091.86	7455.81	7278.88
Adj. Rho-squared vs. observed shares	0.112	0.299	0.31	0.366	0.383

Table 4.8 summarizes the outcomes of the MXL models. Model 1 includes an error component to capture correlations in errors across the carbon offset options. The significant error component estimates (4.056, $p < 0.01$) suggest substantial unobserved variation in preferences for carbon offset options compared to the no-offset option. Model 2 additionally includes state dependence, suggesting that individuals' current RP choices strongly and positively influence their subsequent SP choices (4.283, $p < 0.01$), and thus that an individual's past choices

influence their current choices in a reinforcing manner. Model 3 utilizes random parameters to account for varying sensitivities toward individual attributes, allowing for heterogeneity in how respondents perceive different attributes. The results indicate that the standard deviations depicting the unobserved heterogeneity in attributes (excluding project types) are highly significant. This suggests substantial individual-level variation in preferences across different attribute levels. Model 4 integrates unobserved response heterogeneity, state dependence, and correlations among alternatives. A comparison with Model 3 reveals a marked reduction in the effects of unobserved parameter heterogeneity. This reduction is understandable as the influence of state dependence is inaccurately represented as unobserved response heterogeneity in Model 3. In addition, Model 4 demonstrates a significant decline in the strength of state dependence when compared with Model 2. When unobserved heterogeneity and state dependence are incorporated simultaneously, the effects of both factors appear diminished.

A key difference between the RPL and ECL models lies in the estimated scale differences between RP and SP responses. The ECL models show a scale factor near one, whereas Model 4, which accounts for unobserved heterogeneity, exhibits a scale factor substantially above one. This indicates that after adjusting for unobserved response heterogeneity, the SP context exhibits substantially lower error variance compared to the RP context. In contrast, prior studies often report higher error variance in SP settings, which is typically attributed to the limited range of attributes included in SP designs. Our results align with those of Bhat and Castelar (2002) as they imply that the larger SP variance may be due to overlooked individual response heterogeneity. The error component that creates inter-alternative correlations across offset alternatives is reduced in Model 4 when unobserved heterogeneity and state dependence are factored in, as these factors may indirectly generate inter-alternative correlation patterns.

Table 4.8 Estimates of joint mixed logit models

Variable	Data	ECL (Model 1)		ECL with state dependence (Model 2)		RPL with error component (Model 3)		RPL with error component and state dependence (Model 4)	
		Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
<i>Alternative specific constants and attributes:</i>									
Offset by trip-constant	RP	9.346***	1.975	11.819***	2.095	24.763***	1.964	15.285***	0.085
Offset by trip-constant	SP	3.840***	1.174	3.022***	0.927	5.255***	0.410	0.564***	0.189
One-off offset-constant	RP	9.482***	2.287	11.965***	2.408	24.477***	2.026	14.155***	0.233
One-off offset-constant	SP	3.770***	1.151	2.957***	0.905	5.262***	0.419	0.560***	0.189
Carbon offsetting contribution	SP & RP	0.096**	0.047	0.093**	0.047	0.023	0.054	0.014***	0.005
Project locations									
Other developing country (Base level)									
Domestic	SP					1.162***	0.100	0.133***	0.045
	& RP								
	RP	3.428***	0.762	3.426***	0.762				
	SP	0.728***	0.217	0.719***	0.215				
Overseas destination	SP					0.413***	0.073	0.044***	0.017
	& RP								
	RP	3.254***	0.800	3.254***	0.8				
	SP	0.309***	0.094	0.314***	0.095				
Project type									
Community project (Base level)									
Reforestation and conservation	SP					0.244***	0.066	0.025**	0.011
	& RP								
	RP	1.711***	0.450	1.707***	0.449				
	SP	0.055	0.040	0.056	0.04				
Renewable energy	SP					0.286***	0.069	0.036***	0.013
	& RP								
	RP	1.073***	0.413	1.066***	0.413				
	SP	0.110**	0.051	0.12**	0.052				
Certification	SP					0.207***	0.079	0.024**	0.011
	& RP								
	RP	2.849	1.955	2.845	1.946				
	SP	0.084	0.054	0.064	0.053				
Price (¥)	All	-		-0.006***	0.002	-0.015***	0.001	-0.002***	0.001
		0.006***	0.002						
<i>Random parameter standard deviations:</i>									
Carbon offsetting contribution	SP					0.289***	0.081	0.034***	0.010
	& RP								
Project types									
Other developing country									
Domestic						1.233***	0.143	0.165***	0.056
Overseas destination						0.382**	0.185	0.059**	0.024
Project type									
Community project									
Reforestation and conservation						0.034	0.072	0.011	0.011
Renewable energy						0.043	0.143	0.011	0.013
Certification						0.839***	0.131	0.046	0.037
Price (¥)						0.013***	0.001	0.002***	0.001

SP–RP scale parameter	1.126***	0.333	1.126***	0.334			9.214***	3.049
Error component								
Offset by trip	4.056***	1.243	3.638***	1.115	4.652***	0.374	0.474***	0.149
One-off offset	4.056***	1.243	3.638***	1.115	4.652***	0.374	0.474***	0.156
State-dependence			4.283***	1.451			0.405***	0.149

*Note: Significance levels are denoted as ***, and ** representing significance at the 1%, and 5% levels, respectively. SE = standard error.

4.2.2 Discussion

In this study, we first discuss the rationale for employing choice modeling in offset analysis, followed by an examination and integration of the stated and revealed preferences of Chinese travelers regarding carbon offsetting during air travel. The findings from standalone and combined SP and RP MNL models indicate that preference homogeneity is maintained for certain parameters, specifically offset contribution and price, thus supporting the hypothesis of partial data enrichment. However, we do not observe preference homogeneity for project types, locations, and certifications across SP and RP. The results from joint MXL estimates also underscore the necessity to incorporate (or at least test) unobserved heterogeneity, inter-alternative error correlations, and state-dependence effects when combining SP and RP data for offset analysis.

This study advances theoretical understanding by enriching the field of sustainability and choice analysis by providing evidence supporting the application of the partial data enrichment method in understanding tourists' carbon offset consumption behavior. In addition, the comparative results from various models using SP, self-report RP, and combined data, which identify the similarities and differences between the two, serve as a reference for revisiting current offset SP studies and guiding future research. This enables researchers to critically reflect on their SP findings, thereby more closely approaching tourists' actual preferences for carbon offsets. This, in turn, informs decision-making in tourism and carbon offset practices.

A more in-depth examination of the theoretical, methodological, and practical implications arising from the study's findings is presented as follows.

The estimates from standalone SP and RP MNL models reveal several consistent trends in Chinese overseas travelers' preferences for flying carbon offsets, highlighting a strong inclination toward offsetting flying emissions in both SP and RP settings. Travelers are more likely to choose offset products that enable them to offset more carbon emissions at lower prices, which is in line with the SP findings of Ritchie et al. (2021) from Australian travelers and Rotaris et al. (2020) from Italian air travelers. However, the empirical results from separate and joint MNL models also show differing preferences for project types, locations, and certification between SP and RP. The findings also provide evidence regarding the data enrichment strategy in the context of offset choices, suggesting that a partial strategy (i.e., preference homogeneity holds for a subset of attributes and levels) rather than full data enrichment (i.e., preference homogeneity holds for a full set of attributes and levels) can effectively harmonize the SP and RP datasets. In the context of carbon offsets, preference homogeneity holds for offset contribution and cost parameters but is rejected for project types, locations, and certification. These results validate and support previous SP studies on the utility and economic values of offset contributions (Choi et al., 2018; Rotaris et al., 2020; Wu et al., 2024). However, those related to project types, locations, and certifications warrant further examination in different contexts.

A possible explanation is that these non-quantitative attributes are highly context- and presentation-dependent: their influence hinges on salience, the richness of accompanying information, and whether credibility/tangibility thresholds are crossed at the moment of choice. By contrast, price and own contribution tend to transport well across SP and RP because they are concrete, universally understood, and anchored in budget and fairness considerations; they impose monotonic trade-offs that are less sensitive to framing. For example, the reforestation

and certification commonly weigh more in RP, where real offers bundle logos, visuals, and brief explanations that make the project more tangible and credible; SP vignettes, by necessity, provide thinner descriptions so that these cues may sit below respondents' credibility or attention thresholds. These cases are representative rather than exhaustive: similar mechanisms—salience, information richness, and credibility gating—likely underlie the broader pattern that types/locations/certification vary more across SP and RP, while price and contribution remain comparatively stable.

Practically, these findings offer important guidance for offset developers and policymakers, indicating a promising potential demand for voluntary offsets. However, caution should be taken regarding consumers' preferences for offset attributes, including project types, locations, and certification in different contexts, when leveraging the SP findings of offsets in market development. Additionally, vigilance is necessary concerning the pricing of offset products, which solely relies on SP valuation elicitation. While the RP results of Berger et al. (2022) and Araña & León (2013) indicate a positive WTP for offsets, the former, based on Swiss airline bookings, suggests passengers' considerably lower WTP in an RP setting. The latter findings highlight significant framing effects on the amount paid for offsetting, indicating travelers' fluctuating valuations of offsetting.

By developing and comparing combined MXL models using both RP and SP, we also identify sources of heterogeneity within and across the SP and RP data. First, the results indicate substantial heterogeneity in response to offset attributes and levels across individuals. After accounting for the scale effect (unobserved heterogeneity across SP and RP) and state dependence, the heterogeneity in individual attribute preferences is notably reduced, suggesting that the heterogeneity sources are primarily the differences between SP and RP. Second, the study reveals that positive state dependence indicates a positive impact of current RP choices on future SP choices, potentially due to habitual behavior, a reluctance to explore

other options, and a combination of learning and risk aversion. This finding aligns with previous transportation research (Bhat & Castelar, 2002; Hensher et al., 2015). In addition, when heterogeneity and state dependence are considered together, their individual effects are mitigated. This suggests that analyzing heterogeneity or state dependence in isolation may lead to a conflation of genuine and spurious state-dependence effects. Ignoring unobserved heterogeneity can result in overstating the sensitivity to offset contributions. Consequently, using a standard MNL estimation without accounting for the repetitive nature of SP tasks and response heterogeneity may result in biased estimates of the effect of offset contributions. Fortunately, most offset DCE studies have applied choice models with heterogeneity specifications, which, to some extent, can reflect the real value of offsetting (Choi et al., 2018; Rotaris et al., 2020; Wu et al., 2024). The model fit improves notably with the inclusion of error components, further enhances with the incorporation of unobserved heterogeneity, and demonstrates additional gains when state dependence is accounted for. This highlights the relative strengths of these three effects, suggesting that future studies combining SP and self-report RP on offsets should consider including them. Recognizing unobserved heterogeneity also leads to a significant enhancement in the estimated scale disparity between SP and self-report RP. Once unobserved heterogeneity is considered, the variability of errors in SP choices is considerably lower than that in self-report RP choices. This finding aligns with those of Bhat and Castelar (2002), implying that SP choices occur in a more controlled environment than RP choices, which typically involve more potential for measurement error or the estimation of variable values.

The presence of positive state dependence alongside individual-level heterogeneity, as revealed in this study, carries important implications for both policy design and practical implementation. First, recognizing the impact of positive state dependence can inform long-term strategies for promoting offsetting behaviors. Policies incentivizing the initial adoption of offsetting

behaviors can lead to sustained engagement due to positive experiences. Loyalty programs can further encourage repeat behaviors by rewarding tourists for continued participation. Additionally, as suggested by Song et al. (2023), nudging strategies can promote actions that are likely to be repeated. In addition, the extensive heterogeneity in the responses to various attributes across individuals underscores the importance of segmenting carbon offsetters in the market. Understanding that consumers have varying preferences and motivations for purchasing carbon offsets is crucial. This understanding can enable the creation of targeted strategies that cater to the unique needs and preferences of different consumer groups. As Araghi et al. (2016) and Ritchie et al. (2021) suggest, market segmentation enables policymakers and businesses to craft more targeted policies and marketing initiatives that resonate with the particular interests of different consumer groups. This, in turn, increases the probability of engagement and purchase.

This study is subject to several limitations, which also open up directions for future research. First, future research should investigate the reasons behind parameter heterogeneity concerning project types, locations, and certification in SP and RP. Understanding these underlying factors can provide deeper insights into consumer preferences and improve the design of offset programs. Second, we only consider unobserved heterogeneity across individuals. Future studies can consider observed heterogeneity across individuals, such as using latent class models incorporating socio-demographic variables, which can help identify specific population segments with distinct preferences, thus enabling more personalized and effective interventions. Third, the design, context, and quality of the SP tasks and RP data may affect the outcome of the statistical tests. We only include offsetting purchasing behavior through airlines in both RP and SP contexts. Future research could expand this scope by exploring offset consumption from other providers, such as travel agencies or online platforms, to better understand consumer behavior across various contexts. Moreover, an ordering effect may exist, given that

participants respond to a sequence of RP and ten SP questions, which might contribute to the observed positive state dependence. Further investigation could delve into controlling ordering effects and disentangling the factors leading to the positive state dependence observed in both RP and SP responses. For instance, a randomization design can be implemented by varying the sequence of RP and SP questions among participants. Lastly, the unavailability of comprehensive real-world data on carbon offset purchases posed a limitation. The RP data collected in this study are based on self-reported responses. Despite filtering out fake offsetters, biases may still stem from discrepancies between self-reported behavior and actual purchasing actions (McFadden et al., 2005). Future studies that can access detailed RP data in the real market would be better positioned to investigate any gaps and reveal the reasons behind them.

4.3 Opening the Box: Process Behind Economic Preferences for Carbon Offset

Study 3 adopts a process perspective to explain the patterns identified in Studies 1 and 2, rather than to stand alone. Through in-depth interviews, it opens the “black box” of carbon-offset decisions and identifies four interrelated themes—awareness/knowledge, motivations/attitudes, project attribute preferences, and trust/credibility—that illuminate the psychological processes underpinning offset behavior. These themes generate testable implications that map onto the quantitative constructs and heterogeneity observed in Study 1 (SP, HCM)—price sensitivity, project type/location, timing, provider, and green trust—and help interpret the alignment and divergence diagnosed in Study 2 (data enrichment across SP and RP), including scale differences, dataset-specific effects, and state dependence. Beyond this mapping, Study 3 moves past traditional economic valuation by explicitly bridging the predictive, utility-based tradition and the process-oriented psychological tradition: it specifies awareness and credibility as sequential gates before compensatory (trade-off) evaluation, shows how awareness and knowledge, motivations/attitudes, and trust shape perceived utility, and explains how post-choice learning feeds back into subsequent choices. In this way, Study 3 provides the

integrative mechanism that underwrites both the theoretical and methodological triangulation of the thesis.

4.3.1 Results

The thematic analysis revealed four interrelated dimensions that underpin tourists' engagement with travel carbon offsets: awareness and knowledge, motivations and attitudes, attribute preferences, and trust and credibility. These dimensions capture a layered, iterative process that runs from initial exposure to post-choice (re)evaluation. Rather than operating as independent categories, they interact dynamically throughout the decision journey. As **Figure 4.2** indicates, offset choices are embedded in a broader cycle of cognitive appraisal and utility formation: travelers become aware of the option, engage in active or passive learning, evaluate attributes, form preferences, make a choice, and then update the cycle after the choice.

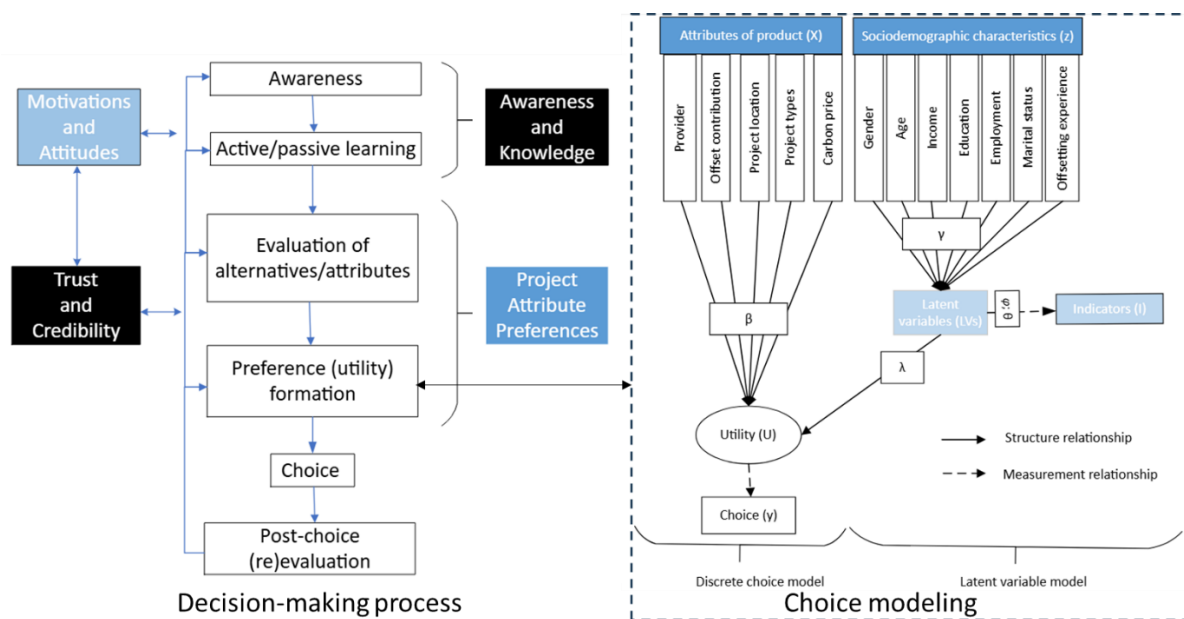


Figure 4.2 Decision-making process framework

Within this cycle, awareness and knowledge function as an entry gate. When the option is not salient or is poorly explained, travelers fail to enter compensatory evaluation, defaulting to

non-choice—an interpretation consistent with the opt-out/in patterns and payment-timing effects observed in Study 1. The same mechanism helps account for Study 2’s SP–RP scale differences, because hypothetical tasks surface the offset clearly, whereas market contexts often present it in noisier or less visible ways.

Motivations and attitudes shape how price and contribution are perceived. Feelings of responsibility and guilt-relief, alongside fairness concerns, modulate price/own-contribution sensitivity in Study 1 and help explain the state dependence in Study 2. Once a credible first purchase resolves doubts and reduces guilt, subsequent uptake becomes more likely.

Attribute preferences—covering project type and location, quantity, and payment structure—provide the psychological rationale for the signs and heterogeneity estimated on the same attributes in Study 1. They also illuminate why some parameters appear dataset-specific in Study 2: cues such as certification, location, or type can be strong and explicit in SP tasks but attenuated or ambiguous in RP contexts.

Finally, trust and credibility operate across all stages rather than as a terminal check. This theme corresponds to the green trust latent variable in Study 1 and clarifies Study 2 results: first, why certification, type, and location cues may carry differently across SP and RP; and second, how post-choice proof-of-impact generates the state dependence recovered in the integrated models.

Figure 4.2 summarises this process model alongside its measurement in the choice framework, and **Table 4.9** distills the themes, codes, and illustrative quotes. Together, they provide the qualitative foundation that explains and contextualises the quantitative patterns reported in Studies 1 and 2. The subsections that follow unpack each theme in turn.

Table 4.9 Thematic coding framework: interpretive codes and quotes from interviewees

Themes	Codes	Sample Perspective or Quote
Awareness & Knowledge	Initial Exposure: First encountered offsetting through airlines, peers, social media, or government messaging.	<i>"I didn't really know about offsetting before the flight attendant explained it during the trip." (O11)</i>
	Information Processing: Ranged from active search to passive recognition.	<i>"I looked it up online to understand how offsetting actually works." (O05)</i>
	Barriers & Misunderstandings: Offset confusion with other behaviors, poor visibility, and technical language.	<i>"I thought offsetting meant not eating on the plane." (N04)</i>
	Awareness of Emissions: Knowledge about travel-related emissions fostered interest.	<i>"I read that flights create huge carbon emissions, and that stuck with me." (N02)</i>
Motivations & Attitudes	Environmental Concern & Responsibility: Motivated by personal ethics and climate impact.	<i>"It's not about the airline—it's my own carbon footprint, and I should do something about it." (O05)</i>
	Psychological Benefit: Offset purchase alleviated guilt about flying.	<i>"Offsetting helps ease my guilt. At least this way, I'm trying to balance it out." (O01)</i>
	Peer Influence & Social Norms: Influenced by others' behaviors.	<i>"My friends were offsetting, so I did too." (O07)</i>
	Cost Sensitivity & Fairness: Viewed as an added burden or unfair expectation.	<i>"The ticket was already expensive. When I saw the offset cost, I said, maybe next time." (N06)</i>
Project Attribute Preferences	Trip-Specific Offsetting: Preference for emissions calculated based on personal flight.	<i>"If I know my flight emitted a certain amount, I want to offset exactly that." (N08)</i>
	Project Type & Familiarity: Reforestation and renewables are preferred for symbolic value and logic.	<i>"Tree planting is visible and understandable, so I trust it more." (O01)</i>
	Location & Co-Benefits: Domestic or destination-based offsets are preferred; development benefits add appeal.	<i>"If this project also helps farmers, it's a win-win and easier to support." (O09)</i>
	Payment method: Points or miles reduce friction; cash payment is accepted when simple.	<i>"I offset all my previous emissions using my frequent flyer miles." (O04)</i>
	Payment structure: Most preferred booking-stage prompts; others reacted to staff cues or app features.	<i>"The stewardess came around to tell us about the project and asked if we wanted to participate." (O11)</i>
	Verification & Incentives: Updates, certificates, and badges encouraged uptake and built emotional value.	<i>"They give you a green light footprint and produce a certificate. That kind of thing makes me feel I contributed." (O09)</i>
Trust & Credibility	Transparency: Needed clarity on how funds were used and how projects functioned.	<i>"If I don't know how they're using the money, it just feels like a black box." (N06)</i>
	Certification & Brand Trust: Third-party verification and a trusted airline reputation reassured participants.	<i>"If it's certified or offered by an airline I know, I'm much more likely to believe it's legit." (O04)</i>
	Proof of Impact: Desire for visible confirmation of real outcomes.	<i>"Seeing photos or updates makes me feel like I made a difference." (N01)</i>
	Post-Purchase Experience: Feedback or follow-up boosted repeat behavior; lack of it reduced confidence.	<i>"I did it once, but I never heard anything afterward. So, I am not sure I would do it again." (O11)</i>

4.3.1.1 Awareness and Knowledge

The decision-making process for carbon offsetting typically begins with travelers' first exposure to the concept. Most interviewees reported minimal prior knowledge and said they first learned about carbon offsets primarily through airline communications, online booking processes, social interactions, or media coverage. The initial exposure was often superficial and ambiguous, which shaped travelers' early impressions.

Several participants recalled their first encounters occurring through airline interactions or travel booking platforms. O11 recalled this vividly: *“Honestly, I had no idea what carbon offsetting was until the flight attendant explained it during the trip. They came down the aisle and asked if we wanted to participate. That was honestly the first time I heard the words ‘carbon offset.’”*

Other travelers reported similarly incidental exposures via the airline. O04 shared how accidentally the information appeared after the booking process: *“That flight left me with a bad impression, so I wrote a review for the airline. After submitting it, I noticed there was a carbon offset option. I casually clicked it and ended up offsetting all my previous flights. Actually, on an earlier occasion, when I was impressed with their excellent service, I had given them a positive review praising the cabin crew. That’s when I first noticed the carbon offset feature, though I didn’t use it at the time.”*

Travelers also emphasized the importance of social networks in shaping their initial awareness. Friends, family, or acquaintances often introduced them to the concept of offsetting. As O07 mentioned: *“I offset because my friends I was traveling with were doing it. We booked together, and they explained what it was. I didn’t know about it before that trip.”*

Institutional campaigns, including government-led initiatives and airport promotions, also played a crucial role in raising awareness. One participant highlighted the importance of governmental messaging: *“Government advertisements about carbon neutrality made me curious about offsets.”* O09 echoed the importance of governmental messaging: *“The central government’s policies and theoretical frameworks also significantly influence us. For instance, in our recent consultations, news reports, and leaders’ speeches, we’ve noticed particular emphasis on ecological environment protection. This focus directly affects how we perceive environmental values in our work and daily lives.”*

Similarly, airport-based messaging sparked curiosity. O03 suggested: *“Public awareness campaigns still need improvement—not just government efforts. For example, airports could display banners about sustainability initiatives, including flight offsetting options.”*

These entry points help determine whether compensatory evaluation starts at all. When the option is surfaced clearly—especially pre-departure at high-attention junctures—travelers are more likely to appraise attributes. This mechanism aligns with Study 1, which found a positive effect for paying before departure (relative to on-site/after travel), indicating that earlier placement of the offset option facilitates evaluation and uptake.

After their initial exposure, travelers generally fell into two categories of information processing: active learners and passive learners. Active processors deliberately sought detailed knowledge and clarification, driven by curiosity or environmental concern. O11 explained: *“After hearing about offsetting on a flight, I felt unsure about exactly what it entailed. That motivated me to search online to understand how offsetting actually works. I found some resources, but honestly, the information was still quite complex and not entirely clear.”*

By contrast, passive learners acknowledged offsetting in passing but did not pursue deeper understanding. O10 described: *“It appeared on the airline app, but it felt like just another extra fee. I didn’t really understand the concept and did not have the patience to dig deeper in that moment.”*

Participants from both groups highlighted barriers to accessibility and usability. Interface challenges often discourage deeper engagement. O11 shared: *“Offsetting options were buried deep in the booking process. You had to click multiple tabs just to find it. It felt deliberately hidden.”*

Beyond interface issues, many travelers pointed to the lack of clear project information. O05 said: *“They did not give detailed project information. It just said ‘carbon-neutral’ without explaining practically what it meant. Without specifics like photos or descriptions, I couldn’t trust it or fully understand what I would be contributing to.”* N05 added: *“The airline’s explanation about offsetting was too vague. They mentioned ‘carbon projects’ but gave no details about where my money would actually go or how exactly it would reduce emissions.”*

Misunderstandings about the nature of offsetting were also common. Several participants confused offsetting with other sustainable practices, such as declining in-flight meals or reducing plastic use. When asked what their offsetting choice involved, N05 recounted: *“I thought offsetting meant refusing meals or plastic items during the flight. So, I chose not to eat on China Eastern Airlines, believing that was offsetting my emissions.”*

Others offered vague or broad interpretations of environmental action, associating offsetting with general ecological themes. N04 shared: *“I prefer tree planting to make the environment better. Or things like protecting the ocean and animals.”*

These responses underscore the conceptual ambiguity and limited public understanding surrounding carbon offsetting. A lack of accessible, accurate, and engaging information often prevented travelers from forming clear expectations or making informed choices.

Moreover, participants' awareness and knowledge extended beyond the offset product itself; they also needed to understand the broader issue of travel-related carbon emissions and their environmental consequences. For several travelers, it was this foundational awareness—of how aviation contributes to climate change—that served as a necessary precondition for valuing and ultimately purchasing offsets. Without a clear link between their flight and its carbon footprint, offsetting felt abstract or disconnected from the environmental problem it sought to address.

In this regard, social media and news coverage were also instrumental in shaping public awareness. N02 described how widespread criticism of celebrity travel behavior prompted reflection on flight-related emissions: *“I think the most important carbon emission is the CO₂ produced by burning fuel during flights. I remember reading a U.S. news story about how Kardashian’s private jet emits so much CO₂ each year. A lot of people criticized him for polluting the environment. That report made me realize how much pollution is caused by air travel.”* As O03 explained: *“Seeing influencers posting about offsetting and sharing their offset certificates online will make individuals realize flights significantly impact the environment, and offsetting can help mitigate this.”* This example illustrates how indirect media exposure can influence how travelers conceptualize carbon emissions, providing a gateway for deeper consideration of offsetting. For some, these narratives helped contextualize their own environmental impact and increased the perceived relevance of personal offsetting actions.

These awareness and knowledge dynamics also help interpret patterns in Study 2. In SP tasks, the offset option sits within a clean, well-defined choice set; in real-market contexts (RP), the

environment is often noisier and less salient, so that effective awareness can be lower, and some attributes receive less attention. This helps account for the relative SP–RP scale difference and for why certain non-quantitative attributes (e.g., certification) appear to transport less robustly than quantitative attributes.

In short, awareness and knowledge are not merely background conditions but also govern entry into the utility-based comparison identified in Study 1 and help explain the SP–RP gap diagnosed in Study 2.

4.3.1.2 Motivations and Attitudes

Participants' decisions to purchase or reject carbon offset products were deeply rooted in underlying motivations, values, and emotional responses. These latent psychological constructs—such as environmental concern, personal responsibility, guilt alleviation, and cost sensitivity—interacted dynamically with other decision-making dimensions, such as the evaluation of project attributes and credibility. This theme captures how participants interpreted the meaning of offsetting in relation to their values, perceived responsibility, emotional responses, and financial considerations. These orientations modulate price/own-contribution sensitivity in Study 1—travelers with stronger responsibility/guilt are more willing to accept price increases or contribute their own funds—and predict repetition in Study 2 via state dependence: once a credible first experience reduces guilt and affirms responsibility, subsequent uptake becomes more likely.

A central motivator identified in the interviews was environmental concern, often grounded in personal ethics. Several participants described offsetting as a means of aligning their behaviors with their underlying environmental values. O10 explained: *“Offsetting helps me feel I’m contributing to something meaningful, like reducing my own impact on the climate.”* O06

reinforced this sentiment: *“I genuinely care about environmental issues, especially global warming. Choosing to offset flights is one clear way I can align my daily decisions with my environmental values.”* O09 added with similar conviction: *“For me, offsetting is more than a choice; it is a reflection of my ethical commitment to the planet. I feel strongly about climate change, and offsetting allows me to act according to those beliefs.”*

Closely related to environmental concern was the feeling of personal responsibility. Many participants framed carbon offsetting not as an optional donation but as a necessary response to their own emissions. O11 emphasized: *“I know my flight produces emissions, so I feel responsible for making up for that in some way.”* O05 added: *“It’s not about the airline—it’s my own carbon footprint, and I should do something about it.”* O04 further elaborated explicitly on this view: *“Since I choose to travel, it feels right that I should also take responsibility for the emissions my travels create. I cannot just push the blame on airlines or governments.”* This sense of accountability shifted the perceived ownership of environmental harm from institutions to individuals, enhancing the perceived legitimacy and urgency of offsetting. In Study 1, such orientations are consistent with the positive WTP and the higher likelihood of opting in when offsets are credibly framed.

Beyond ethical obligation, offsetting also provided psychological benefits. Participants described a sense of emotional relief or guilt reduction associated with their decision to offset. As O01 noted: *“It helps ease my guilt. I know flying is not great for the environment, but at least this way, I’m trying to balance it out.”* Likewise, O09 reflected: *“Offsetting made me feel better about taking long-haul flights, especially when I fly for leisure.”* These narratives suggest that carbon offsetting serves a compensatory emotional function—allowing travelers to reconcile their environmental values with the convenience and desire for air travel. Notably, all of these internal motivations were underpinned by participants’

awareness and understanding of the environmental consequences associated with tourism and aviation. Without such knowledge, their sense of urgency, responsibility, or guilt would likely not have been triggered. This mechanism ties directly to Study 2's state dependence. If a first purchase is followed by convincing evidence of impact, guilt relief is validated, and the next decision becomes easier. If feedback is absent, the relief fades, and repetition is less likely.

Social context also influenced offsetting behaviors, with peer actions and prevailing social norms serving to reinforce motivation for some individuals. O07 remarked: *"I would not have thought to offset if my friends hadn't done it first. It felt like the right thing to do after that."* Likewise, O06 stated: *"When making the purchase, I made sure to look into it and also asked around with friends. Since it's beneficial for our country's environmental efforts, I figured, why not do a good thing?"* O11 elaborated on peer influence more explicitly: *"In my social circle of about 4/5 people, I estimate at least half have made the purchase."* However, social influence could also act as a deterrent.

A few participants mentioned that family members—particularly older relatives—questioned the logic of paying extra for an abstract environmental outcome. According to O07: *"Sometimes those around you don't understand, and that becomes a barrier. Especially older family members—they ask, 'Why spend extra money on something like this?' Friends my age would not question it, but the older generation often does."* N08 echoed this hesitation: *"Elder family members sometimes have concerns. They think I am wasting money by paying more for something intangible."* These perspectives highlight how traditional views or generational misunderstandings can create intra-family disapproval, which discourages offset participation even when personal values support it. Together with the previous examples, these comments reveal how perceived behavioral expectations from others can both lower or raise the threshold for action and validate the legitimacy of offsetting as a social norm.

However, not all participants felt equally compelled. Financial concerns emerged as a significant barrier for many. While the absolute cost of offsetting was often modest, participants framed it as an added financial burden layered onto the already expensive airfare. N01 explained: *“The ticket price was already high. When I saw the offset fee, I thought— Maybe next time.”* N02 questioned the fairness of this additional cost: *“Why do I have to pay extra to fix something the airline caused? Shouldn’t it be their job?”* In a follow-up reflection, N02 continued: *“Offsetting can feel like an unfair extra cost. Airlines make profits from flights, yet passengers must pay more for environmental mitigation. It feels somewhat inequitable.”* Similarly, N06 explained: *“It sometimes feels unfair to pay extra for offsets when I already spend a lot on tickets. It seems the responsibility to solve environmental problems should not fall solely on individual passengers.”*

Despite these economic concerns, many travelers rationalized offsetting costs through an ethical lens, emphasizing that personal values outweighed financial considerations. O01 illustrated this internal ethical-economic tension: *“Even though offsetting adds extra costs, I feel it is the right thing environmentally. I sometimes struggle with concerns about fairness, but ultimately, my conscience drives my decision.”* These sentiments reflect a tension between the perceived value of offsetting and its price, particularly in the absence of institutional accountability or incentives. The fairness concerns documented here also help interpret heterogeneity in Study 1’s price/own-contribution parameters and why dataset-specific effects emerge in Study 2: perceived fairness varies by context (message framing, who is seen to pay), so the same attribute can travel differently from SP to RP.

Importantly, these motives are contingent on prior understanding of aviation’s emissions and on credible signals that offsetting works. Without that knowledge base, feelings of responsibility or guilt are not triggered; without credible follow-up, guilt-relief is temporary

and unlikely to translate into repeat choices—precisely the on/off gating and reinforcement dynamics that underpin Study 1’s adoption patterns and Study 2’s state dependence.

Taken together, the interviews portray motivations and attitudes as constructed and continually revised as travelers process information, social cues, and outcomes. They tilt the economic trade-off observed in Study 1—raising or lowering the subjective value side of the choice—and govern repetition in Study 2 by determining whether a first experience resolves dissonance and affirms responsibility. For practice, this implies a framing that assigns responsibility fairly, demonstrates credible impact (so guilt relief is sustained), and leverages peer norms, all of which shift preferences toward adoption without relying solely on lower prices.

4.3.1.3 Project Attribute Preferences

As participants moved from general motivations to evaluating specific options, they formed distinct preferences over price, project type, location, payment structure/mode, timing, and the tangibility of outcomes. These product-level factors shaped perceived utility directly and determined whether travelers proceeded to purchase. The qualitative reasons given for each attribute mirror the signs and heterogeneity observed in Study 1 and help explain the dataset-specific patterns observed in Study 2.

Most participants with offsetting experience described the price of carbon offset products as reasonable and acceptable. O10 commented: *“I thought the price wasn’t high—just a few dozen yuan.”* However, some participants remained sensitive to price, especially when considering affordability for broader adoption. As N06 expressed: *“The price has to be low. If carbon offsetting is too expensive, ordinary people cannot afford it—and then no one will care about being environmentally conscious.”* In Study 1, this maps to a negative price coefficient and a consistent negative price coefficient across both SP and RP data in Study 2.

One additional pattern that emerged was participants' preference for offsetting the specific emissions associated with their individual flights. This preference for a direct one-to-one match between emissions generated and emissions offset reflected a desire for fairness, personal accountability, and proportionality. Several participants indicated that they preferred offsetting the precise carbon emissions associated with their travel, rather than choosing from arbitrary contribution levels or round-numbered donations. As O08 explained: *"If I know my flight emitted a certain amount, I want to offset exactly that—not just donate some money randomly."* N09 echoed: *"Matching the emissions from my trip makes it feel more meaningful. It feels like I'm taking responsibility for my own travel."*

This preference often intersected with trust and concerns about transparency, reinforcing the need for clear emissions calculations and the ability to personalize offset contributions. Preferences around payment flexibility also revealed meaningful heterogeneity. Several participants expressed a desire to pay using non-monetary resources, such as frequent flyer miles or loyalty points, which were seen as more convenient and psychologically less burdensome. O04 explained: *"I offset all my previous carbon emissions using my frequent flyer miles."* O11, a frequent flyer, reflected on the trade-off between point accumulation and direct payment: *"My points are valuable because I fly a lot. In the end, I chose to pay in cash—less than 50 yuan."*

Regarding timing and interface, most participants preferred to offset during the booking process, citing convenience and the benefit of integrating the action into their regular travel workflow. For these travelers, having the option presented clearly and early in the booking sequence increased visibility and reduced the likelihood of inaction. However, some participants made their purchases after receiving information during or following the flight. In these cases, the decision was typically triggered by in-person explanations or post-booking

prompts. For example, O11 described the influence of airline staff: *“During the flight, the stewardess came around to tell us about the project and asked if we wanted to participate.”*

Others discovered the offsetting option post-purchase, often through airline apps or portals. As O04 elaborated: *“I thought their service was excellent, so I left a good review. Then I noticed the carbon offset feature and used my miles to offset all my previous emissions.”*

These friction-reducing features resonate with the payment-time effects in Study 1 and, behaviorally, help explain why uptake varies across contexts in Study 2. When timing makes the option salient and easy, travelers are more likely to enter compensatory evaluation and act.

The type of offset project was another crucial factor shaping preferences. Reforestation and renewable energy were the most frequently preferred categories. This preference explains the positive sign and heterogeneity on type in Study 1: reforestation, in particular, resonated because of its familiarity, symbolic value, and perceived visibility. As O01 put it: *“Tree planting is visible and understandable, so I trust it more.”*

For many, this preference was rooted in early exposure through environmental education or national campaigns. Others felt a strong connection to renewable energy projects, which they saw as more systemic in nature. N02 reflected: *“In high school geography, I learned about how we’re shifting from coal to gas, and then to more wind and hydropower. My hometown has huge windmills. The government’s been promoting this for years.”* Echoing this sentiment, N02 added: *“Renewable energy makes sense to me—it’s about replacing the source, not just cleaning up after pollution.”*

Beyond the type of project, participants also cared deeply about the geographic location of offset initiatives. Many favored domestic projects or those connected to their travel destination, consistent with the findings of Study 1 and Study 2, citing a greater sense of familiarity, trust,

and relevance. O03 shared: *“Local projects feel closer and more tangible—I can see them, I know where the money is going, and I believe the impact is real.”* This preference suggests that proximity—whether geographic or psychological—enhances credibility and personal connection to the offset effort.

For some, this preference was linked to a sense of national pride or symbolic support for government environmental policies. Others favored projects with clear community co-benefits, especially those aimed at improving livelihoods in underdeveloped areas. For instance, O09 emphasized: *“Personally, I am not only concerned about environmental changes. If this project can also increase income for farmers in poor areas, it’s a win-win and easier to support.”*

A final recurring theme was the importance of tangible and verifiable outcomes. Participants frequently stated a desire for post-purchase feedback in the form of project updates, digital certificates, or visual documentation. These elements helped validate the impact of their contribution and reinforced trust in the offsetting process. N01 noted: *“Seeing actual photos or updates from the project would make me feel like I made a difference—it would not just be a checkbox I clicked.”* This desire for post-purchase confirmation was echoed by O11: *“I think I’d be more likely to offset again if I got proof that something actually happened with my money.”*

Some participants also expected symbolic or material rewards for offsetting. Several referenced digital platforms, like Ant Forest, where users receive visual feedback, badges, or even monetary incentives for environmentally friendly actions. N05 suggested: *“It would be great to get some feedback or a reward—maybe a little money, or bonus points, or something like that.”* N04 agreed: *“If I offset, maybe I could get double points or a special badge—something to show that I did it.”* O11 also appreciated such recognition: *“They give you a green light footprint and produce a certificate. That kind of thing makes me feel like I really contributed.”*

Together, these findings suggest that tourists were not motivated purely by abstract environmental ideals. Rather, they evaluated carbon offset products based on credibility, personal relevance, convenience, and perceived impact. These product-level factors directly shaped perceived utility and often determined whether a traveler would proceed with a purchase.

Importantly, many of these preferences closely align with the quantitative results of Study 1, which identified a high WTP for reforestation projects, domestic initiatives, and offset options that featured co-contributions and pre-departure payment. Furthermore, the heterogeneity observed across interviewees mirrors the preference heterogeneity detected in both Study 1 and Study 2, particularly regarding discrepancies between stated and revealed preferences. This suggests that individual-level factors—such as personal trust, familiarity with offset mechanisms, and exposure to credible information—may partly explain why some tourists become offsetters while others remain non-offsetters. The current qualitative findings thus provide deeper insight into the cognitive and emotional processes underlying offset decisions and illuminate why certain offset product attributes resonate more strongly with different types of travelers—specifically, those they can understand, trust, and connect to personally, whether through cultural familiarity, symbolic meaning, or tangible outcomes.

4.3.1.4 Trust and Credibility

Trust and credibility emerged as foundational elements shaping tourists' engagement with carbon offset products. Unlike a static endpoint in the decision-making process, trust operated as a dynamic and iterative factor, influencing—and being influenced by—awareness, motivations, and attribute evaluations throughout the entire decision journey. Participants consistently expressed that without sufficient trust in the offset product, provider, or process,

they were unlikely to perceive any meaningful utility, regardless of price, environmental concern, or project type.

In Study 1, this belief is captured as the latent construct green trust; here, we observe how it is formed and updated—via transparency in the use of funds, independent certification, provider reputation, and post-purchase proof of impact. When minimum credibility is unmet, travelers screen out alternatives regardless of other attributes, which explains why some SP parameters fail to transport to RP in Study 2 if real-world cues are weak or absent. Conversely, post-choice feedback strengthens trust and directly maps to Study 2’s state dependence: credible prior experiences increase subsequent uptake.

A recurring concern among participants was transparency—particularly clarity around the use of funds and concrete evidence of project implementation. Many travelers sought explicit, verifiable information regarding how their offset contributions were being allocated. N06 articulated explicitly: *“If I do not know how they are using the money, it just feels like a black box. I cannot trust something that is so unclear.”* Similarly, N05 echoed transparency concerns explicitly, clarifying why she had never offset: *“I’ve never bought offsets because the information provided by airlines seemed very vague and untrustworthy. I could not clearly understand how my money would be used or if it would actually make a difference.”* Reinforcing these concerns, N01 further elaborated: *“I need to know exactly how my money is spent—whether on tree planting, purchasing carbon credits, or investing in renewable energy. Without such transparency, it is hard for me to trust the offset provider.”*

This lack of transparency translated into broader skepticism regarding the tangible impact of offset initiatives. Several participants expressed doubt about whether their relatively small contributions genuinely contributed to reducing carbon emissions or merely served as symbolic gestures with limited real-world effect. For instance, N02 expressed doubt: *“I always see the*

offset option, but honestly, it just seems symbolic—like a small personal contribution won't realistically make any real difference.”

In contrast, offsetters generally expressed greater trust that even small contributions might matter, although they acknowledged uncertainties. O02 described their nuanced trust clearly: *“I'm not sure offsets actually work, but I still choose to trust that at least it's better than doing nothing.”*O07 expressed cautious optimism similarly: *“I believe small offsets collectively matter, but honestly, clearer evidence or certification would reassure me even more.”*

Certification and third-party verification emerged as crucial factors for both stated and revealed preferences and choices. Non-offsetters commonly mentioned the lack of third-party assurances as a key barrier to their participation. The results support a positive preference for certification was observed in Study 2, an effect that was more pronounced in the RP. N07 explicitly shared: *“Without third-party certification, I have a tough time believing the offsetting claims airlines make. Official verification would certainly make me reconsider offsetting.”*

On the other hand, participants who had purchased offsets explicitly also cited certifications as vital components that enabled their decisions. O04 clearly explained: *“If there's a certification—like from a third party—I'm way more likely to believe it's legit.”* This opinion was echoed by O07, who remarked: *“Third-party verification makes a huge difference. Knowing the projects have been independently checked makes me feel more confident about my purchase.”*

When certification was absent, brand reputation—particularly of established airlines or travel platforms—played a crucial role in shaping trust. Offsetters explicitly acknowledged airline brand reputation as integral to their purchasing decisions. O04 stated: *“I trust this airline more, so when they offer offsetting, I'm willing to believe in it. But I would not use an outside app I've never heard of.”*

Non-offsetters similarly recognized brand reputation's importance but often remained skeptical, indicating that the brand alone was insufficient without tangible verification. N03 clearly remarked: *"Even with a well-known airline, I still hesitate to buy offsets without clear evidence or proof of impact. Reputation helps, but it's not enough to completely overcome doubts."*

Participants emphasized the critical need for tangible evidence confirming the real-world impact of their offset contributions. Offsetters explicitly valued clear post-purchase evidence—such as project photos, detailed progress updates, or verification reports—to reinforce their continued trust and future participation. O08 requested: *"I want to see where my money went. Give me photos, reports, or anything that shows what was done. That's what makes it real."* O11 explicitly detailed the importance of tangible evidence for maintaining future trust: *"I must see tangible results or feedback to keep trusting the process. Without visible proof, my motivation decreases significantly."*

Likewise, non-offsetters emphasized the absence of tangible evidence as a major obstacle to their initial engagement. N01 noted: *"I considered offsetting many times, but never actually did it. Without clear updates or evidence, I always felt uncertain about where the money would go or if it really made a difference."*

Several participants explicitly referenced platforms like Ant Forest as effective models due to their transparent, visual, and engaging nature. For instance, N09 remarked, *"At least on Ant Forest, I can see my tree and track my progress. If offsetting did something similar, I'd feel better about it."*

Interestingly, the interviews revealed that trust was built progressively through repeated positive experiences. Travelers explicitly noted how timely post-purchase feedback or digital confirmation strengthened their confidence and willingness to offset again in the future. Conversely, a lack of follow-up after an initial purchase often led to uncertainty and reluctance

to repeat the behavior. As O11 reflected: *“I did it once, but I never heard anything afterward. So I’m not sure I would do it again.”* O01 explicitly echoed the necessity of ongoing communication and confirmation: *“After purchasing offsets, if I receive no follow-up or confirmation of impact, my trust quickly fades. Ongoing communication is crucial to sustaining my participation.”*

These insights clearly indicate that trust in carbon offsetting is not a static attribute or mere barrier at a single decision point. Rather, it is continuously negotiated and reinforced through transparent communication, institutional credibility, tangible verification, and consistent follow-up. Trust interacts dynamically with other aspects of the decision-making process, both shaping and being shaped by individuals’ awareness, motivations, and evaluations of the product.

Moreover, these qualitative findings support the influence of trust observed in Study 1 and help contextualize the heterogeneity in trust and preferences observed in Studies 1 and 2. The current findings suggest that tourists’ trust is inherently context-dependent, influenced significantly by whether offsetting is perceived abstractly (as in stated choices) or concretely (as in revealed choices) and the availability and perceived reliability of external assurances.

Overall, participants articulated clearly that trust and credibility fundamentally underpinned their engagement with offset products. To foster trust, providers must offer transparent communication, visible evidence of impact, authoritative third-party certification, and consistent follow-up interactions. These strategies help mitigate skepticism and reinforce travelers’ confidence, ultimately facilitating more sustained and meaningful participation in carbon-offsetting initiatives.

In Study 1, green trust is operationalized as a latent construct capturing perceived reliability, dependability, trustworthiness, and environmental performance of the TCO. In Study 3, the

“trust/credibility” theme encompasses the same underlying belief, its antecedents (e.g., certification, brand reputation, post-purchase proof), and its consequences (repeat behavior). We therefore treat Study-3 “trust/credibility” as the process-level mechanism that forms and updates the green trust state measured in Study 1.

4.3.1.5 Theoretical and Methodological Triangulation

The qualitative evidence specifies the conditions under which travelers enter compensatory evaluation: awareness and minimum credibility operate as sequential gates. Conditional on passing these gates, the attributes modeled in Study 1—price, project type/location, provider, payment timing/mode, and quantity (trip-specific matching)—are traded off with heterogeneous weights, as quantified in Study 1. Study 3 explains these weights by identifying the underlying mechanisms—awareness/knowledge (entry), fairness and responsibility (tilting monetary sensitivity), psychological distance (location/type), and friction (timing/mode)—and by showing how trust and credibility function both as a gate and as a dynamic update (via post-purchase proof-of-impact). In construct terms, Study-3 trust/credibility is the process that forms and updates the green-trust state recovered as a latent variable in Study 1.

Methodologically, these process insights justify the partial data-enrichment approach in Study 2: share parameters where the process indicates similar conditions across SP and RP (e.g., quantitative cues), and allow dataset-specific parameters where context implies divergence (e.g., non-quantitative cues whose salience/credibility varies). They also clarify observed SP–RP scale differences, dataset-specific heterogeneity, and state dependence: credible first experiences plus impact feedback strengthen trust and increase the probability of subsequent uptake. In sum, Study 3 supplies the process map that organises the quantitative findings of Studies 1 and 2 and improves their interpretation and transportability across hypothetical and market contexts.

4.3.2 Discussion

This study aimed to open the “black box” of carbon offset choices by investigating why tourists prefer specific offset product attributes and how they arrive at such decisions. Based on in-depth interviews, four interrelated themes emerged—awareness and knowledge, motivations and attitudes, project attribute preferences, and trust and credibility—which together illuminate the psychological and cognitive processes underpinning offset behavior. These findings move beyond traditional economic valuation approaches by highlighting the dynamic interactions between individual values, trust formation, information processing, and perceived utility. Together, these themes provide the process mechanisms that generate the latent green trust and attribute trade-offs recovered in Study 1 and clarify scale, dataset-specific differences, and state dependence observed in Study 2.

4.3.2.1 Beyond Utility Maximization: A Process-Oriented Understanding

Whereas the two preceding quantitative studies relied on stated and revealed preference models grounded in utility theory to measure preferences and choices, this qualitative investigation provides insight into how and why such preferences are formed. These findings bridge predictive, utility-based models with process-oriented accounts by showing how awareness, motivation, and credibility formation construct the utilities that Studies 1 and 2 measure.

The results support the core tenets of random utility theory (McFadden, 1974), demonstrating that tourists assess offset alternatives based on perceived costs and benefits. However, while hybrid choice models (e.g., Ben-Akiva et al., 2002) integrate psychological constructs into utility-based frameworks, they offer limited insight into the processual nature of decision-making. This study contributes a process-oriented understanding of how utility is dynamically constructed, as visualized in **Figure 4.2**, complementing previous offset studies grounded in

utility theory (Araghi et al., 2016; Babakhani et al., 2017; Blasch & Farsi, 2014; Brouwer et al., 2008; Choi et al., 2018; Lu & Shon, 2012; MacKerron et al., 2009; Mair, 2011; Ritchie et al., 2021; Rotaris et al., 2020; Schwirplies et al., 2019).

Our findings align with Lancaster's (1966) Characteristics of Consumer Goods Framework, which conceptualizes consumer goods based on their inherent characteristics. However, we extend this framework by demonstrating that attributes of carbon offset products are filtered through complex psychological processes of awareness, trust, and personal values. For instance, while Lancaster would suggest that travelers evaluate offset products based on their objective characteristics (e.g., price, project type), our research further reveals that these attributes are perceived through subjective interpretations shaped by prior knowledge, social context, and emotional responses. In our data, objective attributes (price, type, location, timing) become decision weights only after awareness and minimum credibility are satisfied. Otherwise, they are screened out, which helps explain why some SP parameters fail to transport to RP in Study 2.

This nuanced understanding addresses a critical gap in the literature identified by Hensher et al. (2015), who noted that observed choice outcomes never reveal the complete decision-making process. By capturing travelers' narratives about their offset choices, we illuminate the "black box" between product attributes and ultimate decisions, providing a richer account of preference formation than quantitative methods alone can.

4.3.2.2 Key Themes in Tourist Offset Decision-Making

Initial Awareness and Information Processing: Foundations of Offset Decisions

Our analysis of travelers' initial exposure to carbon offsetting reveals significant parallels with process-oriented choice approaches, particularly the choice-set model (Brisoux & Laroche,

1981; Haines et al., 1970; Narayana & Markin, 1975). This model recognizes that decision-making involves selective consideration of alternatives within cognitive limitations. Our findings extend this framework by illustrating how carbon offsetting often begins outside the traditional consideration set, requiring a prior phase of conceptual introduction before it can be evaluated as a viable option.

The data revealed significant variation in how travelers processed information about offsetting, with active and passive learning patterns that mirror distinctions made in dual-process theories of cognition (Kahneman, 2011). Active processors deliberately sought detailed information, while passive learners acknowledged offsetting in passing but did not pursue deeper understanding. This distinction aligns with elaboration likelihood models of persuasion (Petty & Cacioppo, 1986), which proposes that the route through which attitudes are formed depends on an individual's motivation and capacity to process information.

Our findings on information barriers echo concerns raised by Gössling et al. (2009) and Becken and Mackey (2017), who identified information complexity and accessibility as significant obstacles to offset participation. Furthermore, we extend these insights by arguing that how and when options are presented within booking flows can influence whether travelers even reach the stage of evaluating offset attributes.

The confusion between offsetting and other environmental practices (e.g., declining in-flight meals) revealed in our interviews indicates more severe conceptual ambiguity than previously documented. While Lovell and Liverman (2010) noted general misconceptions about offsetting mechanisms, our findings suggest even more fundamental confusion about what constitutes an offset action. This points to a more profound knowledge gap than earlier literature has acknowledged and emphasizes the need for clearer, more accessible educational materials tailored to diverse cognitive processing styles.

Motivations and Attitudes: Psychological Drivers of Offset Utility

The psychological dimensions of offsetting behavior identified in our study align with established behavioral theories while revealing nuances specific to carbon offset consumption. Environmental concern and personal responsibility emerged as primary motivators, consistent with the NAM (Schwartz & Howard, 1984) and VBN theory (Stern, 2000). Our findings extend Stern's (2000) categorization of pro-environmental behavior by positioning carbon offsetting as a hybrid form that combines aspects of both private consumer choices and public environmental support.

The emotional relief or “guilt reduction” described by participants adds a dimension often understated in rational choice models. This finding resonates with Becken's (2007) and Kotchen's (2009a) concept of flying guilt but provides more granular insight into how offsetting serves as an emotional coping mechanism that allows environmentally concerned travelers to reconcile their values with their desire for air travel. This emotional function of offsetting corresponds to what Lindenberg and Steg (2007) might classify as serving both hedonic goals (avoiding negative emotions) and normative goals (acting in environmentally responsible ways).

Social influences on offsetting behavior revealed in our study support the importance of subjective norms in the TPB (Ajzen, 1991). However, our findings also highlight generational divisions in social approval that have not been extensively documented in previous research on offsets. The disapproval from older family members described by some participants suggests that offset norms may be cohort-specific, adding complexity to social influence models that treat normative pressure as uniform across an individual's social network.

Financial concerns emerged as significant barriers in our study, consistent with previous research by Choi and Ritchie (2014) and Schwirplies et al. (2019). However, our analysis extends this understanding by revealing that price sensitivity is not merely about absolute cost but about perceived fairness and responsibility allocation. Many participants questioned why they—rather than airlines—should bear the financial burden of environmental mitigation, reflecting broader concerns about the equitable distribution of climate responsibilities that echo debates in climate justice literature (Caney, 2014).

The tension between environmental values and economic considerations identified in our study supports Bamberg's (2013) SSBC, which recognizes that even environmentally motivated individuals may struggle to translate intentions into action when faced with practical barriers. However, our findings suggest that the TTM (Prochaska & DiClemente, 1983) emphasis on discrete stages may not fully capture the iterative, non-linear nature of offset decision-making, in which travelers continuously renegotiate their willingness to participate based on evolving perceptions of value, trust, and fairness.

These dynamics map to price/own-contribution heterogeneity in Study 1 and to state dependence in Study 2, where credible first experiences reduce dissonance and increase repetition.

Project Attribute Preferences: Evaluation and Utility Formation

Beyond the decision model, our study revealed substantive preferences for specific offset project attributes that both confirm and extend previous research findings. The preference for reforestation projects aligns with results from Blasch and Farsi (2014) and Schwirplies et al. (2019), who identified a greater WTP for forestry-based offsetting. Our qualitative analysis extends these findings by explaining the psychological underpinnings of this preference:

reforestation's familiarity, visibility, and symbolic resonance make it cognitively accessible and emotionally compelling in ways that more abstract offset mechanisms (e.g., methane capture) are not.

The preference for domestic or destination-based projects identified in our study parallels findings from Schwirplies et al. (2019) and Ritchie et al. (2021), who found similar geographic preferences in their quantitative studies. Our research adds depth to these findings by revealing that geographic proximity enhances psychological proximity, making offset projects feel more tangible, trustworthy, and personally relevant. This supports construal level theory (Trope & Liberman, 2010), which posits that reducing psychological distance increases the perceived relevance and motivational impact of abstract concepts such as carbon offsetting.

Our participants' desire for tangible, verifiable outcomes extend insights from previous offset studies that emphasized the importance of certification (MacKerron et al., 2009; Ritchie et al., 2021). However, our findings reveal that certification alone may be insufficient; travelers seek ongoing, visual evidence of impact—such as photos, progress updates, or interactive tracking interfaces. This preference for tangibility and visibility has parallels in other forms of charitable giving (Cryder et al., 2013) but has not been thoroughly explored in carbon offset contexts.

The expressed preference for flexible payment options, including the use of frequent flyer miles or loyalty points, represents a novel finding with limited coverage in previous offset literature. This preference aligns with broader trends in behavioral economics, suggesting that mental accounting and payment decoupling can reduce the perceived pain of payment (Prelec & Loewenstein, 1998), potentially increasing willingness to offset when alternative currencies are available.

Participants' desire for one-to-one matching between their emissions and offset purchases reflects a preference for proportionality that has received minimal attention in previous offset research. This finding suggests that travelers conceptualize offsetting not merely as an environmental donation but as a form of personal carbon balancing or neutralization, with implications for how offset products should be framed and quantified.

Trust and Credibility: The Foundation of Offset Utility

Trust emerged as a foundational element in our study, operating not as a static checkpoint but as a dynamic factor influencing the entire decision journey. This finding extends previous research by Chen et al. (2019) and Schwirplies et al. (2019), who found that trust is a significant predictor of green intentions. Our process-oriented approach reveals how trust is continuously constructed and negotiated through interactions with information sources, providers, and feedback mechanisms. This process account aligns with the green-trust construct in Study 1 and explains Study 2's state dependence: post-purchase proof-of-impact updates trust upward and increases subsequent uptake.

The emphasis on transparency and fund allocation aligns with findings from Gössling et al. (2009), who noted skepticism about how offset payments are used. However, our research provides a more nuanced understanding of how travelers evaluate transparency, suggesting that it encompasses not just clear information about fund allocation but also ongoing communication about project implementation and impact.

The role of brand reputation in shaping trust adds nuance to previous findings by Blasch and Farsi (2014), who identified provider type as significant in offset choices. Our results suggest that established airlines leverage existing brand trust to enhance the credibility of their offset offerings, creating what might be termed a "trust transfer" effect from the core service to the

ancillary environmental product. This insight has implications for white-label versus branded offset strategies, suggesting that embedding offset products within trusted travel brands may enhance perceived legitimacy.

The progressive nature of trust building identified in our study—where repeated positive experiences strengthen confidence and willingness to offset—supports the application of relationship marketing principles to offset programs. This finding suggests that offsetting should not be viewed as a one-time transaction but as part of an ongoing relationship that requires consistent reinforcement through tangible evidence of impact and recognition of contribution. The parallels participants draw to interactive platforms like Ant Forest illustrate the potential of gamification and visualization to strengthen trust and engagement in ways not extensively explored in previous offset research.

4.3.2.3 Contributions

Theoretical Integration: Toward a Comprehensive Model of Offset Decision-Making

The four themes identified in our study—awareness and knowledge, motivations and attitudes, project attribute preferences, and trust and credibility—interact dynamically to shape offset decisions. This integrated process view contributes to theory development by synthesizing elements from multiple established frameworks while addressing their limitations in explaining offset behavior. These insights justify partial data enrichment in Study 2: share parameters where process conditions are comparable across SP and RP (e.g., quantitative attributes), separate them where salience/credibility plausibly differ (e.g., non-quantitative attributes).

The process model presented in **Figure 4.2** provides a more comprehensive framework than any single existing theory, addressing limitations in both economic and psychological approaches. Unlike traditional discrete choice models, which focus primarily on attribute trade-

offs, our model explicitly incorporates the role of information processing, trust building, and emotional responses throughout the decision journey. Unlike purely psychological models such as TPB or NAM, which emphasize internal factors, our approach acknowledges the critical roles of product attributes, provider credibility, and technological interfaces in facilitating or hindering offset participation.

This integrated approach responds to calls by Smallman and Moore (2010) for more holistic models of tourist decision-making that acknowledge both rational and non-rational elements. By positioning offsetting as both an environmental action and a consumer choice, our framework bridges disciplinary divides and offers a comprehensive account of how preferences are formed in contexts that involve both personal values and market transactions.

The emphasis on process rather than static determinants also addresses a limitation noted by McCabe et al. (2016), who argued that traditional decision models fail to capture the dynamic, contextual nature of tourism choices. Our findings demonstrate that offset decisions emerge through ongoing interactions between individual characteristics, product features, institutional factors, and information environments—a more complex and nuanced process than suggested by existing frameworks.

Methodological Contributions: Complementing Quantitative Approaches

Methodologically, this study demonstrates the value of qualitative approaches in complementing quantitative preference studies. While Studies 1 and 2 established patterns of WTP and revealed preference heterogeneity, Study 3 provides explanatory depth by illuminating the psychological mechanisms underlying these patterns. This mixed-methods approach responds to Pearce and Packer's (2013) call for greater methodological diversity in

tourism research, combining the predictive power of economic models with the explanatory richness of qualitative inquiry.

The integration of SP, RP, and qualitative data represents a methodological advancement in offset research, addressing the limitations of single-method approaches. By triangulating findings across methods, we enhance both the validity and comprehensiveness of our understanding of offset decision-making.

The in-depth interview approach also enabled us to capture temporal elements of decision-making that are difficult to assess through cross-sectional surveys or experiments. By exploring how travelers' offset perceptions evolved from initial exposure through evaluation to post-purchase reflection, we provide insight into the dynamic nature of preference formation that extends beyond traditional static models.

Practical Implications: Enhancing Offset Engagement

The study provides a range of implications for airlines, tourism marketers, offset providers, and policymakers seeking to increase participation in carbon offset programs. First, clear and accessible communication is essential. Many participants were confused about what offsetting involves or where their money goes. Effective messaging should avoid jargon and instead focus on tangible, relatable benefits. This aligns with recommendations from Babakhani et al. (2017), who found that message framing significantly influenced offset intentions, and extends their work by specifying the types of information and explanations that travelers find most compelling.

Second, offset products should offer transparent verification—through visual updates, certificates, or progress tracking—to enhance credibility and emotional engagement. This recommendation goes beyond the previous emphasis on certification (Gössling et al., 2009) to

suggest more interactive, ongoing forms of verification that maintain engagement beyond the initial purchase. Implementing digital platforms that allow travelers to track the progress and impact of their contributions could transform offsetting from an abstract one-time purchase into an ongoing relationship with tangible outcomes.

Third, travelers prefer personalization and fairness. Their willingness to offset increases when the contribution is directly tied to their individual flight emissions and when alternative payment methods, like frequent flyer miles, are offered. This insight suggests the potential to integrate offset purchases more seamlessly into loyalty programs and to customize offset amounts based on actual travel patterns. This approach would address both the concerns of fairness and payment flexibility preferences expressed by participants.

Fourth, the reputation of the offering institution matters. Tourists relied on airline credibility and third-party certification as key indicators of trustworthiness. This finding suggests that partnerships between established travel brands and recognized environmental organizations could leverage complementary forms of trust to enhance the credibility of offsets. It also indicates that new or independent offset providers face significant barriers to consumer acceptance without institutional backing or certification.

Lastly, post-purchase feedback is critical. Without follow-up confirmation, even previously motivated travelers may hesitate to participate again. This underscores the need for effective communication strategies that extend beyond the point of purchase to reinforce the impact and value of offset contributions over time. Regular updates, impact reports, and visual evidence of project implementation could help maintain engagement and encourage repeat participation.

These practical implications extend beyond simple marketing adjustments to suggest more fundamental changes in how offset products are designed, integrated into the travel booking

process, and communicated to potential participants. By addressing the full spectrum of decision-making factors identified in our research—from awareness and understanding to trust and feedback—offset providers can develop more effective strategies for engaging travelers in climate mitigation efforts.

4.3.2.4 Limitations and Directions for Future Research

Several limitations should be acknowledged in this study. The sample was composed primarily of overseas Chinese travelers, which may limit the applicability of the findings to domestic tourists or to travelers from other cultural contexts. Cultural factors may influence how individuals perceive environmental responsibility, trust institutions, and evaluate the legitimacy of offset projects. Future research should explore cross-cultural variations in offset decision-making, examining how different value systems and institutional environments shape preferences and behaviors.

Furthermore, the study takes a demand-side perspective; future work should explore the views of supply-side actors such as airline executives, offset platform designers, and sustainability policymakers. Understanding how these stakeholders conceptualize and implement offset programs would provide valuable insight into the institutional factors that shape offset availability, design, and communication. Comparative analysis of successful and unsuccessful offset initiatives could identify best practices and implementation barriers from a provider perspective.

Longitudinal designs could also examine how tourists' offset behaviors evolve over time in response to experiences and feedback. Following travelers through multiple offset decisions would reveal whether initial participation leads to continued engagement or whether offset

fatigue develops over time. Such research could also evaluate how various communication and feedback strategies influence sustained engagement over time.

The role of technological interfaces in facilitating or hindering offset participation emerged as a significant factor in our study, but deserves more focused attention in future research. Experimental studies comparing different interface designs, information presentations, and payment mechanisms could identify optimal approaches for integrating offset options into the travel booking process. This research direction would bridge consumer psychology with human-computer interaction to develop more user-centered offset interfaces.

In addition, while interviews highlight the importance of awareness and minimum credibility as sequential gates, causal identification requires experimentation. Future research should manipulate these gates—e.g., certification visibility, clarity on fund use, trip-specific quantity disclosure, timing within the booking flow, and post-purchase impact updates—using field experiments, A/B tests, or lab-in-the-field studies. Measuring resulting entry into compensatory evaluation and subsequent choices would test the process model directly.

Finally, future research should explore potential synergies between offsetting and other forms of sustainable tourism behavior. Our findings suggest that offsetting is often conceptualized within a broader framework of environmental responsibility, but the relationships between offset participation and other pro-environmental travel choices remain unclear. Investigating whether offset purchases complement or substitute for other forms of sustainable tourism behavior would provide insight into the overall environmental impact of offset programs and their role in promoting broader sustainability transitions in tourism.

By pursuing these research directions, scholars can continue to build a more comprehensive understanding of carbon offset decision-making while developing practical insights to improve the design, effectiveness, and uptake of tourism carbon offset programs.

Chapter 5 Conclusion and Implications

As described in the methodology section, this thesis adopts a triangulation approach to comprehensively investigate tourists' preferences for carbon offset products, integrating stated and revealed preferences with qualitative data. **Figure 5.1** illustrates the integrated triangulation approach employed in this thesis to investigate tourists' preferences for carbon offsets comprehensively.

The top oval depicts Study 1, which used stated-preference data from discrete-choice experiments and hybrid choice modeling. This initial investigation created a foundation for understanding hypothetical decision scenarios, capturing various choice attributes, latent variables (green trust), and socio-demographic characteristics that influence tourists' TCO preferences in controlled settings.

The bottom-left oval represents Study 2, which expanded the investigation by incorporating revealed-preference data alongside stated-preference data. Through data enrichments and comparisons, this study identified trade-offs, equilibrium points, and heterogeneities between how tourists say they would behave (SP) versus their actual behavior (RP) regarding carbon offset purchases.

The bottom-right oval illustrates Study 3's qualitative approach, which used in-depth interviews and thematic analysis. It explains and contextualises the quantitative patterns through semi-structured interviews and thematic analysis, mapping the decision-making process through several key components: awareness, motivations, and knowledge acquisition; active/passive learning processes; evaluation of alternatives/attributes; project attribute preferences; trust and credibility considerations; preference (utility) formation; and post-choice re-evaluation.

The triangular structure connecting all three studies visually reinforces how these complementary approaches converge on the central phenomenon of “Preferences for travel carbon offsets.” This combined analytical framework mitigates the individual shortcomings of isolated methods, delivering a more complete and reliable assessment of the multifaceted factors influencing tourists’ carbon offset decisions. It demonstrates how multiple data sources and analytical approaches collectively enhance research credibility and mechanism-aware explanation of the same phenomenon.

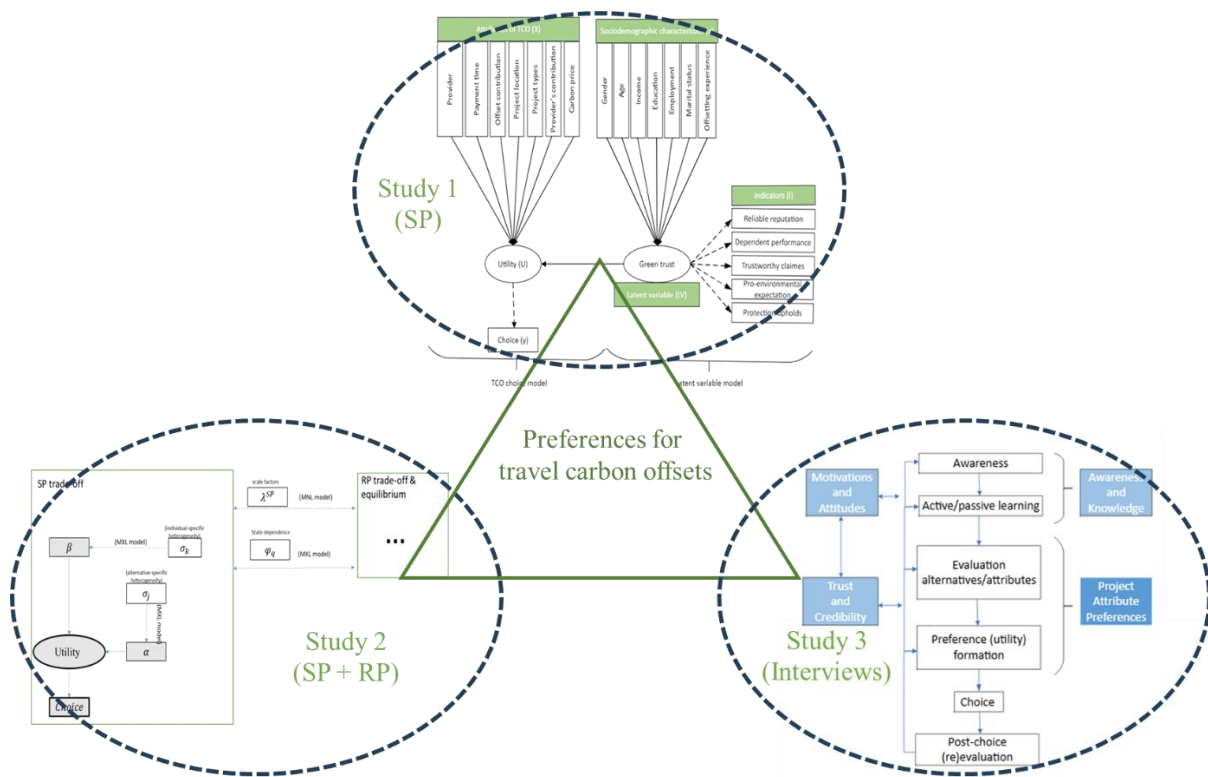


Figure 5.1 Triangulation of thesis findings

5.1 Revisit of Research Objectives

The thesis set out four objectives. RO1 aimed to develop a decision-making framework for TCO that reconciles a psychological, process-oriented perspective with the economic, structure-oriented, utility-based approach. This objective is fulfilled by (1) synthesising the literature to propose an integrative framework that bridges the psychological, process-oriented

perspective with the economic, structure-oriented utility-based choice, (2) operationalizing RUM in Study 1's stated-preference models—explicitly embedding green trust as a latent factor, and (3) formalizing in Study 3 a decision process—awareness and knowledge acquisition; evaluation of alternatives and attributes; trust and credibility formation; choice; and post-choice (re)evaluation. Taken together, these elements specify the TCO decision process: only when travelers are aware of offset options and minimum credibility conditions are satisfied (e.g., acceptable certification or proof of impact) do price or attribute trade-offs proceed.

RO2 sought to articulate an industry-wide TCO concept and quantify determinants of adoption and WTP. Study 1 meets this objective by showing that tourists exhibit a positive propensity to offset and that choices are systematically shaped by a bundle of offset- and travel-related features, price, and latent trust, with meaningful heterogeneity across travelers and contexts.

RO3 was to integrate and compare SP and RP evidence in order to evaluate how inferences travel across hypothetical and market contexts and to diagnose the sources of agreement or divergence. Study 2 addresses this by demonstrating both consistencies and divergences between the two data sources, identifying relative scale differences and unobserved heterogeneity, and detecting state dependence, whereby past offset behavior conditions subsequent decisions. The preferred specifications implement partial data enrichment—pooling parameters where alignment is strong and allowing dataset-specific parameters where it is weak—thereby improving fit and interpretability relative to SP-only and RP-only models.

RO4 sought to explain why and how tourists make offset choices. Study 3 addresses this objective by analyzing the decision process in depth (Chapter 4, Section 4.3). Qualitative evidence shows that awareness and knowledge often arise through airlines, peers, or platforms; motivations and attitudes combine responsibility and guilt-relief with concerns about cost and fairness; project attribute preferences reflect perceived tangibility and psychological distance

(e.g., project type and domestic/destination location), as well as provider and timing considerations; and trust and credibility are shaped by independent certification, provider reputation, and post-purchase proof of impact. These patterns are consistent with—and aid interpretation of—the quantitative results from Studies 1 and 2. Taken together, the findings indicate a recursive, mutually linked process rather than a strictly linear one: four components—awareness/knowledge, evaluation of alternatives and attributes, credibility formation, and choice—inform one another through two-way feedback. Crucially, two gates precede any price/attribute trade-offs: (1) travelers must first be aware of the offset option, and (2) minimum credibility conditions must be met. After a choice (or rejection), post-choice (re)evaluation—including impact updates—feeds back to update awareness and credibility beliefs, thereby reshaping subsequent evaluations and choices. This mutual-loop architecture, with awareness and credibility as sequential gates, clarifies when utility-based trade-offs are enacted or suspended in practice and helps explain the state dependence observed in Study 2. Guided by these objectives, the thesis examined seven research questions. The synthesis below is organised by question and draws on evidence across studies.

5.2 Summary of Key Findings by Revisiting Research Questions

RQ1. Are tourists willing to pay for TCO?

This question addresses RO2. Study 1 indicates that travelers tend to opt in when a TCO is offered and exhibit clear WTP. For a one-tonne trip, the estimated mean WTP for an optimal TCO configuration (domestic project; higher own contribution alongside provider co-contribution; reforestation; payment before departure) is approximately ¥108.

RQ2. What are the factors that influence tourists' choices of TCO?

This question addresses RO2. Study 1 shows that choices are shaped jointly by offset-related attributes (offset quantity, project location, and type) and travel-related attributes (provider

identity, provider co-contribution, payment timing), as well as price and the latent construct of green trust, with substantial preference heterogeneity implying scope for segmentation and tailored design. Study 3 helps explain these patterns by pointing to perceived tangibility and legitimacy (project type), reduced psychological distance (domestic/destination location), friction reduction (timing and familiar payment modes), and fairness considerations (who contributes) as mechanisms through which attributes enter utility.

RQ3. Do discrepancies exist between stated and revealed preferences for offsets?

This question addresses RO3. Study 2 documents both alignment and divergence between SP and RP. Parameters associated with price and offset quantity tend to align across data sources. In contrast, attributes such as project type, location, and certification display differences in magnitude or significance when estimated separately. Joint estimation rejects a fully common parameterisation, indicating that naïve pooling would be misleading.

RQ4. Where do these discrepancies occur, and what are their sources?

This question addresses RO3. Integrated specifications in Study 2 attribute discrepancies to relative-scale differences between SP and RP tasks, unobserved heterogeneity (partly dataset-specific), and state dependence, whereby past offset behavior conditions subsequent choices. Study 3 identifies behavioral mechanisms—awareness and salience, knowledge, perceived impact and legitimacy, fairness concerns, psychological distance, friction/effort, and credibility thresholds—that likely contribute to these gaps across contexts.

RQ5. Can stated and revealed preference data be combined in the context of offset choices?

This question addresses RO3. While full data enrichment is rejected, partial data enrichment is supported. Study 2 indicates that integration performs best when the model recognises relative scale differences, shares parameters only where empirical alignment exists, and

accommodates heterogeneity and state dependence. Under these conditions, integrated models improve interpretability and the transportability of inferences compared with SP-only or RP-only analyses.

RQ6. Why do tourists prefer certain attributes of carbon offset options?

This question addresses RO4. Study 3 explains the preference patterns by highlighting mechanisms of perceived tangibility and legitimacy (familiar and verifiable project types), reduced psychological distance (domestic or destination projects), fairness signals (provider co-contribution), and friction reduction (appropriate timing and familiar payment modes). Trust is strengthened by independent certification, credible providers, and post-purchase impact updates, which together convert intention into action and encourage repetition.

RQ7. How do tourists make decisions when choosing carbon offset products?

This question addresses RO4. The qualitative analysis in Study 3 portrays decision-making as recursive and mutually linked rather than strictly linear. Awareness/knowledge, evaluation of alternatives and attributes, trust establishment, and choice are connected by two-way feedback. Two gates precede any price/attribute trade-offs: travelers must first be aware of the option, and minimum credibility conditions must be met. Post-choice (re)evaluation, especially through impact updates, feeds back to update awareness and credibility beliefs, generating the path(/state) dependence observed in Study 2.

5.3 Theoretical Implications

This thesis advances theory in several complementary directions while synthesising the three studies into a cumulative contribution.

At the core is an integrated decision architecture that reconciles process and structure in travel carbon offsetting. The architecture links psychological processes—awareness and knowledge,

motivations and attitudes, and trust and credibility—to the economic representation of preferences via utility evaluation. In this formulation, utility-based trade-offs (in the Random Utility Maximisation tradition) are enacted only once two sequential gates are crossed: first, the traveler must be aware that offsetting is available; second, minimum credibility conditions must be satisfied. Thereafter, post-choice feedback (such as proof of impact) updates beliefs and dispositions, thereby reshaping subsequent evaluations and choices. By making these process conditions explicit, the architecture accounts for when and why compensatory evaluation occurs, and it explains the path dependence observed in behavior. In doing so, it extends classical discrete-choice foundations (McFadden, 1974; Ben-Akiva et al., 2002) by specifying the processual prerequisites under which a random-utility representation is behaviorally realized.

Such integration also extends the typical pro-environmental behavior theories. by positioning awareness, psychological distance and tangibility (Trope and Liberman, 2010), responsibility and fairness orientations (as in norm-activation and value–belief–norm perspectives: Schwartz and Howard, 1984; Stern, 2000), social-norm influences (Ajzen, 1991), and related constructs as mechanisms that shape the activation and weighting of attributes, the thesis moves beyond descriptive heterogeneity toward mechanism-based heterogeneity. The integrated architecture, therefore, links psychological processes to economic representation in a way that can be theorized and tested across settings: it predicts when non-monetary cues will bind or attenuate, and how post-choice feedback will propagate through subsequent decisions. In this way, it offers a generalisable theoretical account of how process conditions regulate the expression, transportability, and evolution of utility-based preferences for travel carbon offsets.

The thesis also revisits and grounds the rationale for applying discrete choice models to offsets by returning to environmental-economic conceptions of value. Building on Lancaster’s characteristics framework (1966), offsets are treated as bundles of attributes—project type,

location, certification, timing, payment mode—against which money is traded. However, unlike purely commercial products, the “economic value” expressed in offsetting may incorporate indirect use values (Heal et al., 2004). Recognizing these components, long emphasized in environmental economics, clarifies why ethical and environmental motives can be coherently represented as WTP for environmental characteristics rather than existing outside the utility framework.

Conceptually, the thesis extends the domain of tourism offsets by theorizing the tourism carbon offset as an industry-wide product that combines offset attributes (e.g., offset quantity, project type, location, certification) with travel-related attributes (e.g., provider identity, payment timing). To ground the TCO analytically, the thesis looks back to environmental economics and clarifies that offsets carry indirect values, making them amenable to characteristics-based discrete-choice modeling. It then positions the TCO as a trust-based, impure public good and a novel sustainable product embedded in tourism-specific narratives (“quick fix,” “origin–destination connections,” “avoiding the unavoidable”) and shaped by market architecture (airlines/ online travel agencies as providers, certification signals under information asymmetry, trip-specific quantification). This broadened view moves beyond the aviation-only focus of prior work and embeds offsetting within the wider tourism system. Consistent with this conceptualisation, the empirical evidence (Study 1) indicates a positive WTP for such an industry-wide offset product in tourism.

A further theoretical contribution concerns the role of trust. Study 1 models green trust as a latent, utility-relevant construct, while Study 3 identifies its proximal antecedents (independent certification, provider reputation, and post-purchase proof of impact) and its dynamic evolution over time. This specification advances the literature by treating trust not as a static disposition but as a state formed and updated through interaction with institutions and information. The architecture, therefore, explicates the channel through which credibility affects utility and

clarifies why repeated credible experiences generate positive state dependence in the integrated models. In this respect, the thesis complements hybrid choice approaches that incorporate psychological constructs into utility (Ben-Akiva et al., 2002; Hensher et al., 2015) by providing a process account of when such constructs are activated, how they are updated, and why their behavioral expression varies across contexts.

Finally, the work sharpens theory and method on preference transportability and principled data pooling. By providing, to our knowledge, the first direct comparison and integration of stated and revealed preferences for travel offsets, the thesis demonstrates that partial data enrichment is theoretically and empirically appropriate in sustainable product contexts. Quantitative attributes are concrete and widely understood, anchored in universal budget constraints, and therefore tend to transport well across SP and RP. By contrast, non-quantitative cues—project type, location, and certification—are contingent on salience, information richness, and credibility at the moment of choice, making their effects more context dependent across SP and RP. This conditional transportability refines assumptions about pooling data sources and provides a basis for sharing attributes only where their meaning is consensual and alignment across conditions, while allowing context-specific attributes to vary when understandings and effects plausibly hinge on process conditions.

5.4 Practical Implications

Together, the three studies indicate that effective engagement with travel carbon offsets hinges on two preconditions—awareness of the option and trust in the offer—after which attribute trade-offs proceed in a utility-consistent manner. In practical terms, this implies that the most consequential levers for airlines, online travel agencies, and offset providers are those that first make the option visible at natural decision points and then render it trustworthy in a way that is intelligible to non-experts. Study 3 shows that many travelers encounter offsets only

incidentally and often with an incomplete understanding; when awareness is low or the option is poorly surfaced, respondents do not enter compensatory evaluation. Study 1 complements this by demonstrating that, once the option is genuinely considered, choices respond predictably to price and to salient, comprehensible attributes. Study 2 further cautions that non-quantitative attributes (type, location, certification) do not transport uniformly across elicitation contexts, reinforcing the need to present such attributes with sufficient salience and explanation in real market settings.

For airlines and travel platforms, the implication is to place the TCO offer at high-attention junctures in the booking flow and itinerary management, use trip-specific quantities to reduce calculation effort, and provide low-friction payment modes (including loyalty points, where feasible). These choices lower decision costs and increase the likelihood that travelers cross the awareness threshold and engage with attributes rather than defaulting to opt-out. Because fairness perceptions and own-contribution sensitivities vary (as indicated by the heterogeneity in Study 1 and the qualitative accounts in Study 3), providers should also explicitly explain how contributions are determined and, where possible, signal airlines' shared responsibility. Immediately after purchase, concise confirmations and periodic, verifiable impact updates help sustain trust and are consistent with the positive state dependence observed in Study 2, whereby credible prior experiences increase subsequent uptake.

For offset providers and project developers, Study 3 highlights a preference for projects that feel tangible and proximate, which aligns with the positive and heterogeneous effects of project type and location in Study 1 and helps explain why such cues vary across contexts in Study 2. Portfolios that include familiar categories (for example, reforestation and visible renewables) and that offer domestic or destination projects, where appropriate, are more likely to resonate. At the point of choice, the evidence supports a standardised credibility package comprising a recognised certification mark, a one-sentence plain-language assurance about what is verified,

and a very short project description anchored in concrete outcomes. After purchase, lightweight, visual progress signals are preferable to dense technical reports. They operationalize the feedback loop identified in Study 3 as central to maintaining trust and are consistent with the repeat-behavior dynamics indicated in Study 2. In addition to certifying the project, providers may offer incentives to offsetters (for example, digital badges, loyalty status credit, or small-point bonuses explicitly tied to certified purchases) to recognise participation without overstating climate benefits.

Certification bodies and standards organisations can enhance effectiveness by translating technical assurance into consumer-usable signals. The results suggest that a visible badge accompanied by a brief statement clarifying scope and verification is more actionable at the moment of decision than lengthy documentation alone. Enabling interoperable, low-cost mechanisms for providers to relay verified micro-updates would also support the credibility gate identified across the studies, without imposing excessive information costs on consumers. Beyond certifying projects, schemes could also recognise consumers' certified actions (for example, "certified offset purchase" acknowledgements) to reinforce trust, visualize benefits, and provide a non-monetary incentive to repeat.

For policymakers and regulators, the SP–RP divergences around non-quantitative attributes indicate a case for simple, enforceable disclosure requirements for consumer offsets: minimum information at the point of sale, proportionate claims, and accessible redress channels. Complementary public education on travel emissions and the importance of decarbonisation—delivered through airports, airlines, and online travel agencies—can raise baseline awareness and reduce the conceptual ambiguity documented in Study 3. Because Study 2 shows positive state dependence, modest, time-bounded incentives aimed at first-time participation (conditional on certified programmes and transparent communication) may yield dynamic benefits if early experiences are credible. Such instruments would complement, rather than

substitute for, the primacy of direct carbon reduction, while recognising the demand side role of high-integrity offsets in the near term.

Destination management organisations can play a coordinating role when proximity and co-benefits matter. Study 3 indicates that geographic closeness and visible local impacts enhance perceived relevance, suggesting that curating certified, destination-based projects and aligning messages across carriers, platforms, and on-site channels can help travelers encounter consistent narratives from booking through arrival. This coordinated signalling enhances both awareness and credibility while recognising the conditional transportability of non-quantitative attributes documented in Study 2.

Across stakeholders, the central practical implication is coordinated action around the consumer choice cycle identified in this thesis—awareness, credibility, evaluation, purchase, feedback, and repeat. Airlines, online travel agencies, project developers, certification bodies, destination organisations, and regulators should align on a shared mitigation hierarchy (avoid, reduce, then offset), common information standards (plain-language disclosures of tonnes, price, and project basics), interoperable credibility signals (recognisable certifications with concise verification summaries that travel across platforms), and a lightweight data-sharing framework (aggregate metrics on uptake, repeat behavior, and complaints). The aim is not for each actor to optimise a single touchpoint, but to create a coherent journey from booking to post-trip communications in which the option is visible, the offer is trustworthy, and feedback closes the loop. By making the option salient at natural decision points, reducing information frictions at evaluation, simplifying payment at purchase, and delivering timely, verifiable impact updates after purchase, this cooperative architecture strengthens the feedback phase and increases the likelihood of re-engagement—thereby improving the full choice cycle rather than any one stage in isolation.

Finally, and importantly, this thesis advocates a systematic approach to tourism decarbonisation that follows a clear mitigation hierarchy. Tourists should first avoid and reduce emissions wherever feasible, with offsetting reserved as the final step to address residual, hard-to-abate emissions— “avoiding the unavoidable.” Within this hierarchy, this study also clarifies the social-impact pathway of travel carbon offset. When offset schemes provide transparent information, credible verification, and visible destination linkages, travelers’ trust and willingness to offset increase. Offsets also serve as an educational touchpoint about travel-related emissions and available mitigation options. This growth in awareness and the resulting behavioral changes channel more resources to local environmental initiatives such as reforestation and renewable energy projects, creating co-benefits for host communities through cleaner environments, employment, and education. Advancing this pathway requires coordinated action among airlines, online travel agencies, offset providers, certification bodies, destination organisations, and regulators, supported by public education, standardised disclosure, and transparent reporting so that individual choices generate meaningful social and environmental outcomes.

5.5 Limitations and Future Directions

This thesis should be interpreted in light of several limitations that qualify the scope of its inferences and, in doing so, point to clear avenues for future work.

First, external validity is constrained by the empirical setting. The three studies examine Chinese overseas travelers, and the latter two focus on airline-channel offsetting. Cultural norms around environmental responsibility, institutional trust, and fairness, as well as channel features in non-airline settings (e.g., online travel agencies, destination platforms, accommodation providers), may shape preferences differently. Future research could extend the sampling frame across markets and channels, ideally using the harmonised instruments

developed in this thesis, to test the portability of the integrated framework and the partial data-enrichment strategy beyond the airline context.

Second, the revealed preference evidence relies on self-reported purchases rather than transaction-level records. Despite screening procedures, recall and social-desirability biases cannot be ruled out; likewise, stated preference tasks necessarily simplify descriptions. The triangulated design mitigates—but does not eliminate—these measurement issues. A valuable next step is to secure partnerships with platforms capable of providing anonymised transaction data and an open-access experimental interface. Such collaborations would enable joint SP–RP estimation with verified RP, as well as pre- and post-evaluations of interface changes and message framing. Where feasible, field experiments and A/B tests that manipulate salience, timing, and explanatory content could support stronger causal claims about the mechanisms identified in this thesis.

Third, the modeling strategy in Studies 1 and 2 inherits standard behavioral and econometric assumptions. Random utility models approximate processes that Study 3 shows to be iterative and gate-dependent: awareness and credibility function as thresholds, below which compensatory trade-offs do not commence. Although mixed logit, error-component structures, and state-dependence terms relax key assumptions, estimates remain sensitive to distributional choices and to the identification of the relative scale. It would be valuable to test non-compensatory and semi-compensatory specifications (e.g., elimination-by-aspects screens for credibility, dual-process or hybrid heuristics–RUM models), and pursue integrative hybrid choice models in which measured trust dynamics and awareness are explicitly linked to the utility kernel.

Fourth, the quantitative design is cross-sectional. The positive state dependence detected in Study 2 suggests dynamic processes—learning, habit formation, and reassurance from impact

feedback—that would be better identified with panels following the same travelers over multiple trips and choices. Future research could therefore deploy longitudinal designs that track exposure to impact updates, subsequent credibility beliefs, and repeat offsetting, enabling decomposition of persistence into learning versus unobserved heterogeneity.

Finally, the thesis is demand-side in emphasis. Supply-side constraints—certification costs, project pipeline availability, liability around claims, user-experience constraints in booking systems—were not modeled but will shape what is actionable in practice. Future studies could incorporate provider and standard-setting bodies’ perspectives—for example, through managerial interviews and choice studies, and cost–benefit analyses of interface changes—thereby linking consumer response to operational feasibility.

Appendices

Appendix 1. “Are Tourists Willing to Pay for Travel Carbon Offset?”—Questionnaire (Block 1)

“Willingness to pay for travel carbon offset products” Questionnaire.

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Leisure Travel and Carbon Offset Information

1.1 If the COVID restrictions are fully relaxed, would you like to travel abroad for leisure in the near future?

Yes

No

Based on your international leisure travel experiences over the last 5 years, please answer questions 1.2-1.10.

1.2 How many times have you traveled abroad in the last 5 years for leisure purposes?

_____ times

1.3 How long did you stay in your last overseas travel destination?

Up to 3 days

Between 4 and 6 days

Between 7 and 9 days

Between 10 and 12 days

Between 13 and 15 days

Between 16 and 18 days

Between 19 and 21 days

Longer than 21 days

1.4 Who did you travel with during your last overseas trip? (choice one)

Spouse

Child(ren)

Other relatives

Friends

Alone

Others

1.5 How many people did you travel with in your last overseas travel?

_____persons (excluding yourself)

1.6 How long was the total flight time for your last overseas trip?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

1.7 On average, how much did you spend on your last overseas trip, including travel and other expenses at the destination?

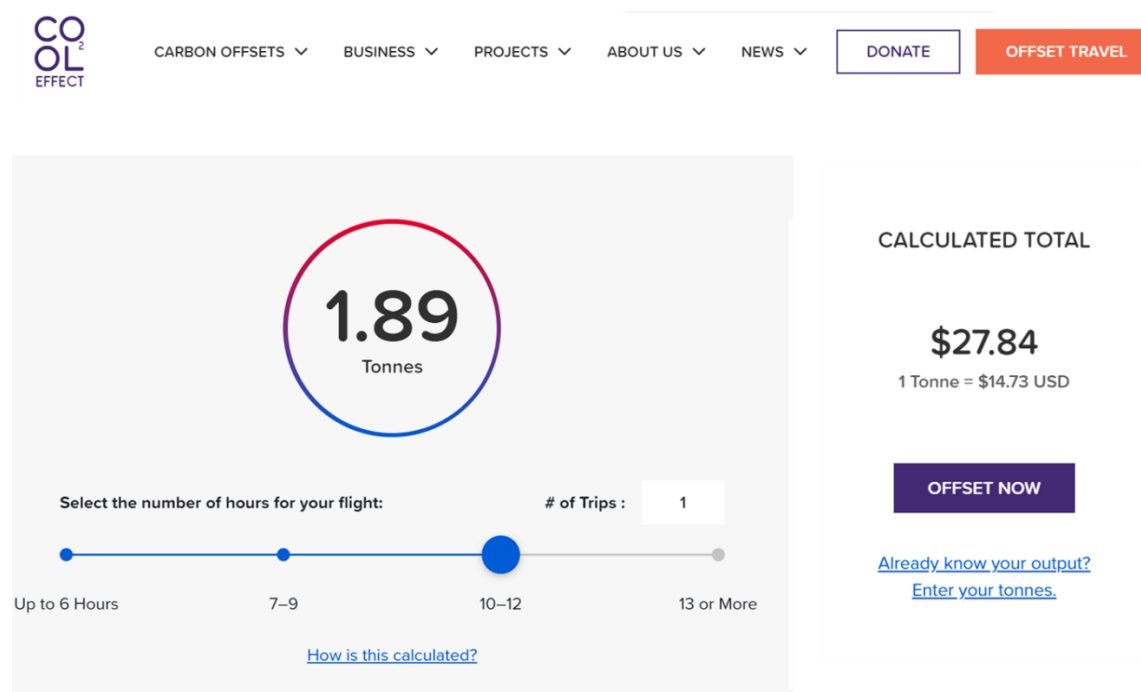
- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000
- ¥30,001–35,000
- ¥35,001–40,000
- ¥40,001–45,000
- ¥45,001–50,000

¥50,001 and above

1.8 Some organizations/companies provide carbon offset options for tourists to reduce their carbon emissions. For example, “My Climate” provides individuals with a carbon offset service (see the following figure). Have you paid for such carbon offsets during your previous travels?

No

Yes



1.9 Why did you pay for the carbon offsets?

A cheap and easy thing to do

Influenced by friends/ relatives/ colleagues

Aware of the information provided

Trust in the companies/organizations/ offset projects

For a good sense of responsibility

Other, _____

1.10 Why did you not pay for the carbon offsets?

Influenced by friends/relatives/colleagues

Saving budget

Carbon offset option is unavailable

Do not trust companies/organizations and offset projects

Other, _____

Section 2: Stated Choice Experiment

Imagine you are planning a *[response to question 1.3]* days leisure trip with *[response to question 1.5]* persons to an overseas destination.

You have booked your flights and rooms through an online travel agency. Now, you find there is a “low-carbon travel” collection on the website. It estimates your carbon emissions for this trip is about *[based on response to questions 1.6 and 1.3]* KG. This section offers you two carbon offset products designed to neutralize your travel emissions. If you choose to offset, your emissions will be removed from the atmosphere through verified carbon offset projects, and you will receive both a certificate and a donation receipt.

There are eight choice sets in the experiment and each choice set includes two alternative carbon offset options (A and B). These options differ only in the attributes listed in the table below; all other attributes remain the same. Additionally, each set includes an opt-out option (Option C), which means you choose not to offset your emissions.

Table 1. Attributes and levels of carbon offset options

Attribute	Description	Levels
CO2 offsetting contribution	You have the option to offset either 50% or the full 100% of the carbon emissions generated by your travel.	0% (0 kg) 50% (440kg) [<i>response to question 1.3 and 1.6</i>] 100% (880kg) [<i>response to question 1.3 and 1.6</i>]
Project location	Where is the project implemented?	Domestic; Overseas destination; Other developing countries
Project types	How are the CO ₂ emissions compensated? Through reforestation and conservation projects, carbon is absorbed by newly planted trees or retained by preserving existing forests, preventing emissions; Renewable energy projects help to build solar, wind, or hydro sites; Community projects introduce energy-efficient technologies or practices in underdeveloped areas, helping reduce emissions at the source; Waste-to-energy projects capture carbon and convert it into electricity.	Reforestation and conservation; Renewable energy; Community project; Waste to energy
Offset product providers	Where do you buy it? You can choose to buy this carbon offset product from middlemen, including airlines, hotels, and online travel agencies, or directly buy it from companies/organizations implementing carbon offset projects.	Airline as the middleman; Hotel as the middleman; Online travel agency as the middleman; Directly provided by a carbon offset company/organization
Contribution from product providers	The product provider increases the amount of CO ₂ offset by 0, 50%, 100%	0 (0kg) 50% (440kg) [<i>response to questions 1.3 and 1.6</i>] 100% (880kg) [<i>response to questions 1.3 and 1.6</i>]
Payment time	When do you pay for the carbon offsets?	Before departure; On-site; After travel
Carbon offset price	What's the price you need to pay to offset 100kg of carbon emissions?	¥5/100KG ¥20/100KG ¥35/100KG ¥50/100KG

2.1 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.1			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Other developing countries	/
Project types	Renewable energy	Waste to energy	/
Offset product providers	Directly provided by a carbon offset company/organization	Online Travel agency as the middleman	/
Contribution from product providers	50%	0%	/
Payment time	Before departure	On-site	/
Carbon offset price	¥35/100kg	¥20/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.2 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.2			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Domestic	/
Project types	Waste to energy	Renewable energy	/
Offset product providers	Hotel as the middleman	Directly provided by a carbon offset company/organization	/
Contribution from product providers	50%	0%	/
Payment time	After travel	On-site	/
Carbon offset price	¥50/100kg	¥5/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.3 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.3			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Domestic	Overseas destination	/
Project types	Reforestation and conservation	Waste to energy	/
Offset product providers	Directly provided by a carbon offset company/organization	Hotel as the middleman	/
Contribution from product providers	0%	100%	/
Payment time	Before departure	On-site	/
Carbon offset price	¥20/100kg	¥50/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.4 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.4			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Other developing countries	Domestic	/
Project types	Renewable energy	Community project	/
Offset product providers	Airline as the middleman	Online Travel agency as the middleman	/
Contribution from product providers	0%	100%	/
Payment time	On-site	After travel	/
Carbon offset price	¥20/100kg	¥35/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.5			
	Option A	Option B	Option C

CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Other developing countries	/
Project types	Waste to energy	Community project	/
Offset product providers	Online travel agency as the middleman	Airline as the middleman	/
Contribution from product providers	0%	50%	/
Payment time	Before departure	After travel	/
Carbon offset price	¥20/100kg	¥20/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.6 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.6			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Domestic	Other developing countries	/
Project types	Community project	Reforestation and conservation	/
Offset product providers	Airline as the middleman	Hotel as the middleman	/
Contribution from product providers	100%	50%	/
Payment time	On-site	Before departure	/
Carbon offset price	¥50/100kg	¥5/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.7			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Other developing countries	Domestic	/
Project types	Community project	Reforestation and conservation	/

Offset product providers	Directly provided by a carbon offset company/organization	Airline as the middleman	/
Contribution from product providers	50%	0%	/
Payment time	On-site	Before departure	/
Carbon offset price	¥35/100kg	¥35/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.8			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Domestic	/
Project types	Reforestation and conservation	Waste to energy	/
Offset product providers	Airline as the middleman	Directly provided by a carbon offset company/organization	/
Contribution from product providers	100%	50%	/
Payment time	After travel	Before departure	/
Carbon offset price	¥5/100kg	¥50/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.9 How much will you pay to offset 400kg of your travel carbon emissions if the carbon offset price you choose is ¥5/100kg?

¥0

¥10

¥20

¥40

2.10 Could you please indicate to what extent you agree that the above scenario is realistic?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

2.11 Do you think this carbon offset product would be a fair product?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

2.12 Do you agree that this product would help tourists offset the environmental consequences of carbon emissions from international travel?

- Completely disagree

- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

Section 3: Perception and attitude

3.1 Please indicate the degree to which you agree with the statement below.

(Green trust towards carbon offset)							
Statement	1. Completely disagree	2. Mostly disagree	3. Slightly disagree	4. Neutral / No opinion	5. Slightly agree	6. Mostly agree	7. Completely agree
I feel that the environmental reputation of this carbon offset product is generally reliable							
I feel that the environmental performance of carbon offset products is generally dependable							
I feel that the environmental claims made by							

carbon offset products are generally trustworthy							
The environmental concerns of carbon offset products meet my pro-environmental expectations							
The carbon offset product upholds its promise to environmental protection							

Section 4: Socio-demographic Information

4.1 Could you please indicate your gender?

- Male
- Female
- Other

4.2 What is your age range?

- 18 to 29 years
- 30 to 39 years
- 40 to 49 years

- 50 to 59 years
- 60 years or older

4.3 Could you please indicate your marital status?

- Single
- Married with child(ren)
- Married with no child
- Separated
- Others

4.4 Could you please indicate your highest educational attainment?

- No formal education
- Primary school
- Secondary education (middle and high school)
- Further education (higher diploma or associate degree)
- Bachelor's degree
- Master's degree
- Doctoral degree

4.5 Could you please indicate your current occupation?

- Student
- Frontline employee
- Junior manager/executive (private or public sectors)

- Senior manager/executive (private or public sectors)
- Educator/Researcher
- Professional (e.g., doctor, lawyer, writer, journalist)
- Self-employed (including housewife/husband)
- Unemployed
- Retired

4.6 Could you please indicate your annual individual income?

- ¥36,000 or below
- ¥36,001-144,000
- ¥144,001-300,000
- ¥300,001-420,000
- ¥ 420,001-660,000
- ¥ 660,001-960,000
- ¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 2. “Are Tourists Willing to Pay for Travel Carbon Offset?”—Questionnaire (Block 2)

“Willingness to pay for travel carbon offset products” Questionnaire.

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Leisure Travel and Carbon Offset Information

1.1 If the COVID restrictions are fully relaxed, would you like to travel abroad for leisure in the near future?

Yes

No

Based on your international leisure travel experiences over the last 5 years, please answer questions 1.2-1.10.

1.2 How many times have you traveled abroad in the last 5 years for leisure purposes?

_____ times

1.3 How long did you stay in your last overseas travel destination?

- Up to 3 days
- Between 4 and 6 days
- Between 7 and 9 days
- Between 10 and 12 days
- Between 13 and 15 days
- Between 16 and 18 days
- Between 19 and 21 days
- Longer than 21 days

1.4 Who did you travel with during your last overseas trip? (choice one)

- Spouse
- Child(ren)
- Other relatives
- Friends
- Alone
- Others

1.5 How many people did you travel with in your last overseas travel?

_____persons (excluding yourself)

1.6 How long was the total flight time for your last overseas trip?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

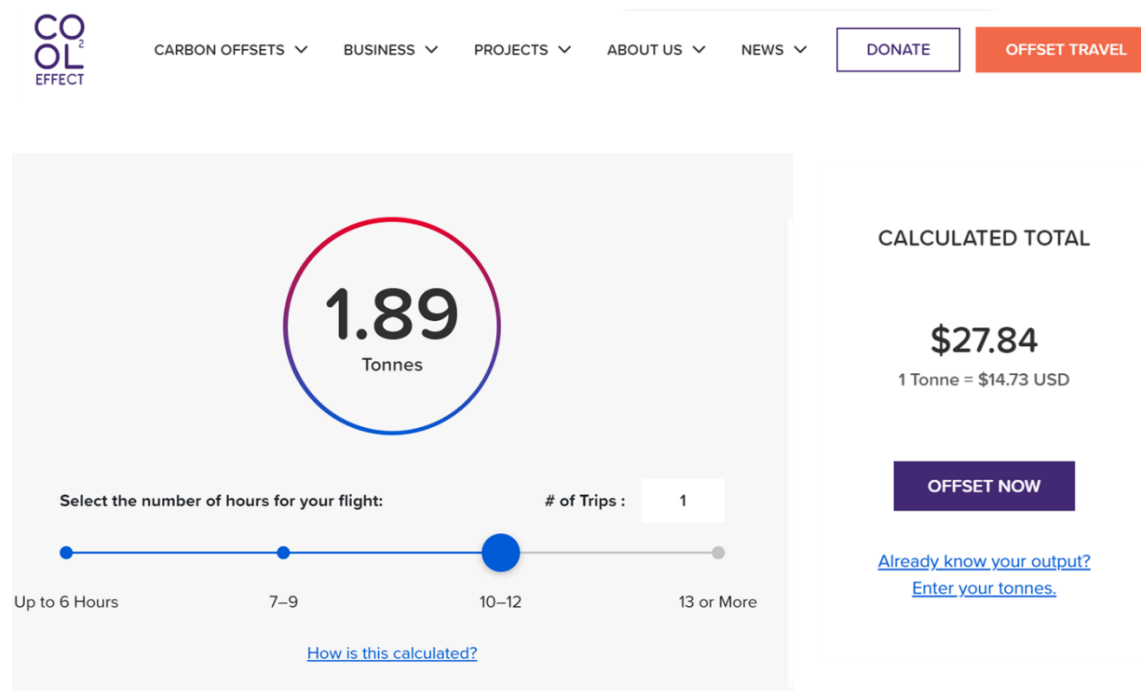
1.7 On average, how much did you spend on your last overseas trip, including travel and other expenses at the destination?

- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000
- ¥30,001–35,000
- ¥35,001–40,000
- ¥40,001–45,000
- ¥45,001–50,000
- ¥50,001 and above

1.8 Some organizations/companies provide carbon offset options for tourists to reduce their carbon emissions. For example, “My Climate” provides individuals with a carbon offset service (see the following figure). Have you paid for such carbon offsets during your previous travels?

No

Yes



1.9 Why did you pay for the carbon offsets?

A cheap and easy thing to do

Influenced by friends/ relatives/ colleagues

Aware of the information provided

Trust in the companies/organizations/ offset projects

For a good sense of responsibility

Other, _____

1.10 Why did you not pay for the carbon offsets?

- Influenced by friends/relatives/colleagues
- Saving budget
- Carbon offset option is unavailable
- Do not trust companies/organizations and offset projects
- Other, _____

Section 2: Stated Choice Experiment

Imagine you are planning a *[response to question 1.3]* days leisure trip with *[response to question 1.5]* people to an overseas destination.

You have booked your flights and rooms through an online travel agency. Now, you find there is a “low-carbon travel” collection on the website. It estimates your carbon emissions for this trip is about *[based on response to questions 1.6 and 1.3]* KG. This section offers you two carbon offset products designed to neutralize your travel emissions. If you choose to offset, your emissions will be removed from the atmosphere through verified carbon offset projects, and you will receive both a certificate and a donation receipt.

There are eight choice sets in the experiment, and each choice set includes two alternative carbon offset options (A and B). These options differ only in the attributes listed in the table below; all other attributes remain the same. Additionally, each set includes an opt-out option (Option C), which means you choose not to offset your emissions.

Table 1. Attributes and levels of carbon offset options

Attribute	Description	Levels
-----------	-------------	--------

CO2 offsetting contribution	You have the option to offset either 50% or the full 100% of the carbon emissions generated by your travel.	0% (0 kg) 50% (440kg) [response to question 1.3 and 1.6] 100% (880kg) [response to questions 1.3 and 1.6]
Project location	Where is the project implemented?	Domestic; Overseas destination; Other developing countries
Project types	How are the CO ₂ emissions compensated? Through reforestation and conservation projects, carbon is absorbed by newly planted trees or retained by preserving existing forests, preventing emissions; Renewable energy projects help to build solar, wind, or hydro sites; Community projects introduce energy-efficient technologies or practices in underdeveloped areas, helping reduce emissions at the source; Waste-to-energy projects capture carbon and convert it into electricity.	Reforestation and conservation; Renewable energy; Community project; Waste to energy
Offset product providers	Where do you buy it? You can choose to buy this carbon offset product from middlemen, including airlines, hotels, and online travel agencies, or directly buy it from companies/organizations implementing carbon offset projects.	Airline as the middleman; Hotel as the middleman; Online travel agency as the middleman; Directly provided by a carbon offset company/organization
Contribution from product providers	The product provider increases the amount of CO ₂ offset by 0, 50%, 100%	0 (0kg) 50% (440kg) [response to questions 1.3 and 1.6] 100% (880kg) [response to questions 1.3 and 1.6]
Payment time	When do you pay for the carbon offsets?	Before departure; On-site; After travel
Carbon offset price	What's the price you need to pay to offset 100kg of carbon emissions?	¥5/100KG ¥20/100KG ¥35/100KG ¥50/100KG

2.1 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.1			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Other developing countries	/
Project types	Renewable energy	Waste to energy	/
Offset product providers	Directly provided by a carbon offset company/organization	Online Travel agency as the middleman	/
Contribution from product providers	50%	0%	/
Payment time	Before departure	On-site	/
Carbon offset price	¥35/100kg	¥20/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.2 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.2			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Domestic	/
Project types	Waste to energy	Renewable energy	/
Offset product providers	Hotel as the middleman	Directly provided by a carbon offset company/organization	/
Contribution from product providers	50%	0%	/
Payment time	After travel	On-site	/
Carbon offset price	¥50/100kg	¥5/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.3 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.3			
	Option A	Option B	Option C

CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Domestic	Overseas destination	/
Project types	Reforestation and conservation	Waste to energy	/
Offset product providers	Directly provided by a carbon offset company/organization	Hotel as the middleman	/
Contribution from product providers	0%	100%	/
Payment time	Before departure	On-site	/
Carbon offset price	¥20/100kg	¥50/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.4 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.4			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Other developing countries	Domestic	/
Project types	Renewable energy	Community project	/
Offset product providers	Airline as the middleman	Online Travel agency as the middleman	/
Contribution from product providers	0%	100%	/
Payment time	On-site	After travel	/
Carbon offset price	¥20/100kg	¥35/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.5			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0%

			of your carbon emissions
Project location	Overseas destination	Other developing countries	/
Project types	Waste to energy	Community project	/
Offset product providers	Online travel agency as the middleman	Airline as the middleman	/
Contribution from product providers	0%	50%	/
Payment time	Before departure	After travel	/
Carbon offset price	¥20/100kg	¥20/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.6 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.6			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 50% of travel carbon emissions	Offsetting 100% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Domestic	Other developing countries	/
Project types	Community project	Reforestation and conservation	/
Offset product providers	Airline as the middleman	Hotel as the middleman	/
Contribution from product providers	100%	50%	/
Payment time	On-site	Before departure	/
Carbon offset price	¥50/100kg	¥5/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.7			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions

Project location	Other developing countries	Domestic	/
Project types	Community project	Reforestation and conservation	/
Offset product providers	Directly provided by a carbon offset company/organization	Airline as the middleman	/
Contribution from product providers	50%	0%	/
Payment time	On-site	Before departure	/
Carbon offset price	¥35/100kg	¥35/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

Choice Set 2.8			
	Option A	Option B	Option C
CO2 offsetting contribution	Offsetting 100% of travel carbon emissions	Offsetting 50% of your travel carbon emissions	Offsetting 0% of your carbon emissions
Project location	Overseas destination	Domestic	/
Project types	Reforestation and conservation	Waste to energy	/
Offset product providers	Airline as the middleman	Directly provided by a carbon offset company/organization	/
Contribution from product providers	100%	50%	/
Payment time	After travel	Before departure	/
Carbon offset price	¥5/100kg	¥50/100kg	/
Which option would you choose?	<input type="checkbox"/> A	<input type="checkbox"/> B	<input type="checkbox"/> C

2.9 How much will you pay to offset 400kg of your travel carbon emissions if the carbon offset price you choose is ¥5/100kg?

¥0

¥10

¥20

¥40

2.10 Could you please indicate to what extent you agree that the above scenario is realistic?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.11 Do you think this carbon offset product would be a fair product?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.12 Do you agree this product would help tourists offset the environmental consequences of carbon emissions from international travel?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

Section 3: Perception and attitude

3.1 Please indicate the degree to which you agree with the statement below.

(Green trust towards carbon offset)							
Statement	1. Completely disagree	2. Mostly disagree	3. Slightly disagree	4. Neutral / No opinion	5. Slightly agree	6. Mostly agree	7. Completely agree
I feel that the environmental reputation of this carbon offset product is generally reliable							
I feel that the environmental performance of carbon offset products is generally dependable							

I feel that the environmental claims made by carbon offset products are generally trustworthy							
The environmental concerns of carbon offset products meet my pro-environmental expectations							
The carbon offset product upholds its promise to environmental protection							

Section 4: Socio-demographic Information

4.1 Could you please indicate your gender?

- Male
- Female
- Other

4.2 What is your age range?

- 18 to 29 years
- 30 to 39 years

- 40 to 49 years
- 50 to 59 years
- 60 years or older

4.3 Could you please indicate your marital status?

- Single
- Married with child(ren)
- Married with no child
- Separated
- Others

4.4 Could you please indicate your highest educational attainment?

- No formal education
- Primary school
- Secondary education (middle and high school)
- Further education (higher diploma or associate degree)
- Bachelor's degree
- Master's degree
- Doctoral degree

4.5 Could you please indicate your current occupation?

- Student
- Frontline employee

- Junior manager/executive (private or public sectors)
- Senior manager/executive (private or public sectors)
- Educator/Researcher
- Professional (e.g., doctor, lawyer, writer, journalist)
- Self-employed (including housewife/husband)
- Unemployed
- Retired

4.6 Could you please indicate your annual individual income?

- ¥36,000 or below
- ¥36,001-144,000
- ¥144,001-300,000
- ¥300,001-420,000
- ¥ 420,001-660,000
- ¥ 660,001-960,000
- ¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 3. “Stated vs. Revealed Preferences for Travel Carbon Offset”—Questionnaire for Offsetters (Block 1)

“Preferences for flying carbon offset products” Questionnaire

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

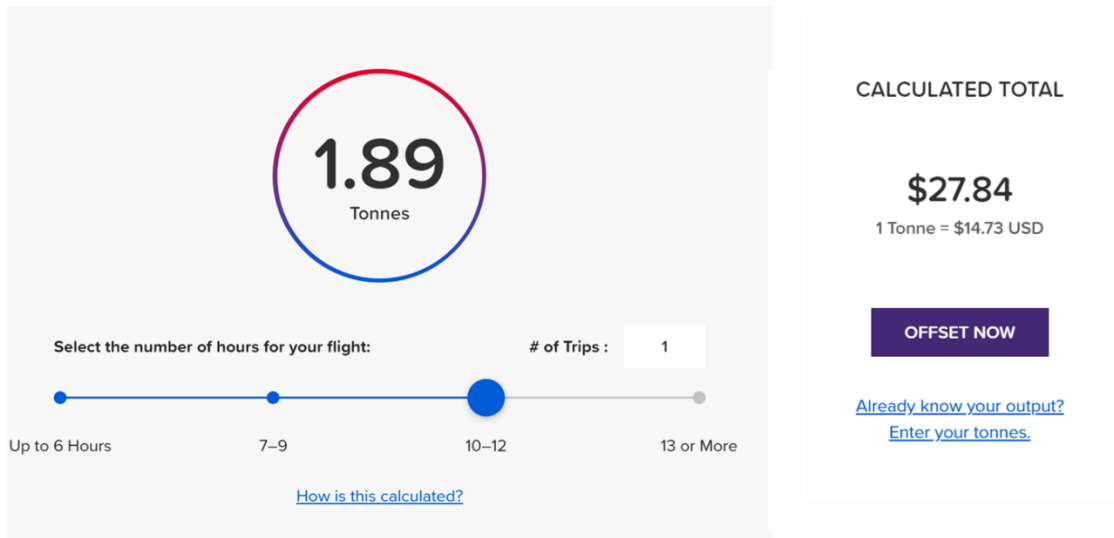
Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Travel Carbon Offset Information

1.1 In the past three years, how many times have you taken an international trip?

_____ times

Some airlines offer consumers the opportunity to purchase carbon offset products, as shown in the image below:



1.2 In your past international flight bookings, how often did you include a carbon offset product? [Dropdown]

1.3 When was the last time you purchased a flight carbon offset product?

Based on your most recent experience of purchasing a carbon offset product when booking an international flight, please answer the following questions.

1.4 Where was the departure city for your last international flight when you purchased a carbon offset product?

1.5 Where was the destination city for your last international flight when you purchased a carbon offset product?

1.6 What was the total flight duration (one-way) for your last international trip when you purchased a carbon offset product?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

1.7 On which platform did you purchase the carbon offset product for your last flight?

- Official carbon offset company website
- Official airline website
- Online travel agency website
- Other: _____
- I don't know because _____

1.8 What type of carbon offset product did you purchase for your last flight?

- Offset per trip (one-way)
- Offset per trip (round trip)
- One-time donation (based on carbon offset amount)
- One-time donation (based on amount)
- Other: _____

1.9 What is the carbon offset amount (in tonnes) of the product you purchased for your last flight?

1.10 How much more did you pay for the carbon offset product for your last flight?

1.11 Which projects were funded by the carbon offset product you purchased for your last flight?

- Reforestation and conservation projects
- Renewable energy projects
- Community projects
- Other

I don't know because _____

1.12 Where were the projects developed for your carbon offset product?

Domestic

Destination country/region

Other country/region

Other: _____

I don't know because _____

1.13 What certification standard did your carbon offset product adhere to?

American Carbon Registry (ACR)

Climate Action Reserve (CAR)

Gold Standard (GS)

Verified Carbon Standard (VCS)

California Air Resources Board (ARB)

China Certified Emission Reduction (CCER)

Other certification: _____

No certification

I don't know because _____

1.14 Did you purchase carbon offset products for any of the following individuals?

Yes, for spouse

Yes, for children

- Yes, for parents
- Yes, for other family members
- Yes, for friends
- Yes, for others
- No

1.15 Besides the carbon offset amount, payment price, project type, project location, and certification standard, what other factors influence your choice of carbon offset product? _____

1.16 Why did you purchase carbon offset products?

- A cheap and easy thing to do
- Influenced by friends/ relatives/ colleagues
- Aware of the information provided
- Trust in the companies/organizations/ offset projects
- For a good sense of responsibility
- Other, _____

1.17 How long did you stay at your destination during your most recent international trip?

- 1-3 days
- 4-6 days
- 7-9 days
- 10-12 days

- 13-15 days
- 16-18 days
- 19-21 days
- more than 21 days

1.18 What was the total per-person expenditure during your most recent international trip (including meals, accommodation, transportation, sightseeing, and shopping)?

- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000
- ¥30,001–35,000
- ¥35,001–40,000
- ¥40,001–45,000
- ¥45,001–50,000
- ¥50,001 and above

Section 2: Stated Choice Experiment

2.1 Imagine you are booking a flight for a leisure trip to an international destination.

You have booked a [response to question 1.6] hour flight (one-way flight duration).

After purchasing your flight ticket on the airline’s website, you come across a

“carbon offset” button. Would you click it?

No

Yes

2.2 Now, you see a carbon emission calculator. Would you calculate the carbon emissions of your flight?

No

Yes

2.3 Your carbon emission for this flight is approximately [response to question 6]

2.4 Would you be willing to pay for carbon offsetting

No

Yes

We now offer two travel carbon offset options. By choosing to offset your carbon emissions, you will contribute to reducing them through a certified carbon offset project.

There are eight choice sets below, each with two carbon offset products: Offset per trip (A) and one-time offset (B). The two product alternatives differed only in the attributes shown in the table below, with all other attributes identical. An opt-out alternative (C) was included to allow you to choose not to offset any emissions.

		Offset by per trip (Option A)	One-off Offset (Option B)
--	--	--	--------------------------------------

		With the per-trip offset option, travelers have the choice to offset the carbon emissions generated by each individual flight they take. The offset amount is calculated based on the flying duration and the associated carbon footprint.	The one-off offset option involves offsetting a fixed amount of carbon emissions as a one-time contribution. Travelers have the option to offset a predetermined quantity of emissions without the need to calculate emissions for each trip.
Attributes	Description	Attribute levels	
CO2 offsetting contribution	You could choose to offset the carbon emissions of your one-way or round-trip.	<i>[response to question 1.6]</i> (one-way trip); 2* <i>[response to question 1.6]</i> (round trip)	
CO2 offsetting contribution	You could choose to offset a specific amount of flying carbon emissions.		1 tonne; 2 tonnes; 3 tonnes; 4 tonnes
Project types	How are the CO ₂ emissions compensated? Afforestation and conservation projects: Planting new trees or preserving old ones to capture carbon. Renewable energy projects: wind power, photovoltaic, waste incineration, and other renewable energy initiatives. Community projects: Introducing energy-saving methods or technologies in underdeveloped communities.	Afforestation and conservation projects; Renewable energy projects; Community projects	
Project location	Where is the project implemented?	China; Overseas destination; Other developing countries	
Certification	Does the offset project have certifications under a recognized standard?	Yes; No	
Carbon offset price	What's the price you need to pay to offset?	¥20/tonne[<i>show real price=price level* CO₂ offsetting contribution</i>] ¥60/tonne ¥100/tonne ¥140/tonne	

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6]</i> (one-way trip)	2tone	/
Project type	Overseas destination	China	
Project location	Afforestation and conservation projects	Community projects	/
Certification	yes	no	/
Carbon offset price	¥60/tonne/show real price=price level* CO ₂ offsetting contribution]	¥20/tonne/show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.6 According to your choice, you will offset ___tone emissions?

[response to question 1.6]

2

1

2**[response to question 1.6]*

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* <i>[response to question 1.6]</i> (round trip)	2tone	/
Project type	China	Other developing countries	

Project location	Community projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥140/tonne[show real price=price level* CO ₂ offsetting contribution]	¥60/tonne[show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[response to question 1.6] (round trip)	1tone	/
Project type	Other developing countries	Overseas destination	
Project location	Afforestation and conservation projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥140/tonne [show real price=price level* CO ₂ offsetting contribution]	¥140 /tonne [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.9 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[response to question 1.6] (one-way trip)	3tone	/
Project type	Overseas destination	China	
Project location	Afforestation and	Renewable energy projects	/

	conservation projects		
Certification	yes	no	/
Carbon offset price	¥20/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.10 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[<i>response to question 1.6</i>] (one-way trip)	1tonne	/
Project type	Other developing countries	Overseas destination	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥140/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.11 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[<i>response to question 1.6</i>] (one-way trip)	4tonne	/
Project type	China	Other developing countries	

Project location	Community projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥60/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥60/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.12 Please choose one option that you prefer from the choice set. [*8 choice cards for each respondent*].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [<i>response to question 1.6</i>] (round trip)	4tone	/
Project type	China	Other developing countries	
Project location	Renewable energy projects	Community projects	/
Certification	no	yes	/
Carbon offset price	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥60/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.13 Please choose one option that you prefer from the choice set. [*8 choice cards for each respondent*].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [<i>response to question 1.6</i>] (round trip)	3tone	/
Project type	Other developing countries	China	

Project location	Community projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥20/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.14 Could you please indicate to what extent you agree that the above scenario is realistic?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

2.15 Do you think this carbon offset product would be unfair?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.16 Do you agree or disagree that this product would help tourists offset the environmental consequences of carbon emissions from flying?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

Section 3: Socio-demographic Information

3.1 Could you please indicate your gender?

Male

Female

Other

3.2 What is your age range?

18 to 29 years

30 to 39 years

40 to 49 years

- 50 to 59 years
- 60 years or older

3.3 Could you please indicate your marital status?

- Single
- Married with child(ren)
- Married with no child
- Separated
- Others

3.4 Could you please indicate your highest educational attainment?

- No formal education
- Primary school
- Secondary education (middle and high school)
- Further education (higher diploma or associate degree)
- Bachelor's degree
- Master's degree
- Doctoral degree

3.5 Could you please indicate your current occupation?

- Student
- Frontline employee
- Junior manager/executive (private or public sectors)

- Senior manager/executive (private or public sectors)
- Educator/Researcher
- Professional (e.g., doctor, lawyer, writer, journalist)
- Self-employed (including housewife/husband)
- Unemployed
- Retired

3.6 Could you please indicate your annual individual income?

- ¥36,000 or below
- ¥36,001-144,000
- ¥144,001-300,000
- ¥300,001-420,000
- ¥ 420,001-660,000
- ¥ 660,001-960,000
- ¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 4. “Stated vs. Revealed Preferences for Travel Carbon Offset”—Questionnaire for Offsetters (Block 2)

“Preferences for flying carbon offset products” Questionnaire

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

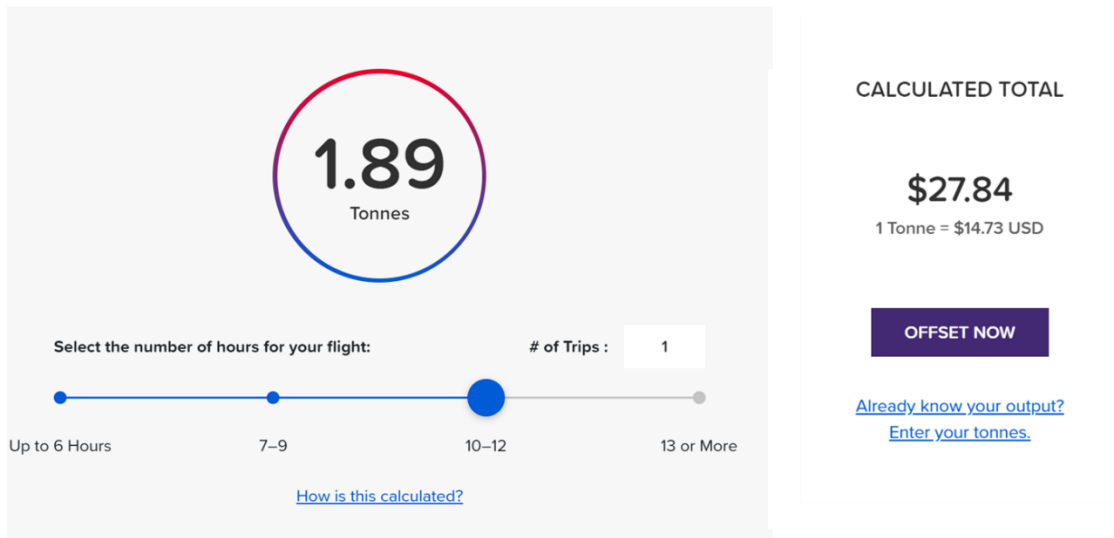
Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Travel Carbon Offset Information

1.1 In the past 3 years, how many times have you taken an international trip?

_____ times

Some airlines offer consumers the opportunity to purchase carbon offset products, as shown in the image below:



1.2 In your past international flight bookings, how often did you include a carbon offset product? [Dropdown]

1.3 When was the last time you purchased a flight carbon offset product?

Based on your most recent experience of purchasing a carbon offset product when booking an international flight, please answer the following questions.

1.4 Where was the departure city for your last international flight when you purchased a carbon offset product?

1.5 Where was the destination city for your last international flight when you purchased a carbon offset product?

1.6 What was the total flight duration (one-way) for your last international trip when you purchased a carbon offset product?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

1.7 On which platform did you purchase the carbon offset product for your last flight?

- Official carbon offset company website
- Official airline website
- Online travel agency website
- Other: _____
- I don't know because _____

1.8 What type of carbon offset product did you purchase for your last flight?

- Offset per trip (one-way)
- Offset per trip (round trip)
- One-time donation (based on carbon offset amount)
- One-time donation (based on amount)
- Other: _____

1.9 What is the carbon offset amount (in tonnes) of the product you purchased for your last flight?

1.10 How much more did you pay for the carbon offset product for your last flight?

1.11 Which projects were funded by the carbon offset product you purchased for your last flight?

- Reforestation and conservation projects
- Renewable energy projects
- Community projects
- Other

I don't know because _____

1.12 Where were the projects developed for your carbon offset product?

Domestic

Destination country/region

Other country/region

Other: _____

I don't know because _____

1.13 What certification standard did your carbon offset product adhere to?

American Carbon Registry (ACR)

Climate Action Reserve (CAR)

Gold Standard (GS)

Verified Carbon Standard (VCS)

California Air Resources Board (ARB)

China Certified Emission Reduction (CCER)

Other certification: _____

No certification

I don't know because _____

1.14 Did you purchase carbon offset products for any of the following individuals?

Yes, for spouses

Yes, for children

- Yes, for parents
- Yes, for other family members
- Yes, for friends
- Yes, for others
- No

1.15 Besides the carbon offset amount, payment price, project type, project location, and certification standard, what other factors influence your choice of carbon offset product? _____

1.16 Why did you purchase carbon offset products?

- A cheap and easy thing to do
- Influenced by friends/ relatives/ colleagues
- Aware of the information provided
- Trust in the companies/organizations/ offset projects
- For a good sense of responsibility
- Other, _____

1.17 How long did you stay at your destination during your most recent international trip?

- 1-3 days
- 4-6 days
- 7-9 days
- 10-12 days

- 13-15 days
- 16-18 days
- 19-21 days
- more than 21 days

1.18 What was the total per-person expenditure during your most recent international trip (including meals, accommodation, transportation, sightseeing, and shopping)?

- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000
- ¥30,001–35,000
- ¥35,001–40,000
- ¥40,001–45,000
- ¥45,001–50,000
- ¥50,001 and above

Section 2: Stated Choice Experiment

2.1 Imagine you are booking a flight for a leisure trip to an international destination. You have booked a *[response to question 1.6]* hour flight (one-way flight duration). After purchasing your flight ticket on the airline’s website, you come across a “carbon offset” button. Would you click it?

No

Yes

2.2 Now, you see a carbon emission calculator. Would you calculate the carbon emissions of your flight?

No

Yes

2.3 Your carbon emission for this flight is approximately *[response to question 6]*

2.4 Would you be willing to pay for carbon offsetting?

No

Yes

We now offer two travel carbon offset options. By choosing to offset your carbon emissions, you will contribute to reducing them through a certified carbon offset project.

There are eight choice sets below, each with two carbon offset products: Offset per trip (A) and one-time offset (B). The two product alternatives differed only in the attributes shown in the table below, with all other attributes identical. An opt-out alternative (C) was included to allow you to choose not to offset any emissions.

		Offset by per trip (Option A)	One-off Offset (Option B)
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		With the per-trip offset option, travelers have the choice to offset the carbon emissions generated by each individual flight they take. The offset amount is calculated based on the flying duration and the associated carbon footprint.	The one-off offset option involves offsetting a fixed amount of carbon emissions as a one-time contribution. Travelers have the option to offset a predetermined quantity of emissions without the need to calculate emissions for each trip.
Attributes	Description	Attribute levels	
CO2 offsetting contribution	You could choose to offset the carbon emissions of your one-way or round-trip.	<i>[response to question 1.6]</i> (one-way trip); 2* <i>[response to question 1.6]</i> (round trip)	
CO2 offsetting contribution	You could choose to offset a specific amount of flying carbon emissions.		1 tonne; 2 tonnes; 3 tonnes; 4 tonnes
Project types	How are the CO ₂ emissions compensated? Afforestation and conservation projects: Planting new trees or preserving old ones to capture carbon. Renewable energy projects: wind power, photovoltaic, waste incineration, and other renewable energy initiatives. Community projects: Introducing energy-saving methods or technologies in underdeveloped communities.	Afforestation and conservation projects; Renewable energy projects; Community projects	
Project location	Where is the project implemented?	China; Overseas destination; Other developing countries	
Certification	Does the offset project have certifications under a recognized standard?	Yes; No	
Carbon offset price	What's the price you need to pay to offset?	¥20/tonne[<i>show real price=price level* CO₂ offsetting contribution</i>] ¥60/tonne ¥100/tonne ¥140/tonne	

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [response to question 1.6] (round trip)	1tone	/
Project type	Overseas destination	China	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥100/tone [show real price=price level* CO ₂ offsetting contribution]	¥20/tone [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.6 According to your choice, you will offset ___ tone emissions?

[response to question 1.6]

2

1

2* [response to question 1.6]

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [response to question 1.6] (round trip)	4tone	/

Project type	Other developing countries	China	
Project location	Community projects	Afforestation and conservation projects	/
Certification	no	yes	/
Carbon offset price	¥20/tonne [show real price=price level* CO ₂ offsetting contribution]	¥60/tonne [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO₂ offsetting contribution	[response to question 1.6] (one-way trip)	2000 千克	/
Project type	China	Other developing countries	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	no	yes	/
Carbon offset price	¥60/tonne [show real price=price level* CO ₂ offsetting contribution]	¥100/tonne [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.9 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
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CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	3tone	/
Project type	Other developing countries	Overseas destination	
Project location	Renewable energy projects	Community projects	/
Certification	no	yes	/
Carbon offset price	¥60/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥140/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.10 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	4tone	/
Project type	Other developing countries	Overseas destination	
Project location	Afforestation and conservation projects	Renewable energy projects	/
Certification	yes	no	/
Carbon offset price	¥140/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥20/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.11 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[<i>response to question 1.6</i>] (round trip)	2tone	/
Project type	China	Overseas destination	
Project location	Afforestation and conservation projects	Community projects	/
Certification	yes	no	/
Carbon offset price	¥100/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.12 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[<i>response to question 1.6</i>] (round trip)	3tone	/
Project type	Overseas destination	Other developing countries	
Project location	Afforestation and conservation projects	Community projects	/
Certification	yes	no	/
Carbon offset price	¥20/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥60/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.13 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	1 tone	/
Project type	Overseas destination	Other developing countries	
Project location	Community projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥100/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥140/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.14 Could you please indicate to what extent you agree that the above scenario is realistic?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

2.15 Do you think this carbon offset product would be unfair?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

2.16 Do you agree or disagree that this product would help tourists offset the environmental consequences of carbon emissions from flying?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree
- Completely agree

Section 3: Socio-demographic Information

3.1 Could you please indicate your gender?

- Male
- Female
- Other

3.2 What is your age range?

- 18 to 29 years
- 30 to 39 years
- 40 to 49 years
- 50 to 59 years
- 60 years or older

3.3 Could you please indicate your marital status?

- Single
- Married with child(ren)
- Married with no child
- Separated
- Others

3.4 Could you please indicate your highest educational attainment?

- No formal education
- Primary school
- Secondary education (middle and high school)
- Further education (higher diploma or associate degree)
- Bachelor's degree
- Master's degree
- Doctoral degree

3.5 Could you please indicate your current occupation?

- Student
- Frontline employee
- Junior manager/executive (private or public sectors)
- Senior manager/executive (private or public sectors)
- Educator/Researcher
- Professional (e.g., doctor, lawyer, writer, journalist)
- Self-employed (including housewife/husband)
- Unemployed
- Retired

3.6 Could you please indicate your annual individual income?

- ¥36,000 or below
- ¥36,001-144,000
- ¥144,001-300,000
- ¥300,001-420,000
- ¥ 420,001-660,000
- ¥ 660,001-960,000
- ¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 5. “Stated vs. Revealed Preferences for Travel Carbon Offset”—Questionnaire for Non-offsetters (Block 1)

“Preferences for flying carbon offset products” Questionnaire

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

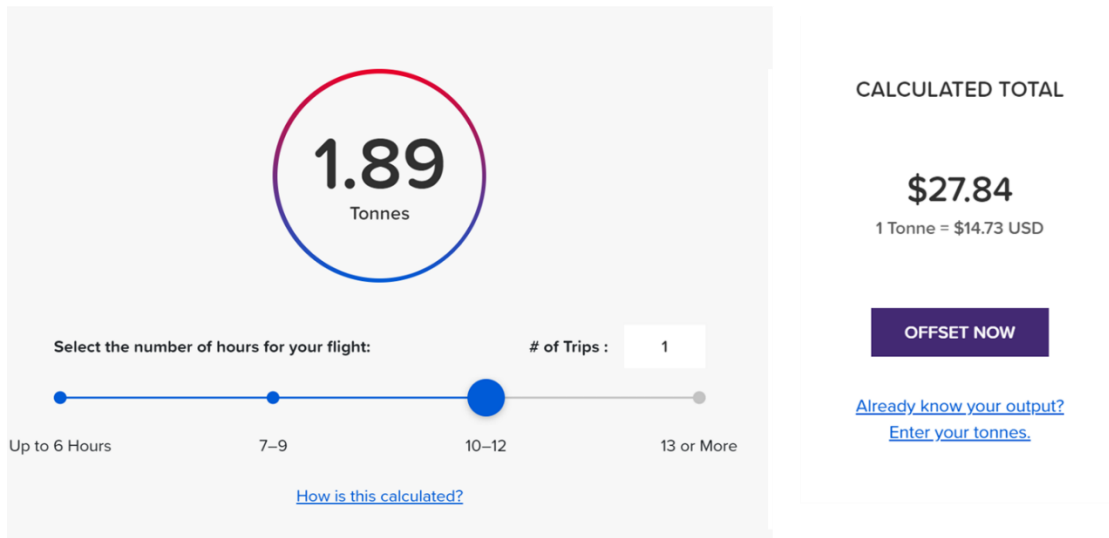
Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Travel Information

1.1 In the past 3 years, how many times have you taken an international trip?

_____ times

Some airlines offer consumers the opportunity to purchase carbon offset products, as shown in the image below:



1.2 In your past international flight bookings, how often did you include a carbon offset product? [Dropdown]

1.3 Why did you not pay for the carbon offsets?

- Influenced by friends/relatives/colleagues
- Saving budget
- Carbon offset option is unavailable
- Do not trust airlines/offset companies
- Do not trust offset projects
- Other, _____

Based on your international leisure travel experiences over the last 5 years, please answer the following questions.

1.4 Where was the departure city for your last international flight when you purchased a carbon offset product?

1.5 Where was the destination city for your last international flight when you purchased a carbon offset product?

1.6 What was the total flight duration (one-way) for your last international trip when you purchased a carbon offset product?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

1.7 How long did you stay at your destination during your most recent international trip?

- Up to 3 days
- Between 4 and 6 days
- Between 7 and 9 days
- Between 10 and 12 days
- Between 13 and 15 days
- Between 16 and 18 days
- Between 19 and 21 days
- Longer than 21 days

1.8 What was the total per-person expenditure during your most recent international trip (including meals, accommodation, transportation, sightseeing, and shopping)?

- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000

¥30,001–35,000

¥35,001–40,000

¥40,001–45,000

¥45,001–50,000

¥50,001 and above

Section 2: Stated Choice Experiment

2.1 Imagine you are booking a flight for a leisure trip to an international destination. You have booked a *[response to question 1.6]* hour flight (one-way flight duration). After purchasing your flight ticket on the airline’s website, you come across a “carbon offset” button. Would you click it?

No

Yes

2.2 Now, you see a carbon emission calculator. Would you calculate the carbon emissions of your flight?

No

Yes

2.3 Your carbon emission for this flight is approximately *[response to question 6]*

2.4 Would you be willing to pay for carbon offsetting

No

Yes

We now offer two travel carbon offset options. By choosing to offset your carbon emissions, you will contribute to reducing them through a certified carbon offset project.

There are eight choice sets below, each with two carbon offset products: Offset per trip (A) and one-time offset (B). The two product alternatives differed only in the attributes shown in the table below, with all other attributes identical. An opt-out alternative (C) was included to allow you to choose not to offset any emissions.

		Offset by per trip (Option A) With the per-trip offset option, travelers have the choice to offset the carbon emissions generated by each individual flight they take. The offset amount is calculated based on the flying duration and the associated carbon footprint.	One-off Offset (Option B) The one-off offset option involves offsetting a fixed amount of carbon emissions as a one-time contribution. Travelers have the option to offset a predetermined quantity of emissions without the need to calculate emissions for each trip.
Attributes	Description	Attribute levels	
CO2 offsetting contribution	You could choose to offset the carbon emissions of your one-way or round trip.	<i>[response to question 1.6]</i> (one-way trip); 2* <i>[response to question 1.6]</i> (round trip)	
CO2 offsetting contribution	You could choose to offset a specific amount of flying carbon emissions.		1 tonne; 2 tonnes; 3 tonnes; 4 tonnes
Project types	How are the CO ₂ emissions compensated? Afforestation and conservation projects: Planting new trees or preserving old ones to capture carbon. Renewable energy projects: wind power, photovoltaic, waste incineration, and other renewable energy initiatives. Community projects: Introducing energy-saving methods or	Afforestation and conservation projects; Renewable energy projects; Community projects	

	technologies in underdeveloped communities.	
Project location	Where is the project implemented?	China; Overseas destination; Other developing countries
Certification	Does the offset project have certifications under a recognized standard?	Yes; No
Carbon offset price	What's the price you need to pay to offset?	<u>¥20/tone</u> [<i>show real price=price level* CO₂ offsetting contribution</i>] <u>¥60/tone</u> <u>¥100/tone</u> <u>¥140/tone</u>

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[<i>response to question 1.6</i>] (one-way trip)	2tone	/
Project type	Overseas destination	China	
Project location	Afforestation and conservation projects	Community projects	/
Certification	yes	no	/
Carbon offset price	<u>¥60/tone</u> [<i>show real price=price level* CO₂ offsetting contribution</i>]	<u>¥20/tone</u> [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.6 According to your choice, you will offset ___ tone emissions?

[*response to question 1.6*]

2

1

□2*[response to question 1.6]

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[response to question 1.6] (round trip)	2tone	/
Project type	China	Other developing countries	
Project location	Community projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥140/tonne [show real price=price level* CO ₂ offsetting contribution]	¥60/tonne [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[response to question 1.6] (round trip)	1tone	/
Project type	Other developing countries	Overseas destination	
Project location	Afforestation and conservation projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥140/tonne [show real price=price level* CO ₂ offsetting contribution]	¥140 /tonne [show real price=price level* CO ₂ offsetting contribution]	/

Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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2.9 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	3tone	/
Project type	Overseas destination	China	
Project location	Afforestation and conservation projects	Renewable energy projects	/
Certification	yes	no	/
Carbon offset price	¥20/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥100/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.10 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	1tone	/
Project type	Other developing countries	Overseas destination	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥140/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥100/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	/

Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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2.11 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6]</i> (one-way trip)	4tone	/
Project type	China	Other developing countries	
Project location	Community projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥60/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥60/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.12 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* <i>[response to question 1.6]</i> (round trip)	4tone	/
Project type	China	Other developing countries	
Project location	Renewable energy projects	Community projects	/
Certification	no	yes	/
Carbon offset price	¥100/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥60/tone <i>[show real price=price level* CO₂ offsetting contribution]</i>	/

Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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2.13 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[<i>response to question 1.6</i>] (round trip)	3tone	/
Project type	Other developing countries	China	
Project location	Community projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	¥20/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.14 Could you please indicate to what extent you agree that the above scenario is realistic?

- Completely disagree
- Mostly disagree
- Slightly disagree
- Neutral / No opinion
- Slightly agree
- Mostly agree

Completely agree

2.15 Do you think this carbon offset product would be unfair?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.16 Do you agree or disagree that this product would help tourists offset the environmental consequences of carbon emissions from flying?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

Section 3: Socio-demographic Information

1.9 Could you please indicate your gender?

Male

Female

Other

1.10 What is your age range?

18 to 29 years

30 to 39 years

40 to 49 years

50 to 59 years

60 years or older

1.11 Could you please indicate your marital status?

Single

Married with child(ren)

Married with no child

Separated

Others

1.12 Could you please indicate your highest educational attainment?

No formal education

Primary school

Secondary education (middle and high school)

Further education (higher diploma or associate degree)

Bachelor's degree

Master's degree

Doctoral degree

1.13 Could you please indicate your current occupation?

Student

Frontline employee

Junior manager/executive (private or public sectors)

Senior manager/executive (private or public sectors)

Educator/Researcher

Professional (e.g., doctor, lawyer, writer, journalist)

Self-employed (including housewife/husband)

Unemployed

Retired

1.14 Could you please indicate your annual individual income?

¥36,000 or below

¥36,001-144,000

¥144,001-300,000

¥300,001-420,000

¥ 420,001-660,000

¥ 660,001-960,000

¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 6. “Stated vs. Revealed Preferences for Travel Carbon Offset”—Questionnaire for Non-offsetters (Block 2)

“Preferences for flying carbon offset products” Questionnaire

Dear respondent,

We are carrying out an academic study on tourists’ carbon offset choices. Your opinions are very important for this research. The questionnaire will take approximately 15–20 minutes to complete. Participation is anonymous, and all personal information will be treated with strict confidentiality. The contents of the questionnaire will be used for scientific research only. We sincerely appreciate your participation in this survey!

Hospitality and Tourism Research Center
School of Hotel and Tourism Management
The Hong Kong Polytechnic University

Section 1: Past Travel Information

1.1 In the past 3 years, how many times have you taken an international trip?

_____ times

Some airlines offer consumers the opportunity to purchase carbon offset products, as shown in the image below:

1.2 In your past international flight bookings, how often did you include a carbon offset product? [Dropdown]

1.3 Why did you not pay for the carbon offsets?

- Influenced by friends/relatives/colleagues
- Saving budget
- Carbon offset option is unavailable
- Do not trust airlines/offset companies
- Do not trust offset projects
- Other, _____

Based on your international leisure travel experiences over the last 5 years, please answer the following questions.

1.4 Where was the departure city for your last international flight when you purchased a carbon offset product?

1.5 Where was the destination city for your last international flight when you purchased a carbon offset product?

1.6 What was the total flight duration (one-way) for your last international trip when you purchased a carbon offset product?

- 6 hours or less
- Between 7 and 9 hours
- Between 10 and 12 hours
- 13 hours or longer

1.7 How long did you stay at your destination during your most recent international trip?

- Up to 3 days
- Between 4 and 6 days
- Between 7 and 9 days
- Between 10 and 12 days
- Between 13 and 15 days
- Between 16 and 18 days
- Between 19 and 21 days
- Longer than 21 days

1.8 What was the total per-person expenditure during your most recent international trip (including meals, accommodation, transportation, sightseeing, and shopping)?

- ¥5,000 and below
- ¥5,001–10,000
- ¥10,001–15,000
- ¥15,001–20,000
- ¥20,001–25,000
- ¥25,001–30,000

¥30,001–35,000

¥35,001–40,000

¥40,001–45,000

¥45,001–50,000

¥50,001 and above

Section 2: Stated Choice Experiment

2.1 Imagine you are booking a flight for a leisure trip to an international destination. You have booked a *[response to question 1.6]* hour flight (one-way flight duration). After purchasing your flight ticket on the airline’s website, you come across a “carbon offset” button. Would you click it?

No

Yes

2.2 Now, you see a carbon emission calculator. Would you calculate the carbon emissions of your flight?

No

Yes

2.3 Your carbon emission for this flight is approximately *[response to question 1.6]*

2.4 Would you be willing to pay for carbon offsetting?

No

Yes

We now offer two travel carbon offset options. By choosing to offset your carbon emissions, you will contribute to reducing them through a certified carbon offset project.

There are eight choice sets below, each with two carbon offset products: Offset per trip (A) and one-time offset (B). The two product alternatives differed only in the attributes shown in the table below, with all other attributes identical. An opt-out alternative (C) was included to allow you to choose not to offset any emissions.

		Offset by per trip (Option A) With the per-trip offset option, travelers have the choice to offset the carbon emissions generated by each individual flight they take. The offset amount is calculated based on the flying duration and the associated carbon footprint.	One-off Offset (Option B) The one-off offset option involves offsetting a fixed amount of carbon emissions as a one-time contribution. Travelers have the option to offset a predetermined quantity of emissions without the need to calculate emissions for each trip.
Attributes	Description	Attribute levels	
CO2 offsetting contribution	You could choose to offset the carbon emissions of your one-way or round-trip.	<i>[response to question 1.6]</i> (one-way trip); 2* <i>[response to question 1.6]</i> (round trip)	
CO2 offsetting contribution	You could choose to offset a specific amount of flying carbon emissions.		1 tonne; 2 tonnes; 3 tonnes; 4 tonnes
Project types	How are the CO ₂ emissions compensated? Afforestation and conservation projects: Planting new trees or preserving old ones to capture carbon. Renewable energy projects: wind power, photovoltaic, waste incineration, and other renewable energy initiatives. Community projects: Introducing energy-saving methods or	Afforestation and conservation projects; Renewable energy projects; Community projects	

	technologies in underdeveloped communities.	
Project location	Where is the project implemented?	China; Overseas destination; Other developing countries
Certification	Does the offset project have certifications under a recognized standard?	Yes; No
Carbon offset price	What's the price you need to pay to offset?	<u>¥20/ton</u> [show real price=price level* CO ₂ offsetting contribution] <u>¥60/ton</u> <u>¥100/ton</u> <u>¥140/ton</u>

2.5 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[response to question 1.6] (round trip)	1 tone	/
Project type	Overseas destination	China	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	yes	no	/
Carbon offset price	<u>¥100/ton</u> [show real price=price level* CO ₂ offsetting contribution]	<u>¥20/ton</u> [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.6 According to your choice, you will offset ___ tone emissions?

[response to question 1.6]

2

1

□2*[*response to question 1.6*]

2.7 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2*[<i>response to question 1.6</i>] (round trip)	4tone	/
Project type	Other developing countries	China	
Project location	Community projects	Afforestation and conservation projects	/
Certification	no	yes	/
Carbon offset price	¥20/tone [show real price=price level* CO ₂ offsetting contribution]	¥60/tone [show real price=price level* CO ₂ offsetting contribution]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.8 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[<i>response to question 1.6</i>] (one-way trip)	2000 千克	/
Project type	China	Other developing countries	
Project location	Renewable energy projects	Afforestation and conservation projects	/
Certification	no	yes	/
Carbon offset price	¥60/tone [show real price=price level* CO ₂ offsetting contribution]	¥100/tone [show real price=price level* CO ₂ offsetting contribution]	/

	<i>offsetting contribution]</i>	<i>offsetting contribution]</i>	
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.9 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	3tone	/
Project type	Other developing countries	Overseas destination	
Project location	Renewable energy projects	Community projects	/
Certification	no	yes	/
Carbon offset price	¥60/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	¥140/tonne <i>[show real price=price level* CO₂ offsetting contribution]</i>	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.10 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	<i>[response to question 1.6] (one-way trip)</i>	4tone	/
Project type	Other developing countries	Overseas destination	
Project location	Afforestation and conservation projects	Renewable energy projects	/
Certification	yes	no	/

Carbon offset price	¥140/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥20/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.11 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [<i>response to question 1.6</i>] (round trip)	2tonne	/
Project type	China	Overseas destination	
Project location	Afforestation and conservation projects	Community projects	/
Certification	yes	no	/
Carbon offset price	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥100/tonne [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.12 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	2* [<i>response to question 1.6</i>] (round trip)	3tonne	/
Project type	Overseas destination	Other developing countries	
Project location	Afforestation and	Community projects	/

	conservation projects		
Certification	yes	no	/
Carbon offset price	¥20/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥60/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.13 Please choose one option that you prefer from the choice set. [8 choice cards for each respondent].

	Offset by per trip	One-time offset	None of them
CO2 offsetting contribution	[<i>response to question 1.6</i>] (one-way trip)	1 tone	/
Project type	Overseas destination	Other developing countries	
Project location	Community projects	Renewable energy projects	/
Certification	no	yes	/
Carbon offset price	¥100/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	¥140/tone [<i>show real price=price level* CO₂ offsetting contribution</i>]	/
Which option would you choose?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2.14 Could you please indicate to what extent you agree with the above scenario being realistic?

- Completely disagree
- Mostly disagree
- Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.15 Do you think this carbon offset product would be an unfair or a fair product?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

2.16 Do you agree or disagree that this product would help tourists offset the environmental consequences of carbon emissions from flying?

Completely disagree

Mostly disagree

Slightly disagree

Neutral / No opinion

Slightly agree

Mostly agree

Completely agree

Section 3: Socio-demographic Information

3.1 Could you please indicate your gender?

- Male
- Female
- Other

3.2 What is your age range?

- 18 to 29 years
- 30 to 39 years
- 40 to 49 years
- 50 to 59 years
- 60 years or older

3.3 Could you please indicate your marital status?

- Single
- Married with child(ren)
- Married with no child
- Separated
- Others

3.4 Could you please indicate your highest educational attainment?

- No formal education
- Primary school
- Secondary education (middle and high school)

- Further education (higher diploma or associate degree)
- Bachelor's degree
- Master's degree
- Doctoral degree

3.5 Could you please indicate your current occupation?

- Student
- Frontline employee
- Junior manager/executive (private or public sectors)
- Senior manager/executive (private or public sectors)
- Educator/Researcher
- Professional (e.g., doctor, lawyer, writer, journalist)
- Self-employed (including housewife/husband)
- Unemployed
- Retired

3.6 Could you please indicate your annual individual income?

- ¥36,000 or below
- ¥36,001-144,000
- ¥144,001-300,000
- ¥300,001-420,000
- ¥ 420,001-660,000

¥ 660,001-960,000

¥ 960,001 and above

This concludes the survey. Thank you for your valuable participation.

Appendix 7. “Opening the Box: Process Behind Economic Preferences for Carbon Offset”—

Interview Protocol for Offsetters

1. Have you purchased carbon offset products to offset your travel emissions?
2. How did you book your flight, accommodation, and purchase carbon offsets?
3. How familiar are you with carbon offset products?
4. Can you explain what carbon offsetting means to you? [Brief explanation]
5. How did you first learn about carbon offset products?
6. What do you think are the main sources of carbon emissions in the travel industry?
[Brief Introduction of Carbon Offsetting]
7. What motivates you to participate in carbon offset activities? (Why do you purchase offsets? What is your purpose, and how important is it?)
8. What factors would encourage you to participate in carbon offsetting during travel?
9. Do you feel a sense of responsibility to offset your travel emissions? Why?
10. How effective do you think carbon offset programs are in mitigating climate change?
11. When choosing carbon offset products, which attributes or features are most important to you?
12. How satisfied are you with the overall experience of offsetting your carbon footprint?
13. Do you have any other thoughts you’d like to share regarding carbon offsetting?
14. How do you think travelers’ awareness and understanding of carbon offsetting can be improved?

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