A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE HOSPITALITY SECTOR

Enhancing sustainable practices

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06/06/2024

Abstract

This work project examines the transformative impact of Artificial Intelligence (AI) on the hospitality sector, focusing on enhancing sustainable practices, innovating efficient practices for hosts, and leveraging chatbots to improve guest experiences. Through a comprehensive review of current literature and advanced applications, it explores how AI technologies can optimize operations, personalize services, and promote sustainability. The study highlights the integration of AI with existing business processes to maximize benefits and addresses the ethical implications of automated systems. This research underscores AI's potential to revolutionize the hospitality industry, offering insights for stakeholders and suggesting directions for future innovation.

Abstract - Enhancing sustainable practices (Filippo Fuscagni)

This section of the project part investigates guests' perspectives of AI's role in promoting sustainability in hospitality. Our research looks at how visitors perceive sustainable technologies and how AI influences their decisions. The findings indicate a preference for high-impact technology such as solar panels, emphasizing the necessity for individualized methods. Furthermore, AI interventions have potential for altering long-term behaviour’s, particularly when combined with economic incentives. This integrated strategy not only improves guest experiences but also promotes sustainable practices, resulting in significant sustainability improvements in the hospitality industry.

Keywords: Artificial intelligence, hospitality, guest, host, sustainability, chatbot, forecasting, efficiency, digital transformation, new product development, technological innovation, technology adoption, technology strategy, short-term rental

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

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1. Introduction (Group part)

The hospitality industry is widely acknowledged for its substantial contributions to global economic growth. This sector is dedicated to delivering memorable experiences and providing impeccable service to guests, continually adapting to changing consumer expectations, technological advancements, and increasing sustainability concerns. One of the most transformative forces reshaping the industry is the integration of Artificial Intelligence (AI), which continues to redefine traditional service and management models.

This work project aims to investigate the critical role that AI plays in the hospitality industry, emphasizing how this technology is revolutionizing both opportunities and challenges. Our investigation began with a comprehensive literature review to provide an overview of the hospitality sector, AI, and the current state of AI usage, with a particular focus on the perspectives of guests and hosts, as well as sustainability concerns. Motivated by the desire to understand the practical implications of AI on the sector, we adopted a threefold research structure: enhancing sustainable practices, leveraging chatbots to improve guest experiences, and innovating efficient practices for hosts.

To achieve these objectives, we employed two complementary methodological approaches. First, a quantitative approach involved conducting surveys among guests to collect data on their motivations, interests, and expectations regarding AI and the new trends in the hospitality sector. Second, a qualitative approach consisted of interviewing hosts to gain insights into their perspectives, challenges, and opportunities in utilizing AI to manage their properties.

By analysing the collected data, we formulated eight distinct research questions, which were thoroughly examined in the analysis section to draw pertinent implications. Ultimately, we propose three innovative solutions designed to revolutionize the hospitality sector in a more efficient and sustainable manner, creating tangible benefits for the broader community using AI. These proposals represent a well-considered balance between the needs of various

stakeholders and the industry's growing demand for technological transformation, ensuring a more sustainable and efficient future for hospitality.

2. Literature review (Group part)

The scope of this literature review is to explore the dynamics of the hospitality industry, focusing on sustainability and technological innovations such as Artificial Intelligence (AI). The review begins by contextualizing the hospitality industry within the broader framework of travel and tourism, emphasizing its economic and social importance in Europe. It discusses the traditional components of the industry and notes the transformative impact of short-term rental platforms which have reshaped consumer preferences and market operations.

The text delves into emerging trends and challenges within the industry, highlighting issues such as the lack of clear regulations, the phenomenon of overtourism, and the pressing need for sustainable practices. The discussion underscores the sector's substantial environmental footprint, advocating for enhanced sustainability measures in European buildings and the pivotal role of EU directives aimed at reducing energy consumption and greenhouse gas emissions.

AI's role is critically examined, defining its fundamental concepts before exploring its application in the hospitality sector. The review outlines how AI technologies are revolutionizing customer interactions through personalization and automation, enhancing guest experiences, and improving operational efficiencies for hosts. It also considers AI's potential to contribute to sustainability by fostering more efficient resource management and lessening the environmental impact of tourism activities.

From the perspectives of guests, hosts, and environmental impact, this review assesses the multifaceted influence of AI on the hospitality industry. For guests, AI enhances service personalization and efficiency. For hosts, it provides tools for improved revenue management

and operational practices. In terms of sustainability, AI is recognized as a key enabler of greener practices within the industry. By integrating these diverse perspectives, the review aims to offer a comprehensive understanding of the current and potential impacts of AI and sustainability initiatives on the stakeholders in the hospitality sector. It underscores the need for continuous innovation and adaptation as essential drivers for future development and sustainability in this dynamic industry.

2.1 The hospitality industry (Group part)

According to Calvo and Sanchez (2016) “Hospitality is the act or practice of being hospitable, of receiving and entertaining guests, visitors or strangers, with liberality and goodwill” (p. 3). The hospitality industry can be defined as a subset of the travel and tourism industry and mainly comprises the accommodation and food and beverage industry (Surender, 2022). The accommodation industry includes all establishments offering overnight and lodging services such as hotels, hostels, holiday homes, etc. (Statista, 2022). On the other side, food and beverage refers to the industry that deals with all food-related services such as packaging, preparation, and service, which includes restaurants, fast food outlets, bars, etc. (Jagmohan, 2013). “Accommodation is the main service offered by a hospitality unit. If there is no accommodation service, hospitality does not exist" (Ionel, 2021, p. 1). This service is essential to enable the functioning of the other hospitality sector.

2.1.1 The European hospitality: the role and figures

The tourism sector in Europe has reached an extraordinary level of development, fostered not only by the continent's invaluable cultural heritage, but also by the well-established system of hotels, restaurants, bars, and other activities that make up the European hospitality industry (HOTREC, 2023). This sector exerts a significant impact both socially and economically. With over two million businesses operating in the sector and more than ten million workers employed, hospitality is one of the largest sources of employment and economic prosperity in

Europe (HOTREC, 2023). Moreover, it contributes substantially to the continent's gross domestic product, at 2-3 % (HOTREC, 2023). The wide range of hospitality-related economic activities, ranging from accommodation management to food preparation and service, creates a dynamic and resilient economic fabric that fuels tourism and contributes to the overall growth of the European economy.

2.1.2 The importance of Short-Term Rental (STR) in the accommodation sector

Within the accommodation industry, the Short-Term Rental (STR) sector, also known as "vacation rental," has assumed a predominant role since the emergence of booking platforms. Short-term rental refers to furnished homes that guests typically consider as an alternative to hotels and are given through internet platforms operated by individuals and investors (Furukawa & Onuki, 2019). The STR industry represents a key segment of the hospitality industry that is highly appreciated by consumers for its flexibility, cheaper prices, and greater accessibility compared to the experience offered by hotels. In Europe, the number of users is estimated to reach 210.40 million by 2028, with a projected annual growth of 1.20% until then and an expected market value of US$35.13bn (Statista, 2023). These figures highlight the importance of this sector within the Hospitality industry and the European economy.

2.1.3 Booking Platforms: the impact in the Short-term rental sector

With their birth in 1990 and their development in the early 2000s, booking platforms revolutionized the short-term rental and hospitality industry (Giannoni, Brunstein, & Guéniot, 2021). These platforms enable the host to reach a large number of people, administer properties more effectively, and provide benefits such as revenue optimization and booking management. At the same time, guests enjoy competitive costs, a large choice, and transparency ensured by other consumers' feedback (Cardoso, 2018). These factors justify the exponential growth of booking platforms. In the first half of 2023, in Europe, guests booked a total of 237 million

nights through these platforms, an increase of 18.8% compared to the previous year (European Commission, 2023).

The four most used platforms in Europe are Booking.com, Airbnb, Expedia Group, and TripAdvisor, which enjoy worldwide popularity (Bianchi, 2024). Booking.com leads the way with 565.2 million site visits worldwide (Bianchi, 2024). These platforms have revolutionized the STR sector, offering hosts and guests numerous advantages. However, the impressive growth of these platforms has triggered several emerging trends and issues that require further attention.

2.2 Issues and trends (Group part)

As highlighted in the previous paragraph, the hospitality, and Short-Term Rental (STR) sectors stand out for their significant complexity and the variety of stakeholders involved, such as guests, hosts, technology, and the entire supply chain connected to them. In this constantly evolving context, these sectors face increasingly challenging dynamics, driven by the rise of the sharing economy and the advancement of Artificial Intelligence (AI). These forces are marking an era of unprecedented opportunities and new challenges, promising to reshape market dynamics with increasingly personalized and innovative experiences. Faced with these changes, complex issues related to regulation, social impact, and sustainability emerge. These challenges necessitate deep reflection and the development of adaptive strategies, which we will explore in the next paragraph, positioning ourselves at the heart of the sector's future dynamics.

2.2.1 Lack of regulation and problems concerning over-tourism

The Short-Term Rental (STR) market, part of the sharing economy, introduces beneficial outcomes, such as extra income for users, enhanced allocation and utilization of resources, and the creation of new economic activities within cities and municipalities (Quattrone, Proserpio, Quercia, Capra, & Musolesi, 2016). However, one of the main challenges the STR sector faces

is the absence of clear regulations at both the national and European levels. There is still an ongoing debate about whether STR should be considered part of the hospitality and tourism accommodation sector or a private form of income (Iacovone, 2023). This debate arises as the STR industry is shifting towards the professionalization of hosts managing the properties, which has consequently changed the internal structure of sharing economy platforms from peer-to-peer to a business-to-consumer model (Iacovone, 2023). This transition has resulted in professional hosts capturing most profits, displacing non-professional hosts, and establishing professional hosting as the main strategy for achieving a competitive advantage on these platforms (Iacovone, 2023).

Another element to consider is the negative side effects of extensive urban exploitation, primarily due to uncontrolled and unregulated tourism operations, often referred to as overtourism. This problem has considerably contributed to a scarcity of available housing in popular tourist sites, rising rental rates, and decreased liveability in some areas (European Parliament, 2023).

As illustrated in Figure 1 (Appendices), in August 2023, the EU recorded 124.7 million nights booked through the four main online platforms, representing a 28% increase in booked nights compared to pre-pandemic levels in 2019 (European Parliament, 2023). In response to the increase in short-term rental, not all major tourist destinations have enacted local regulations to restrict access to these accommodations (European Parliament, 2023). Only a few cities, such as Amsterdam, New York, and Berlin, have introduced policies limiting STR to only the primary residence or parts of it (Iacovone, 2023). Meanwhile, in cities like Barcelona and Paris, renting a secondary home requires a license or a change in categorization from residential to commercial (Iacovone, 2023).

2.2.2 Driving sustainability in European buildings: The role of EU directives

Over the last decade, the hospitality industry has embraced “going greener” (Khatter, 2023). According to Khatter (2023), “The hospitality industry is characterized by its significant consumption of energy and natural resources to cater to the needs of its clientele” (p. 1). Amid rapid development, there is a growing recognition of the importance of quality and sustainability, highlighting the sector's increased environmental responsibilities (Khatter, 2023).

However, using non-toxic items and reducing waste alone are insufficient for making a significant sustainable impact (Khatter, 2023). A transformation of the entire industry is necessary, starting with its infrastructure—the buildings (Khatter, 2023). Buildings are the largest energy consumers in Europe (European Commission, 2024). With 85% of the EU’s buildings constructed before 2000, about 75% are energy inefficient (European Commission, 2024). In 2021, buildings accounted for 42% of the EU’s total energy consumption and contributed to over one-third of the EU’s greenhouse gas emissions related to energy (European Commission, 2024). To address these issues and enhance energy efficiency, the EU has implemented a legislative framework, which includes the revised “Energy Performance of Buildings Directive EU/2010/31 and Energy Efficiency Directive EU/2023/1791” (European Commission, 2024). These directives aim to establish a decarbonized building stock by 2050, foster a stable investment environment, and empower consumers and businesses to make more conscious energy and cost-saving decisions (European Commission, 2024).

This means that at least 75% of European buildings will need renovation in the next 25 years (European Commission, 2024). Furthermore, according to European directives, a building that does not meet the specified requirements within the given timeframe cannot be sold or rented out (European Commission, 2024). Moreover, homeowners and hosts should note that investing in sustainable real estate operations can lead to improved property values (between 2% and

10%) and significantly higher rental incomes (2% to 8%) (Bassi & Moscatelli, 2020). This is a crucial aspect for all hospitality and short-term rental operators who will need to improve the energy efficiency of their buildings in the coming years. Today's challenge is to make residential real estate more sustainable by enhancing building energy efficiency, sustainability of the production process, minimizing waste, limiting the consumption of non-renewable resources, and using environmentally friendly materials (Bassi & Moscatelli, 2020).

2.2.3 New trends and the use of Artificial Intelligence in the hospitality sector

Currently, technological innovations and Artificial Intelligence (AI) are driving businesses to shift from traditional systems to digital transitions. As we will explore in the next section, AI is identified as a 'family of technologies' capable of recognizing, analysing, acting, learning, and demonstrating enhanced features of human intelligence (Kong, Wang, Qiu, Cheung, & Bu, 2023, p. 1). In many sectors, including the hospitality industry, the adoption of AI is essential as it presents numerous opportunities and challenges (Pongsakon, 2023).

In the highly competitive hospitality industry, hosts face the dual challenge of meeting elevated customer expectations and reducing costs (Pongsakon, 2023). The adoption of AI offers a pathway to enhance performance and maintain a competitive edge (Pongsakon, 2023). By leveraging AI and automation, hosts can optimize operations, enhance service quality, and improve productivity and efficiency, while also making their operations more sustainable by reducing waste (Koo, Xiang, Gretzel, & Sigala, 2021). From the guest's perspective, AI facilitates personalized requests, suggestions, and purchases, enabling direct engagement through technology (Ruel & Njoku, 2021). Additionally, given the sector's lack of clear and general guidelines, AI can establish standards and ensure the accuracy of fraud prevention measures by analysing the vast, data-intensive information collected through bookings (Pongsakon, 2023). AI can also support the implementation of smart tourism agendas that emphasize sustainability, resilience, and improved well-being (Ruel & Njoku, 2021).

2.3 Sustainability in hospitality: understanding and solutions (Group part)

The hospitality sector is integral to the tourism industry as it forms a crucial part of the overall traveller's experience. To fully understand the environmental impact of the hospitality industry, it is essential to begin by analysing the impact of the tourism sector, given the close link between the two sectors and their significant environmental effects (Halleux, 2017).

Tourism is a major economic driver and a steadily growing global phenomenon that exerts strong environmental pressures. It is anticipated that the number of tourists will reach 1.8 billion by 2030, underscoring its relevance and impact (Baloch, et al., 2022). This sector significantly contributes to environmental degradation through CO2 emissions, intensive use of natural resources such as water and energy, and the generation of solid and liquid waste (Baloch, et al., 2022). Tourism-related emissions account for 4.9% of global emissions, with 20% attributable to accommodation and 75% to transportation (Halleux, 2017). Water consumption is another critical concern, utilized for a variety of tourism services including sanitation, cooking, and luxury facilities like spas and swimming pools. According to the European Environment Agency (EEA), the daily water consumption of a tourist is approximately four times higher than that of a permanent resident (Collins, Kristensen, & Thyssen, 2009). Additionally, the waste generated in the tourism sector significantly surpasses that produced by the resident population (Halleux, 2017).

The hospitality industry is notable for its significant environmental impact, which includes substantial water and energy consumption, as well as waste generation. The environmental impact of accommodation is often underestimated, despite its significant emissions (19 kg of CO2 per guest per night) and high levels of energy and water usage (UNWTO, 2012). Understanding and addressing the environmental effects of the hospitality and accommodation industry is crucial not only for reducing its negative impacts on the environment but also for ensuring the long-term sustainability of the tourism sector.

2.3.1 The role of sustainable tourism in the hospitality industry

The environmental impact of tourism and the hospitality industry, as highlighted above, is significant and not negligible. For this reason, the concept of sustainable tourism proves to be fundamental for the development and survival of this sector, revealing its relevance at both a global and European level. According to the United Nations World Tourism Organisation (UNWTO), sustainable tourism is defined as "Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities" (UNWTO, 2005, p. 12). This definition advocates a balance between economic, social, and environmental aspects, reflecting the principles and definitions also proposed by the European Commission.

The latter reaffirms the fundamental role of sustainability for the competitiveness of the sector, proposing a holistic approach involving all the main stakeholders, with numerous initiatives reported in the "Agenda for a Sustainable and Competitive European Tourism" (European Commission, 2023). The European Commission has developed the European Tourism Indicators System (ETIS), aimed at helping tourist destinations address environmental, social, and economic challenges (European Commission, 2023).

In the area of accommodations, two initiatives have been proposed by the European Union: the EU Ecolabel, which can be used on a voluntary basis by hosts to promote their environmental awareness, and the EMAS programme, aimed at improving and promoting environmental performance in the hospitality industry (European Commission, 2023). There is a clear focus of the major global and European organisations on finding ways to address and develop sustainable tourism, which needs the collaboration of all the main stakeholders in this industry, including hosts and guests who play a key role.

2.3.2 Guest and host perspectives towards sustainability in hospitality

The concept of sustainability, once undervalued in the tourism and hospitality industry, has become a key element. It is now regulated and promoted by leading global and European institutions (UNWTO and the European Commission), representing a competitive advantage sought after by key players in the hospitality and accommodation industry.

According to a Booking.com report (2023), 53% of tourists are inclined to choose more sustainable solutions due to the recent news on climate change, with even 80% confirming the importance of sustainable travel. This emerges from an analysis conducted on a sample of 33,000 tourists from 35 countries around the world, who are re-evaluating the concept of value, giving more and more importance to a unique and regenerative experience that therefore does not only seek to lessen its impact on the environment but also contributes positively to the community visited (Booking.com, 2023).

In addition, regarding accommodations, the same research revealed that 65% of tourists value staying in facilities certified as sustainable, while 59% will actively seek such accommodation in the future (Booking.com, 2023). In this context, accommodation hosts must not only respond to travellers' increased need for sustainable solutions, but also recognize their role in positively impacting the environment and host community. Hosts, therefore, are adopting sustainable solutions for a variety of reasons, as evidenced by perceived benefits such as financial savings, competitive advantage, economic profits, employee loyalty, customer retention, regulatory compliance, risk management and social responsibility (Khatter, 2023).

2.3.3 The current sustainable technologies

The technological practices adopted nowadays in the sector are aimed at mitigating environmental impact, focusing mainly on the efficient management of water and energy resources, despite their considerable initial cost (Chemmanur & Fenech, 2024). Among the most effective solutions are the use of energy-efficient lighting systems, such as LED lights,

and the use of HVAC sensors systems that are programmable according to outdoor temperature and room occupancy (Vincent, 2023). In addition, water-saving technologies, such as recycling grey water from toilets, are increasingly being adopted. Intelligent inventory management tools enable accurate analysis of food consumption, reducing waste (Vincent, 2023). The use of renewable energies such as solar, wind, geothermal, biofuel and hydrogen, together with the use of biodegradable and compostable materials, is another strategy to reduce environmental impact (Vincent, 2023).

However, a more accessible alternative to promote sustainability is to obtain sustainability certification through the transparent collection and disclosure of data on environmental practices. Among the companies providing such services, Travalyst is a leader, also offering solutions to major booking platforms such as Booking.com, Expedia Group and TripAdvisor (Travalyst, 2024). These technologies not only actively contribute to reducing environmental impact, but also serve as a tool to communicate, promote, and certify sustainability efforts.

2.4 Defining artificial intelligence: A comprehensive overview (Group part)

Artificial intelligence (AI) is a discipline poised at the intersection of computer science and human cognitive processes, aiming to both understand and create entities capable of intelligent behaviour. According to Mijwil (2022) artificial intelligence constitutes a foundational pillar within the domain of computer science and is dedicated to the creation of computational systems capable of performing tasks that traditionally require human intelligence. In his paper "Has the Future Started? The Current Growth of Artificial Intelligence, Machine Learning, and Deep Learning", Mijwil highlights the distinction between artificial intelligence, machine learning, and deep learning emphasizing the progression from a broad attempt to replicate human intelligence (AI), towards more focused efforts on data-driven learning (ML), and further, to the emulation of neural processes for complex problem solving (DL). This tiered conceptualization underscores the nuanced advancements in the field and highlights the specific

contributions of each area to the overarching ambition of creating intelligent, autonomous systems (Mijwil, 2022).

Russell and Norvig identify AI as a field that encompasses the development of systems equipped with capabilities such as learning, reasoning, problem-solving, perception, and language understanding with a significant emphasis is placed on the rational agent approach, where an agent is anything that can perceive its environment through sensors and act upon that environment through actuators (1995). The core objective of AI, in this context, is to create agents that operate optimally, maximizing their expected utility based on their perceptual inputs and the knowledge they have acquired. Drawing on Kaplan and Haenlein's exploration of artificial intelligence in "Siri, Siri in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence" defined AI as a system capable to correctly interpret external data, to learn from such data, and to use these learnings to achieve specific goals and tasks through flexible adaptation, stands at the forefront of business innovation and strategy (2019). Russell and Norvig (1995), evidenced different perspectives on what constitute AI and its objectives. These are "Thinking Humanly," "Thinking Rationally," "Acting Humanly," and "Acting Rationally."

This classification underscores the diverse methodologies within AI, highlighting key philosophical and practical inquiries. "Thinking humanly" aims to replicate human cognition, striving to endow machines with the ability to think. Haugeland describes this ambition as creating "machines with minds, in the full and literal sense" (1985), echoed by Bellman's definition focused on automating tasks like decision-making and learning (1978) "Thinking rationally" focuses on enabling machines to reason logically, distinct from mimicking human thought. Charniak and McDermott view this as studying "mental faculties through the use of computational models" (1985), and Winston defines it as enabling machines "to perceive, reason, and act" (1992). "Acting humanly" involves machines performing tasks that would be

deemed intelligent if done by humans. Kurzweil encapsulates this as the creation of “machines that perform functions that require intelligence when performed by people” (1990). "Acting rationally" is about designing agents that optimize outcomes, with Poole, Mackworth, and Goebel focusing on “the design of intelligent agents” (1998).

These definitions together paint a comprehensive picture of AI, spanning from efforts to replicate human cognition and behaviour to the rational design of intelligent agents. They underline the diverse objectives within the field, ranging from understanding and mimicking human thought processes to achieving optimal problem-solving and decision-making capabilities in machines.

2.5 Artificial intelligence in the hospitality sector (Group part)

The application of Artificial Intelligence (AI) in the hospitality and tourism sector reflects a transformative journey that is profoundly influencing guest experiences and operational efficiencies. Spanning three decades, the proliferation of AI research has mirrored technological advancements, shifting from foundational technologies to the exploration of consumer interactions with AI-driven services. As shown in the paper “30 years of artificial intelligence (AI) research relating to the hospitality and tourism industry “, “AI research relating to the hospitality and tourism industry shows a growing trend. The first paper was published in 1991, and since 2018, the number of publications and citations rapidly increased, obtaining considerable research attention” (Kong, Wang, Qiu, Cheung, & Bu, 2023, p. 2169). As stated by Huub Ruel and Esther Njoku in their paper "AI Redefining the Hospitality Industry", This transformative technology has fundamentally altered the traditional models of tourism and hospitality “disrupting the traditional system, as this technological innovation enables customers to access reliable and accurate information that allows them to customise their requests, make reservations and purchase hotel and tourism products and services directly through technological platforms, rather than dealing with a hotel, booking agent, or professional

travel agent" (2021, p. 55). AI's role in hospitality extends beyond mere automation to enable service innovation through the delivery of personalized services. Smart services and robotics, including chatbots and robots, are "employed to augment human intelligence and physical capabilities" (2021, p. 56). This innovation "streamlining services, enabling reduction of errors, improving speed of decisions and service, identifying demand signals, identifying guests by names through facial recognition technology, predicting customer demands, providing real-time language translation software to interact with international customers and providing interactive virtual, as well as physical assistance for customers" (2021, p. 56). Such capabilities significantly enhance the guest experience by catering to their specific needs with a personal touch, setting businesses apart from their competitors (2021).

In the article "Artificial Intelligence (AI) and Robotics in Travel, Hospitality, and Leisure," published in Electronic Markets (2021) the authors explore the transformative impacts of AI and robotics on the Travel, Hospitality, and Leisure (THL) sectors positing that AI and robotics are not just technological trends but foundational elements reshaping the future of the THL sectors (Koo, Xiang, Gretzel, & Sigala, 2021). AI "also represent important efforts to enable the local-global nexus. In this sense, technology-based social reality is another facet of smart tourism that builds on AI and robotics capabilities and requires further exploration" (Koo, Xiang, Gretzel, & Sigala, 2021, p. 1).

2.5.1 Applications

The uses and applications are vast, the comprehensive paper titled "Artificial Intelligence: A Systematic Review of Methods and Applications in Hospitality and Tourism" (Doborjeh, Hemmington, Doborjeh, & Kasabov, 2021) offers a crucial examination of Artificial Intelligence (AI) applications and methodologies within the tourism and hospitality sector. This review encapsulates AI's transformative role across various facets of the industry, ranging from data modelling, demand forecasting, to enhancing customer service experiences. The study

done by Doborjeh, Hemmington, Doborjeh, and Kasabov, systematically analyses content from 146 articles published between 2010 and 2021, identifying themes such as AI methods and applications in the THL sector (2021). The analysis reveals a significant trend towards employing analytical AI methods for big data, including statistical machine learning, Artificial Neural Networks (ANNs), and Deep Learning Neural Networks (DLNNs), each tailored for specific hospitality and tourism contexts. These methodologies have been instrumental in clustering, classification, and prediction tasks, facilitating nuanced insights into tourist behaviour, demand forecasting, and service personalization. Moreover, the review highlights the adoption of AI-based applications such as robotics, Virtual/Augmented Reality (VR/AR), and chatbots/virtual assistants within the sector. These applications are reshaping guest experiences by providing immersive engagements, personalized services, and efficient customer interactions, underscoring AI's critical role in driving service innovation and operational excellence.

2.6 Guest perspective (Group part)

The paper "Leveraging ChatGPT and other generative artificial intelligence (AI)-based applications in the hospitality and tourism industry: practices, challenges, and research agenda," by Dwivedi, Pandey, Currie, & Micu (2023), offers an in-depth analysis of how generative AI technologies, notably ChatGPT, are revolutionizing the hospitality and tourism sectors. The study addresses the integration of these technologies to enhance customer experiences and streamline operational efficiencies, while also highlighting potential challenges and ethical considerations. Dwivedi et al. (2023) propose comprehensive research about various applications of ChatGPT, ranging from enhancing visitor experiences through accurate and timely information to supporting supply side stakeholders by providing insights into customer preferences and operational strategies.

One of the main applications regards the AI Chatbots. “Chatbot, short for chat robot, with the help of artificial intelligence, communicates with humans and has an underlying computer program associated with it” (Ramachandran, 2018, p. 1). The incorporation of AI through chatbots within the hospitality and tourism industry marks a significant evolution towards enhancing guest experiences and operational efficiencies. The article “Adoption of AI-based chatbots for hospitality and tourism” delves into the adoption dynamics of AI-powered chatbots within the hospitality and tourism sector, providing a nuanced understanding of consumer behaviour towards these technologies (Pillai & Sivathanu, 2020). By extending the Technology Adoption Model (TAM) with additional constructs pertinent to the hospitality context, such as perceived trust, perceived intelligence, anthropomorphism, and technology anxiety, the study offers a comprehensive framework to assess the adoption intentions and actual usage of chatbots by consumers.

The findings reveal that factors like perceived ease of use, perceived usefulness, perceived trust, perceived intelligence, and anthropomorphism significantly influence consumers' intentions to adopt chatbots for their travel planning needs. Contrary to expectations, technological anxiety did not present a substantial barrier to chatbot adoption, suggesting an increasing familiarity and comfort with digital technologies among consumers in the hospitality domain. The study also highlights the negative moderation effect of stickiness to traditional travel agents on the relationship between adoption intention and actual chatbot usage, indicating a lingering preference for human interaction in travel planning among certain consumer segments.

2.7 Host perspective (Group part)

Renting out a house can provide an attractive supplementary income; however, the success of this activity depends on the host's ability to generate revenue (Bassi & Moscatelli, 2020). Before delving fully into this sector, we could define “hosts” as individuals who manage their properties by interacting with all stakeholders and have listed their properties on online rental

platforms like Airbnb and Booking.com (Quattrone, Proserpio, Quercia, Capra, & Musolesi, 2016). Short-term hosts are a significant component of the sharing economy, as without hosts there would be no short-term rentals (Guttentag, 2019). Furthermore, they have flexibility and the possibility to adjust various parameters, such as price, use of instant booking, and specific cancellation policies, to maximize their revenue (Giannoni, Brunstein, & Guéniot, 2021).

They are attracted by both financial and experiential advantages, such as the enjoyment of meeting new people and sharing unused space (Guttentag, 2019). Even so, those who focus solely on profit are encouraged to manage their apartments strictly as businesses, rather than as opportunities for home sharing. As Iacovone (2023) suggests, "Hosts with more than ten listings had a lower price per night than single hosts (-9.2%) and an increase of 8.9% in monthly revenue" (p. 2). To succeed in the STR market, hosts must analyse the market, understand consumer needs, and observe new trends in hospitality such as innovation and sustainability. On this basis, the future goal for hosts is to exploit innovative and sustainable systems that simplify property management and reduce costs, thereby increasing the profitability and efficiency the property (Bassi & Moscatelli, 2020).

2.7.1 Responsibilities of a Short-Term Rental (STR) host

A host's primary responsibilities in short-term rentals involve a wide range of activities aimed at enhancing the guest experience and operational efficiency. These responsibilities include providing basic materials such as bedding, towels, and household equipment, as well as listing the property on rental platforms with detailed information such as pricing, availability, apartment characteristics, location, size, photos, house rules, and tips (Airbnb, 2024). They are also responsible for delivering excellent customer service, which includes responding quickly to customer inquiries and addressing unexpected issues (Airbnb, 2024). Additional duties involve guest management logistics, such as checking in and out visitors, cleaning, and establishing insurance for damages (Airbnb, 2024). On the financial side, tasks include

managing finances (such as handling payments, taxes, and platform fees), reservation administration, property upkeep, and formulating investment plans for property improvements (Airbnb, 2024). Furthermore, implementing marketing strategies to promote the listing and maintaining quality control are critical to success (Airbnb, 2024). A host's strategic responsibilities also include pricing and revenue management, which involves adjusting prices based on key factors that influence pricing and guest preferences to increase reservations, meet expectations, and enhance profitability (Chattapadhyay & Mitra, 2019).

2.7.2 The role of technology and AI in supporting hospitality hosts

In the hospitality sector, AI and Big Data are enhancing phases of revenue management, particularly in setting short-term rental rates. Hosts typically face the challenge of pricing, complicated by unique listing features such as concierge and tour guide services, besides standard factors like competitions and seasonal demand (Gibbs, Guttentag, Gretzel, Yao, & Mo, 2018). Platforms like Airbnb and Booking.com use machine learning to offer dynamic pricing recommendations, based on demand trends, competition, and expected property supply (Gibbs, Guttentag, Gretzel, Yao, & Mo, 2018). This approach helps hosts maximize their financial return on investment.

Additionally, AI combined with Internet of Things (IoT) technology in apartments optimizes operational efficiency and sustainability. Back-of-house management systems, as illustrated in Figure 2 (Appendices), are categorized into three major areas: Guest-Facing Systems, In-Room IoT Sensors, and Hospitality Services (Kansakar, Munir, & Shabani, 2019). IoT devices such as thermostats and motion detectors can reduce electricity costs by 20–45% by improving temperature and lighting management in unoccupied rooms (Kansakar, Munir, & Shabani, 2019). These systems not only enhance guest comfort but also support cost-saving and environmental sustainability. Further innovations in guest-facing systems are revolutionizing hospitality by collecting visitor preferences to create personalized service profiles, thus

enhancing service customization, and fostering repeat business (Kansakar, Munir, & Shabani, 2019). Hospitality services now extend beyond keyless entry and automatic check-ins to include location-based services like digitally guided tours and local recommendations, improving the overall guest experience (Kansakar, Munir, & Shabani, 2019).

In today's technological landscape, tools like AirDNA, Wheelhouse, PriceLabs, and Mashvisor support property managers, yet their integration into business models is often limited. The rapid advancement of technology and a growing commitment to sustainability and waste reduction underscore the essential role of AI in transforming the hospitality industry, making it a necessary component for real and effective change.

3. General motivation and areas of the study (Group part)

Building upon the findings presented in our earlier literature review, this chapter outlines the key motivations driving our research within the hospitality industry. Our examination of the literature on AI in the hospitality sector has revealed significant insights but also highlighted notable gaps. This realization prompted a deeper investigation into the personal experiences of those directly impacted by these trends, particularly hosts and guests. The primary motivation for this research is to delve into the personal experiences, expectations, and concerns of stakeholders that are underrepresented in existing literature.

As detailed in the literature review, the hospitality industry's impact on the environment is profound and multifaceted. This research aims to build on that foundation by exploring whether AI can serve as a tool for the industry to respond to environmental pressures and the increasing consumer demand for eco-friendly travel experiences. Understanding these dynamics is crucial for evaluating the industry's progress toward sustainability and the effectiveness of current practices, thereby bridging the theoretical frameworks discussed previously with real-world AI applications and stakeholder attitudes toward adopting them.

Following up on the potential of AI technologies, this research further investigates the transformative impact of AI on the hospitality sector. Specifically, we will examine AI-driven tools such as chatbots, which have introduced new efficiencies and personalized guest interactions. The aim is to critically assess how chatbots can enrich the guest experience and how they are perceived by guests, providing insights into strategic applications. Furthermore, we aim to understand the hosts' perceptions of AI and whether they consider it a useful tool to increase operational efficiency.

By focusing on both hosts and guests, we aim to capture a broad spectrum of perspectives concerning their experiences, desired improvements, key challenges, and views on sustainability and AI. This exploration will help us understand how these stakeholders perceive the use of AI. The insights gained will serve to paint a comprehensive picture of AI's impact on the industry's landscape, which can guide future strategic decisions, innovations, and policymaking in the hospitality sector.

4. Research structure: a threefold approach (Group part)

We have structured our investigation around three distinct research topics: Enhancing sustainable practices, leveraging chatbots to improve guest experiences, and innovating efficient practices for hosts. Each section not only addresses specific research questions but also builds a comprehensive narrative that explores the implications and applications of Artificial Intelligence (AI) and sustainable technologies in hospitality.

4.1 Enhancing sustainable practices (Filippo Fuscagni)

The importance of sustainability in the hospitality industry is a topic of crucial interest, as demonstrated by our thorough literature review. This topic therefore requires a thorough investigation, which we conducted through the exploration of two specific research questions. During our study, we focused on the link between sustainable technologies, including Artificial

Intelligence (AI), and guest behaviour, which is of particular importance in this context. This is due to the multiple decisions made by guests both inside and outside accommodation facilities, which can have a significant environmental impact.

Initially, with our first research question (Q1), we delved into the evaluation of technologies that guests consider crucial for improving the sustainability of accommodations. This assessment was not limited to examining the diverse options available; it also carefully considered how these technologies are perceived and evaluated by the guests themselves, information that is vital for hosts as well.

In the second research question (Q2) we explored how the integration of AI systems can influence guests' decisions towards more sustainable behaviour during their stay. During this investigation, we focused on the role of chatbots and other AI solutions in guiding guests towards more sustainable and responsible choices. The primary objective was to understand whether an engaging and user-friendly interface such as a chatbot could have a positive impact on guest behaviour, thus promoting more sustainable and responsible behaviour in the tourism context.

This integrated approach, which combines sustainable technologies with AI, not only aims to meet guests' growing demand for environmental sustainability, but also to provide valuable guidance for future innovation in the hospitality industry. In this way, we contribute to a more conscious and future-oriented tourism environment by carefully considering both guest choices inside the accommodation, such as the use of air conditioning and water resources, and those outside, such as supporting local initiatives with a positive environmental impact.

5. Data collection methods (Group part)

In this section, we will describe how we used both quantitative and qualitative data collection methods to explore the integration of Artificial Intelligence (AI) in the hospitality sector. Our

quantitative approach involves a detailed survey aimed at gathering data across a broad demographic to analyse how diverse groups perceive and utilize AI in relation to sustainability and customer experiences. This allows for a systematic examination of responses to draw meaningful insights into potential market trends and behaviours. Complementarily, our qualitative approach includes conducting interviews with short-term rental hosts to delve deeper into their experiences and viewpoints on using AI for property management and enhancing sustainability. This combination of methods enriches our understanding of the nuanced impacts of AI applications and supports the development of informed strategies for its future integration.

5.1 Quantitative survey data collection (Filippo Fuscagni)

This section of the research focuses on the crucial task of collecting quantitative data through surveys, thus providing the empirical basis for examining the complex interplay between guest experiences, preferences, and the integration of Artificial Intelligence (AI) in the Short-Term Rental (STR) sector. The main objective is to meticulously collect and analyse data to gain a detailed understanding of how sustainability and AI technologies are perceived and used among various demographic segments, thus offering insights into potential market trends and behaviours in the STR context.

The survey, adopted as the primary research strategy, directly collected quantitative data from participants in short-term rental experiences. This method facilitated the systematic collection of data across a broad demographic spectrum, enabling the application of statistical analysis to uncover insights into users' preferences, behaviours, and potential trends.

Several types of questions were used to effectively obtain essential data. Likert scales provided a nuanced landscape of responses, allowing subtle insights into respondents' attitudes and satisfaction levels. In addition, numerical rating questions assessed levels of satisfaction or importance, while yes-or-no questions collected conclusive data on specific behaviours or beliefs. Open-ended questions supplemented the quantitative data, allowing respondents to

express thoughts or issues, thus providing valuable contextual insights alongside the numerical data (Survey questions, Appendices).

The study categorised the population according to demographic and behavioural criteria, including age, profession, frequency of platform use, main motivations for using the services, average length of stay and interest in AI, chatbots and sustainability topics. Survey's aspiration was to obtain a balanced representation of the four main generations: Generation Z, Generation X, Generation Y (Millennials) and Boomers (Table 1, Appendices), enabling the examination of different perspectives and experiences regarding short-term rental services and AI-based technologies to improve experiences overall and promote sustainable behaviour.

A total of 200 valid responses were received, each of which was carefully analysed in the context of the study. Throughout the data collection process, strict adherence to data protection standards was maintained, with no sensitive information being requested or retained to ensure maximum confidentiality and privacy for participants.

5.2 Qualitative interview data collection (Filippo Fuscagni)

To address research questions 6, 7, and 8 we formulated various hypotheses and conducted interviews with short-term rental hosts to collect their experiences and insights on improving their hospitality services. During these discussions, we developed targeted questions to test our hypotheses and employed a qualitative analysis approach to explore deeper into the problems and opportunities associated with AI application in this sector. Our focus was on exploring the role of AI in property management and its contributions to sustainability in this sector, aiming to understand its potential impact on future industry trends.

From the ten interviews conducted, we decided to report in the appendices only those with hosts who are most likely to contribute rich and with relevant data to answer our research questions. To protect the sensitive data and financial information of the participants, only the initials of

their first and last names will be disclosed, and the interview topics have been categorized by thematic area. Our study used both primary and secondary data collection methods. Primary data were collected through semi-structured interviews and group discussions within host-specific Facebook groups. The interviews' findings were supported by secondary data, which included household consumption statistics, information on the potential of automated houses, and the results of a guest survey on the adoption of AI in this sector. This last analysis validated our expectations by offering a detailed insight into guest opinions and how they may impact host decisions.

6. Data analysis (Group part)

Data analysis is conducted across three primary research topics: “Enhancing sustainable practices” (Q1-Q2), “Leveraging chatbots to improve guest experiences” (Q3-Q4-Q5), and “Innovating efficient practices for hosts” (Q6-Q7-Q8). For each topic, the relevance and rationale for selecting the specific research question are outlined. This is followed by a detailed assessment of the research methodology, including how the analysis is conducted and a description of the analytical tools used. The results of the analysis are then presented, leading to a discussion of the practical implications these findings have for the hospitality industry.

6.1 Enhancing sustainable practices (Q1-Q2) (Filippo Fuscagni)

6.1.1 Q1 - Which technologies does the guest consider necessary to increase the sustainability of the accommodation?

Understanding guest perceptions of the environmental impact of technologies adopted in accommodations is crucial for identifying the technologies most valued by those interested in sustainability and who believe in the potential of technology to improve a home's environmental impact (Vincent, 2023). Today, the sustainable technologies available are diverse, ranging from energy efficiency solutions such as smart thermostats, LED lights, and increased insulation, to renewable energy sources like solar panels (Vincent, 2023). Additionally, water-saving devices

like low-flow taps, rainwater harvesting systems, and waste management technologies such as recycling bins are essential. However, more than just offering a list of options, it is vital to understand that adopting such technologies involves not only technical implementation but also consumer perception and utility. Considering how guests perceive and assess these technologies is crucial to ensure that the choices made by hosts meet real customer needs and preferences.

This highlights the importance of carefully analysing guest perceptions of sustainable technologies. Being aware of guest preferences regarding these technologies can provide a real competitive advantage for hosts. A customer-centric approach results not only in a more satisfying experience but also in better alignment with corporate sustainability goals. This approach reflects a tangible commitment to providing services and solutions that respect the environment, thus helping to promote conscious and responsible hospitality.

H1: Guest prioritize sustainability technologies and components in flats for environmentally friendly accommodation.

6.1.1.1 Evidence assessment

The analysis of the perception of sustainable accommodation technologies is crucial in order to provide guests with clear indications on which technologies are most appreciated and which are less relevant or considered unnecessary for defining a sustainable accommodation. This can guide hosts' future decisions in terms of accommodation investments and enable them to gain a competitive advantage through a customer-oriented strategy.

To answer this research question, the data analysis focused on the responses of 200 respondents to the questionnaire, in particular question number 21, which asked: 'How important to you is the presence of the following sustainability components? Please rate each option from 1 to 5, where 1 = Not very important and 5 = Very important'. The 15 options proposed represent the main technologies currently adopted by hosts in accommodation.

To identify the most appreciated technologies in the sample of 200 participants, an average was calculated for each technology. This showed an extremely positive perception towards the 'Solar panels for renewable energy generation' technology, with an average rating of 4.146 and 48% of participants giving the highest importance rating (5). The next two technologies in terms of appreciation are 'Improving building insulation to reduce heating and cooling consumption', with an average of 4.115, and 'Recycling containers to facilitate recycling', with an average of 4.075. The technology considered the least 'sustainable' was 'Sustainable textiles for sheets, towels and other textiles', with a significantly lower average of 3.556 out of 5, with only 21.5% of participants giving the highest score. Next, preferences were examined according to age and interest in sustainability, dividing the sample into four generations. Solar panels piqued the interests of all four generations (Generation Z, Y, X, and Boomers) with a greater average interest than other technologies (Table 2, Appendices).

However, it emerged that Generation Y and Generation X attach less importance to 'Organic or eco-friendly toiletries', with a lower average than the other groups. Similarly, Generation Z shows less interest in 'Sustainable fabrics for bed sheets, towels and other textiles', while Boomers show less interest in 'Energy-efficient taps and showers to reduce water consumption'. The sample was divided into two groups according to interest in sustainability. One group consists of the people who voted below the average interest in sustainability, while the other group consists of the people who voted above the average. The final average of interest in sustainability, obtained from question number 14 of the questionnaire, was 6.711.

In addition, from the point of view of interest in sustainability, both people with a high and a lower interest showed a particular interest in solar panels, although people with a lower interest showed a lower average for all the other sustainability aspects considered in question 21 (Survey questions, Appendices).

6.1.1.2 Findings

Data analysis reveals that guests give significant priority to sustainable technologies and components in flats, fully confirming the H1 hypothesis. Clear preferences emerge for some sustainable technologies over others, with solar panels for renewable energy generation topping the list of appreciation. This suggests that guests consider these technologies essential to define eco-friendly accommodation and reflects the importance of offering sustainable options to meet their needs.

Analysis of the data shows that all generations attach much more importance to 'high impact' technologies, such as solar panels and technologies to improve building insulation in order to reduce emissions and energy waste caused by air conditioning inside the accommodation. However, such investments, although high impact, require a considerable financial outlay and, as a result, are not as widespread. When present, the home is immediately recognised as sustainable.

In contrast, sustainable initiatives such as the use of organic or ecological personal hygiene products, sustainable fabrics for bedding, towels and other textiles, or sustainable cleaning products are perceived as less sustainable, even if they adopt cheaper but equally sustainable solutions. It is fascinating to understand consumer perceptions on this aspect and to recognise that they may not be well informed about some of the initiatives taken by the host, that they are not perceived as sustainable or eco-friendly just because they are not as visible as a solar panel or because they are undervalued.

While all generations show a common interest in solar panels, variations in evaluations of other technologies emerge. This underlines the importance of a customised approach in integrating sustainable technologies to meet the specific needs and preferences of different customer segments. Moreover, it is interesting to note that guests' preferences are not only limited to generations but are also influenced by their level of interest in sustainability. In fact, the analysis

shows that those with a greater interest in sustainability tend to evaluate all considered technologies more positively. This suggests that greater awareness and sensitivity to sustainability may positively influence guests' preferences and overall perception of their accommodation experience. Lastly, despite differences in overall interest in sustainability, solar panels remain a particular point of interest for all groups. These findings support the importance of focusing on universally appreciated sustainable solutions, such as solar panels, to improve the overall guest experience and maintain a competitive advantage in sustainable hospitality.

6.1.1.3 Implications

The research results indicate considerable customer interest in sustainable technologies in accommodation, with a particular preference for solutions such as solar panels and building insulation technologies and recycling bins. However, this interest varies between different generations of guests, with those who show a greater sensitivity to sustainability rating all the technologies considered positively. Furthermore, a differentiated perception of sustainable initiatives emerges, as some are easily recognisable, while others may be underestimated. Improving education and communication on sustainability issues could help to reduce this underestimation by increasing customers' awareness and encouraging them to fully appreciate different sustainable initiatives.

Knowledge of technologies appreciated by consumers not only affects the overall customer experience but is also of paramount importance in guiding hosts' investment decisions in sustainable hospitality. In order to remain competitive in the market and be perceived as sustainable, hosts must take customer preferences into account when selecting which technologies to adopt and which investments to make. This implies not only implementing sustainable solutions, but also effective and transparent communication about the sustainable choices made to meet customers' expectations and promote a positive view of accommodation. In this way, hosts can not only enhance their reputation as sustainable operators, but also

stimulate demand from increasingly sustainability-conscious customers, thus securing a prominent position in the hospitality and short-term rental market.

6.1.2 Q2 - How can the integration of Artificial Intelligence systems influence guests' decisions in terms of sustainable behaviour?

The use of artificial intelligence systems to promote sustainable behaviour among guests could play a crucial role in the short-term rental sector, known for its significant environmental impact, which is largely dependent on consumer choices and actions, as shown in the literature review. One possibility for exploiting AI is through the integration of chatbots, which offer personalized guidance to guests on sustainable practices during their stay. Such chatbots could act as interactive assistants, promoting long-term habits without overloading guests with details. Additionally, AI systems could monitor guest behaviour, providing personalized feedback on sustainability practices and their environmental impact. This personalized approach, combined with the chatbot's role in raising environmental awareness, could encourage guests to adopt more eco-sustainable behaviour.

The implementation of incentive mechanisms linked to sustainable choices, such as offering refunds or rewards, could further motivate guests to engage in environmentally responsible actions. This approach could help cultivate a culture of sustainability within the sector. Exploring the hypothesis that an engaging and user-friendly interface, such as a chatbot, can positively influence guest behaviour is not only relevant, but also essential to assess its feasibility and long-term effectiveness in promoting more sustainable and responsible tourism.

H2: AI can improve sustainable guest behaviours.

6.1.2.1 Evidence assessment

Understanding whether and how artificial intelligence can influence guests' choices and behaviour during their stay in hospitality facilities is of crucial importance, considering the significant impact that consumer preferences have in the hospitality industry, as highlighted in

the literature review (section 2.3). In order to examine this hypothesis, we analysed the answers to the following questions in the questionnaire:

- Question 14: *'On a scale of 1 to 10, how important do you consider the sustainability of the accommodation facilities where you stay? (1 = Not very important, 10 = Very important)'*
- Question 15: '*Would you be willing to reduce energy consumption within the accommodation using the monitoring (energy consumption, water use etc) and advice provided by the chatbot, if the owner offered you a partial refund (1% - 3% of the cost of the booking) at the end of your stay?'*

In question 14, we recorded an average interest of 6.71, dividing the sample of 200 people into two distinct groups: those who rated below average (47 participants) and thus show less interest in sustainability, and those who rated at or above average (153 participants). Regarding the second question, 171 participants (85.5%) showed interest in the idea of reducing energy consumption by using AI and getting a refund. This remarkable take-up of the questionnaire prompted us to conduct further analyses.

We divided our group of 200 people into two categories: those interested in sustainability, who gave a score of more than 6 out of 10 to this aspect, and those less interested, whom we will call 'non-sustainable people' and who gave a score of less than 6. Among the 153 people interested in sustainability, 91% (139 people) showed interest in adopting technological solutions to reduce energy consumption. This figure underlines a growing interest in sustainability and a real willingness to adopt more eco-friendly practices with the support of innovative technologies.

However, what is even more interesting is the reaction of participants less inclined towards sustainability. Despite their initial lack of interest, more than half of this group (66%, or 31

people) were open to changing their behaviour in favour of more sustainable practices if appropriate incentives were provided. This suggests that, even among those who may not be sensitive to sustainability initially, there is a potential to adhere to virtuous behaviour when appropriate incentives are present. This dynamic reveals the importance of creating an enabling environment and providing targeted incentives to promote sustainable behaviour even among those who may be less inclined to change.

In order to confirm the relationship between interest in sustainability and the intention to adopt eco-sustainable behaviour supported by AI, we conducted a one-factor Anova test using 'sustainable grades' as an independent variable, assigned by the respondents in response to question 14. These scores reflect the participants' level of environmental interest and sensitivity. The answers to question number 15 were used as dependent variables, with value 1 assigned to 'yes' answers and value 0 to 'no' answers. During the analysis, we observed a total variance of 5. This value indicates substantial diversity in participants' responses, suggesting that there are significant differences in their levels of interest and propensity towards eco-sustainable behaviour supported by AI.

Setting the significance level (α) to 0.05 and considering 198 degrees of freedom (due to a missing response), the test result indicated a p-value below α (Table 3, Appendices). This result confirms the presence of a statistically significant relationship between 'sustainable grades' and the intention to adopt sustainable behaviour supported by AI. These results suggest that a greater interest in sustainability is associated with a greater willingness to embrace eco-sustainable AI-supported solutions in hospitality. This relationship may have significant implications for the management and development of corporate policies aimed at sustainability, offering solid empirical support for the effectiveness of such solutions in promoting eco-conscious behaviour among consumers.

6.1.2.2 Findings

The analysis conducted offers a detailed and significant insight into the correlation between interest in sustainability and the adoption of eco-friendly behaviour supported by artificial intelligence in the hospitality industry. This research provides solid confirmation of the hypothesis that the use of artificial intelligence can positively influence the sustainable behaviour of guests.

The division of the sample according to interest in sustainability revealed interesting trends. The group interested in sustainability showed a significant predisposition towards reducing energy consumption through AI-based solutions, highlighting a concrete willingness to adopt more eco-sustainable practices. This indicates a growing consensus on the importance of sustainability and a propensity to integrate innovative technologies to achieve these goals.

Particularly significant is the change observed in the attitude of those who might initially show limited interest in sustainability. This phenomenon reveals a crucial behavioural dynamic in hospitality. Interestingly, a significant percentage of this category was open to changing their behaviour towards more eco-sustainable practices when offered appropriate incentives.

This indicates that although they may initially show indifference towards sustainability, adopting approaches that provide suitable incentives can positively influence their propensity to follow eco-sustainable behaviour. This phenomenon provides clear support for the hypothesis that the availability of suitable incentives, such as the use of artificial intelligence to monitor guests' behaviour and provide information and advice on sustainable practices, can act as a catalyst for the adoption of more sustainable practices.

The statistical confirmation obtained through the one-factor Anova test further reinforces these observations, indicating a significant correlation between interest in sustainability and intention to adopt eco-sustainable behaviour supported by AI (Table 3, Appendices). These findings

underline the importance of integrating AI-based solutions to promote sustainable behaviour in the hospitality industry, offering relevant implications for business management and policy development. In other words, they demonstrate that the environment and conditions can play a key role in shaping individuals' decisions and behaviour, including with regard to sustainability. A holistic strategy that raises guests' awareness of the importance of sustainability and provides tangible incentives could be crucial in engaging a wide range of individuals in adopting more sustainable practices, thus contributing to a significant transformation in the hospitality industry towards greater environmental sustainability.

6.1.2.3 Implications

The implications of this research are profound for the hospitality industry, offering valuable insights into how AI can promote sustainable behaviour among guests. By harnessing AI technologies, hospitality businesses have the opportunity not only to optimise their operations, but also to promote a culture of environmental responsibility. The results reveal a clear correlation between guests' interest in sustainability and their propensity to adopt eco-sustainable practices facilitated by AI interventions. Moreover, the study highlights the effectiveness of targeted incentives, such as refunds or rewards, in motivating guests to embrace sustainable behaviour, even those who initially show less inclination towards sustainability. This underlines the importance of creating an enabling environment and providing tangible incentives to promote eco-conscious actions. Hence, the research underlines the potential of AI-powered solutions in driving significant transformations in the hospitality industry towards greater environmental sustainability, offering valuable implications for property management and policy development.

7. Solutions and practical applications (Group part)

Using distinct qualitative and quantitative research approaches, we investigated and examined the perspectives of both hosts and guests within the short-term rental industry, with a special

emphasis on sustainability. We developed specific hypotheses which, upon evaluation, revealed significant implications for all considered research questions.

Despite representing opposite sides in the short-term rental industry, both hosts and guests have shown a clear interest in implementing Artificial Intelligence (AI) to promote sustainability and improve the sector, although for different reasons. Hosts primarily use AI to reduce energy costs, streamline customer service, and attract environmentally conscious customers. Conversely, guests are motivated to use AI for more effective customer service, participation in reimbursement programs, and contributing to minimizing the environmental impact of the industry. These dynamics underscore the potential of AI as a beneficial tool for both parties involved in the hospitality sector.

Moreover, economic interests primarily motivate both hosts and guests, often preceding ethical considerations. Within this framework, AI emerges as an indispensable tool for enhancing sustainability awareness and identifying unexplored opportunities for cost reduction that benefit hosts and generate additional revenue for guests. Effective collaboration between hosts and guests is essential, as they mutually influence each other's choices, and their balance can influence the sector's sustainability and efficiency.

During our research, we identified three principal applications through which AI could profoundly influence this sector: “Intelligent energy consumption analysis”, “Project refund” and “Chatbots as customer service and concierge agents”. We will proceed by exploring each of these applications, beginning with the “Intelligent energy consumption analysis”.

7.1 Project Refund: economic incentives for sustainable behaviour and attracting sustainability-oriented consumers (Filippo Fuscagni)

As both quantitative and qualitative analyses reveal, interest and active participation in sustainability tend to increase when economic incentives are offered alongside moral ones. In this context, we propose the use of AI to integrate these economic incentives with sustainability

themes. AI can enhance awareness of sustainability and reveal cost-reduction opportunities that would otherwise remain hidden, benefiting both hosts and guests. Effective collaboration between hosts and guests is crucial for the implementation of this initiative, as engagement from both parties is essential: without guest commitment, hosts lack sufficient incentive to invest in these technologies; similarly, without reimbursement from the host, guests are not motivated to adopt more environment-responsible behaviours.

Our qualitative analyses show that many hosts consider constant monitoring of energy consumption essential for developing effective cost-reduction strategies. Currently, the home automation market offers the possibility to install smart home systems with remote control and continuous monitoring. Our proposal is to leverage these technologies by integrating a chatbot in apartments that offers practical advice for more sustainable behaviour. For example, the chatbot could provide precise instructions for recycling, suggest how to organize food in the refrigerator, remind the importance of turning off the water, adjust indoor temperature based on outdoor conditions and the power of the solar panel, and indicate the most opportune times to use appliances like washing machines or dryers. These measures not only help hosts reduce energy costs but also bring tangible benefits to the environment.

To further encourage the transition to more sustainable practices, we propose monitoring energy consumption and quantifying its economic value at the end of the stay. Artificial Intelligence can calculate the daily consumption of guests and assess the energy cost based on current prices. Energy-saving levels can be established; guests who fall into these tiers would receive an economic refund as recognition of their responsible behaviours towards the apartment and the environment. Moreover, a quantitative study highlights the effectiveness of specific incentives, such as refunds or rewards, in motivating guests to adopt sustainable behaviours, even among those who initially show less inclination towards sustainability. This initiative not only promotes the development of ecological habits among guests but also supports the adoption of

a circular economy that benefits all stakeholders in the hospitality sector, positively influencing sustainable behaviours.

Additionally, this initiative could foster the development of a sustainable community on short-term rental platforms, enabling the use of refunds to secure discounts at other sustainable facilities or for local eco-friendly activities such as hiking, canoeing, biking, etc. This strategy promotes a virtuous cycle in which all stakeholders engage in sustainable business practices: hosts save on energy costs and attract sustainability-conscious consumers, guests benefit from refunds or discounts on various activities and amenities, the community gains from the sustainable measures implemented by hosts, and the environment benefits from reduced waste.

This emphasizes the importance of creating a favourable context and offering tangible incentives to promote ecologically conscious behaviours. The research thus underscores the potential of AI-based solutions to drive significant transformations in the hospitality sector towards greater environmental sustainability, offering valuable implications for property management and the development of sustainability-oriented policies.

8. Conclusion (Group part)

We believe that the future of the short-term rental sector is intricately linked to the utilization of Artificial Intelligence (AI) and new technologies, which are essential in addressing the primary challenges encountered so far. The ideas presented are just a starting point, as AI has diverse applications within this sector. AI has the potential to be a revolutionary innovation in shifting the industry toward higher sustainability and efficiency.

This development results from the synergetic integration of the solutions we have identified and which we can see from Figure 3 (Appendices): “Intelligent energy consumption analysis” enables hosts to select optimally sustainable and efficient technologies for their properties, considering both the specific needs of guests and the historical energy consumption data of the

apartment. Additionally, this analytical tool facilitates the calculation of “Refunds” for guests based on their demonstrated sustainable behaviour during their stays. This functionality is further enhanced by “Chatbots”, which not only streamline customer service for hosts and enrich the guest experience but also empower hosts to remain abreast of the latest available technologies and provide guidance to guest on adopting more sustainable practices to maximize their refunds.

Leveraging the robust capabilities in analytics, data storage, and processing speed of AI within this sector yields numerous benefits. For hosts, AI represents an enhancement in energy and operational efficiency, as well as increased visibility by meeting the demands of sustainability-oriented guests. For guests, it offers the opportunity to receive economic recognition, more personalized service, and a more environmentally responsible stay. Beyond these stakeholders, the entire community and the environment also benefit, as AI promotes more responsible environmental behaviours and fuels a virtuous cycle, incentivizing everyone to adopt more sustainable practices.

However, it is crucial to emphasize that the implementation of AI cannot occur in isolation. Effective integration of these solutions with existing technologies and business processes is imperative to maximize benefits and ensure continuous innovation within the hospitality sector. This approach not only enhances operational efficiencies but also fosters an ecosystem conducive to sustained technological advancement.

In conclusion, we assert that the adoption of AI and emerging technologies is not merely advantageous but fundamental to the future of the short-term rental sector. By embracing these innovations, the industry can anticipate not only improved service delivery and operational efficiencies but also a substantial shift towards more sustainable and personalized guest experiences.

9. Understanding of study limitations (Group part)

Our study employed quantitative methods for research questions 1-5 and qualitative methods for research questions 6-8, providing comprehensive insights into the impact of Artificial Intelligence (AI) on the hospitality sector. Recognizing the limitations of each approach is crucial for accurately interpreting the results and expanding the scope of future research.

In our quantitative analysis, we gathered significant insights into the perceptions and impacts of AI concierge chatbots and sustainable technology in the travel and hospitality sector. Despite its valuable contributions, it is important to acknowledge various limitations that could affect the interpretation and generalizability of the results.

A primary limitation concerns the sample size and its demographic diversity. Although we obtain 200 responses to the survey, this still represents a small or demographically homogeneous sample, which restricts the ability to generalize results to a broader population. The findings may predominantly reflect the opinions of specific demographic groups based on geographical location, age, or socioeconomic status. Another limitation is the use of self-reported data, which introduces inherent biases, such as social desirability bias. Participants may provide responses they perceive as socially acceptable rather than those reflecting their true opinions. This bias is particularly concerning given that participants are mostly acquaintances of the authors, who might feel obliged to express greater interest in chatbots or sustainability to support our' research.

Another significant limitation involves the factors included in the regression analysis. The study may not have fully accounted for all potential variables influencing user perceptions and behaviours. For example, the regression analysis for question 3 could have been enriched by including other critical factors such as prior technological experiences, cultural attitudes towards AI, and specific travel-related needs that were not comprehensively controlled for in the analysis. This inclusion could refine the results, enhancing the explanatory power of the

models used, which currently exhibit modest R-squared values (0.341) and Adjusted R-squared values (0.299).

Regarding the qualitative part of our analysis, we conducted interviews with ten hosts. Although this analysis provided preliminary insights, the sample size could have been expanded to further strengthen the results. However, time constraints and the reluctance of many hosts to share sensitive information hindered significant sample expansion. Methodological expansion could have included large-scale interviews segmented by country to explore different perspectives on AI adoption and interest in reducing environmental impact. Such research extension would have allowed us to analyse how cultural, economic, and political variables influence AI usage across different national contexts. A detailed investigation like this could have identified regions particularly receptive to adopting innovative technologies, facilitating the identification of innovation clusters and areas of technological resistance.

Furthermore, the scope of the research could have been extended to include not only private residences but also hotels, bed and breakfasts, hostels, and other hospitality facilities. This broader approach would have provided a more complete and representative view of the impact of our proposals on the entire hospitality sector. By analysing different types of facilities, it would have allowed for a detailed comparison of results across various facility types, promoting a thorough assessment of the effectiveness and scalability of our proposals in the hospitality sector.

We could have conducted a simulation of the prototype in a home setting. Such a simulation would have provided a clear, empirical overview of the immediate effects of the proposed solutions in terms of energy efficiency and sustainability, among other relevant indicators. This would have also allowed us to assess the direct impact on the performance of the dwelling, including energy savings, carbon emission reductions, and other tangible benefits.

Finally, interviewing leading platforms such as Airbnb and Booking could have allowed us to explore common challenges for hosts and their views on sustainability. This could have also included assessing the possibility of implementing incentives for sustainable behaviours and discussing the feasibility of integrating such initiatives. Engaging in dialogues with startups and entities in the water, energy, and sustainability sectors, as well as with software developers and engineers, would have broadened our understanding of development methodologies, associated costs, and the compatibility of innovative technologies with existing infrastructures.

By addressing these limitations and considering additional efforts that could have been implemented, we aimed to provide a comprehensive understanding of our contributions and the scope of future research in the field of AI adoption in the hospitality sector.

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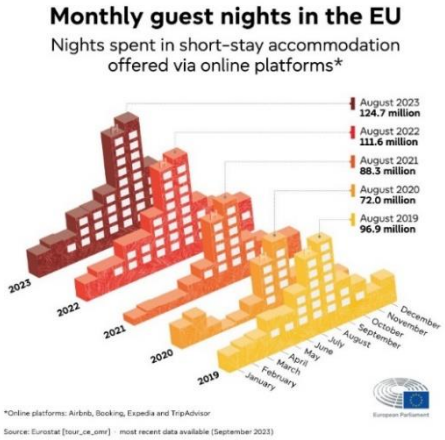
11. Appendices (Group part)

11.1 Table of Figures (Group part)

Figure 1 - The number of nights guests spent in short-stay accommodation in the EU using online platforms.

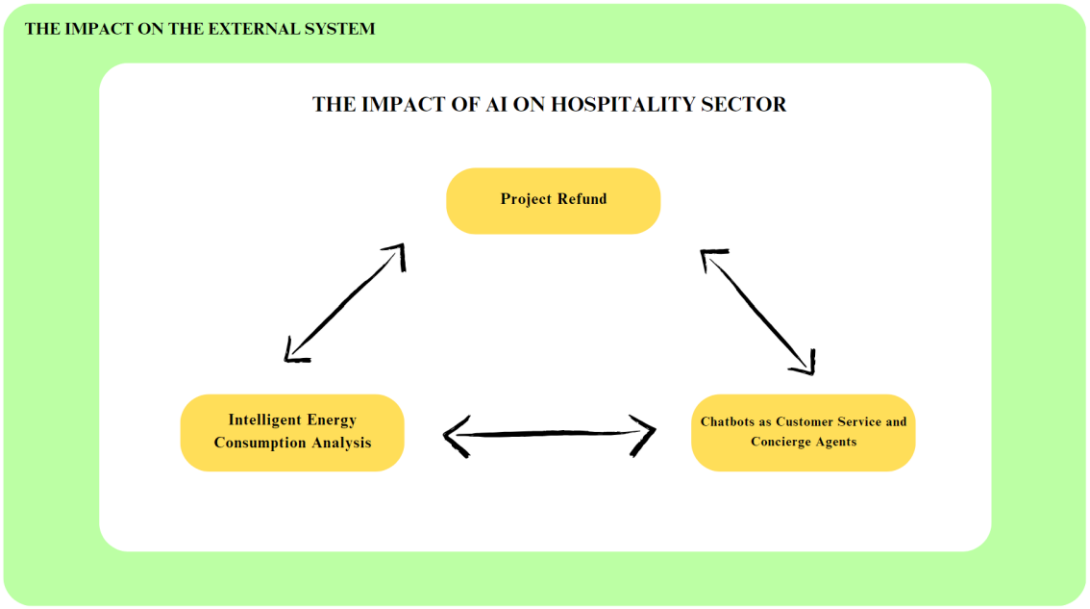


Sources: European Parliament 2023

Figure 2 - The state-of-the-art hospitality services.

Sources: Kansakar, Munir e Shabani 2019

Figure 3 - The impact of AI on the hospitality sector



Sources: Authors

11.2 Index of Tables (Filippo Fuscagni)

Table 1 - Sample demographic distribution

Age	Generation	N.
0-18	Underage	2
18-24	Gen Z	120
25-34	Gen Y	13
35-44	Gen X	4
44-54	Gen X	14
55+	Baby Boomer and Boomer	47
Total		**200**

Sources: Authors calculations

Table 2 - Top 3 preferences for each generation

GENERATIONS	INSULATION TECHNOLOGIES	SOLAR PANELS	RECYCLING BINS
GEN Z	4,116	4,148	4,071
GEN Y	4,148	4,148	4,050
GEN X	4,143	4,154	4,058
BOOMER	4,138	4,147	4,030

Sources: Authors calculations

Table 3 - One-Factor Anova Test: Statistical Validation: sustainable grades (question 14) and the willingness to participate in the refund initiative (question 15)

ANOVA Table

Y |Sustainability grad	X|AI refund (YES/NO)	
	Yes	1
	No	0

Y Bar (Variable)	6,7	n	199
Y Bar (1)	7,0	n (1)	171
Y Bar (0)	4,7	n (0)	29
			200

α	0,05

Other way to get to Total Sum of Squares!	
Variance	5,0
Total	997,1

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Sum of Squares	F	CV	P-Value	
Factor (Gender)	133,8	1	133,8	30,5	3,89	0,000000	-> CV(1,19,0.05) = **3,89**
Error	863,3	197	4,4				
Total	997,1	198	5,0				

Conclusions	Reject Ho	P-value < α	Variables are dependent

F > CV: **Reject H0**, with a 0.05 level of significance, meaning that I do not believe that the mean value parameters are the same for ... So Y

F < CV: **Fail to Reject H0**, with a 0.05 level of significance, meaning that I believe that the mean value parameters are the same for ... So Y

Sources: Authors calculations

11.3 Survey questions (Group part)

1. How old are you?
    - Under 18
    - 18 – 24
    - 25 – 34
    - 34 – 44
    - 45 – 54
    - 55+
2. Are you currently a student or other?
    - Student
    - Other

3. How often do you use Airbnb/Booking?
    - Never
    - Rarely (less than once a year)
    - Occasionally (1-2 times a year)
    - Regularly (3-5 times a year)
    - Very often (more than 5 times a year)
4. On average, how many days does your short-term rental stay last?
    - Up to 2 days
    - From 3 to 5 days
    - From 5 to 10 days
    - More than 10 days
5. What is the main reason for your short-term rental stays?
    - Vacation
    - Work
6. How interested are you in the idea of a chatbot concierge that uses AI to offer you personalized suggestions and gives you the chance to book experiences and services directly through chat?
    - Very interested
    - Quite interested
    - Indifferent
    - Slightly interested
    - Not interested at all
7. What services or experiences would you like the AI chatbot concierge to suggest you and help you to book? (Select all the options you find appropriate)
    - Restaurants

- Tours (museums, guided torus, etc)
- Transportation (e.g., car rental, taxi)
- Special events (concerts, shows)
- Unique experiences (local cooking lessons, private tours, etc.)
- Nightlife (clubs, etc)

8. How much would you rate the following suggestion sources? Rate from 1 (very bad) to 5 (very good)
    - Host
    - Local friend
    - Review based research engine (ex. Google, TripAdvisor, etc.)
    - Travel influencers or blogger
    - Activities booking platforms (Airbnb Experiences, Booking, Ryanair, Viator, GetYourGuide, Kayak, etc.)
    - Online travel magazines (ex. Lonely Planet, Rick Steves)
    - Personal Concierge (Amex, Quintessentially, etc.)
    - AI Chatbot Concierge
9. Would you rate to the AI chatbot concierge increase if you knew that the AI chatbot concierge suggests only activities and services that are selected and tested by a local expert?
    - Maybe
    - Yes
    - No
10. If yes, how much would the new rate be?
    - 1
    - 2

- 3
- 4
- 5

11. How important are the following factors in choosing your source of suggestion? Please rate from 1 (not important) to 5 (very important)
    - Quality of recommendations
    - Tailor made recommendations
    - Respect for privacy
    - Low price
    - Easy to use
    - Fast answers
12. How much would you be willing to pay for an AI Chatbot Concierge?
    - I am not willing to pay
    - Up to €5 per day
    - From €5 to €10 per day
    - From €10 to €20 per day
    - More than €20 per day
13. Do you have any suggestions or features you would like to be included in the chatbot concierge?
14. On a scale from 1 to 10, how important do you consider the sustainability of the accommodations you stay in? (1 = Least important, 10 = Most important)
15. Would you be willing to decrease your energy consumption within the accommodation by using the monitoring (energy consumption, water use etc) and advice provided by the chatbot, if the owner offered you a partial refund (1% to 3% of the booking cost) at the end of the stay?

- Yes
- No

16. What are the main benefits you think could come from a sustainable accommodation? (Please select all the relevant answers)
    - Reduction of environmental impact
    - Improvement of the overall stay experience
    - Awareness and engagement of guests in adopting sustainable practices
    - Contribution to the protection of the environment
    - Increase overall value of the accomodation
17. What do you think are the main problems or challenges with sustainability in accommodations where you have stayed in the past? (Please select all the relevant answers)
    - Lack of recycling practices
    - Excessive consumption of resources (water, energy)
    - Lack of transparency regarding sustainable practices adopted
    - Difficulty in accessing sustainable options (e.g., public transportation, eco-friendly restaurants)
    - Other
18. Do you think the use of advanced technologies such as Artificial Intelligence (AI) can contribute to improving the sustainable guest experience during a stay in accommodation?
    - Yes
    - No

19. What are the main reasons you would appreciate the use of AI and new technologies to improve the sustainable experience during the stay? (Please select all the relevant answers)
    - Facilitation in adopting sustainable practices (e.g., energy-saving tips, smart waste management)
    - Engagement of guests through interactive sustainability experiences
    - Curiosity and desire to experience new technologies
    - Ease of use and convenience in accessing sustainable services
    - Other
20. What are the main reasons you think the use of AI and new technologies cannot improve the sustainable experience during the stay? (Please select all the relevant answers)
    - Lack of trust in the effectiveness of AI technologies for sustainability
    - Concerns about privacy and data security
    - Preference for more traditional approaches to sustainability
    - Other
21. How important do you consider the presence of the following sustainability components? Rate each option from 1 to 5, where 1 = Least important and 5 = Most important
    - Smart thermostats for optimizing energy consumption in heating and cooling
    - LED lighting and other low-energy lighting solutions
    - Improved building insulation to reduce the need for heating and cooling
    - Solar panels for renewable energy generation
    - Low-flow faucets and showers to reduce water consumption
    - Maintenance to avoid water wastage, such as prompt repair of leaks
    - Rainwater collection systems for irrigation

- Recycling bins to facilitate recycling
- Promotion of sustainable mobility, including providing information on public transport and offering bicycles or electric vehicles
- Sustainable cleaning products
- Organic or eco-friendly toiletries
- Sustainable textiles for linens, towels, and other textiles
- Low-energy appliances
- Information on the accommodation's sustainability efforts to guests
- Sustainable house manual, with tips on how to reduce energy wastage and other eco-friendly practices

22. What other considerations would you like to share regarding sustainability in accommodations and its impact on stays?