Key drivers for the adoption of circular economy practices in the tourist accommodation sector

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Abstract

Purpose – This article assesses the degree of adoption of the circular economy model in the tourist accommodation sector. Additionally, the study aims to understand whether the type of accommodation, size, and year of construction or remodelling have an impact on the adoption of circular economy practices.

Design/methodology/approach – The study is based on a survey administered to directors and owners of tourist accommodation facilities in Portugal. The questionnaire was developed based on an extensive literature review of circular economy practices in the accommodation sector.

Findings – Accommodation companies currently operate in a linear economy model and are still in the early stages of transitioning to a more circular economic model. Among the most commonly implemented practices are those that represent expenditure savings for accommodation companies. The findings also suggest a growing awareness and commitment to sustainability and circular economy practices in the tourist accommodation sector, particularly in more recently constructed or renovated accommodation.

Originality/value – To the best of our knowledge, this study is the first to evaluate the accommodation characteristics that impact the adoption of sustainability and circular economy practices in the tourist accommodation sector. It contributes to the literature by providing primary quantitative data supporting the adoption of such practices.

Keywords - Circular economy practices, tourist accommodation characteristics, sustainability practices, accommodation sector, pairwise comparisons

Paper type - Research paper

Introduction

Tourism can have several adverse impacts on its surroundings and the environment, primarily because it follows a linear economy model that uses various natural resources, including land, water, energy, and food, resulting in negative externalities (Daskin *et al*., 2020; Florido *et al*., 2019; Manniche *et al*., 2021; Rodríguez *et al*., 2020). On the other hand, the tourism industry has great potential to contribute to the achievement of the United Nation's (UN) Sustainable Development Goals (SDGs) (Rodríguez *et al*., 2020), including playing a relevant role in the global response to climate change through more efficient and less polluting operations (Girard and Nocca, 2017; Ponte *el al*., 2021). Furthermore, tourism can link different dimensions of sustainability, as it depends on the presence of environments, cultures, and communities (Girard and Nocca, 2017; Martins *et al*., 2022) and is an important contributor to employment and gross

domestic product (GDP) in many countries and regions (Daskin *et al*., 2020; Rodríguez *et al*., 2020). Moreover, the increasing consumer concern about issues related to biodiversity and sustainability is a clear trend in tourism product policies (Pekerşen and Canöz, 2022; Santos *et al*., 2023; Vargas-Sánchez, 2018). This highlights the importance of balancing the various aspects of sustainability as one of the main determinants of competitiveness and a critical factor in ensuring long-term sustainable tourism. (Einarsson and Sorin, 2020; Girard and Nocca, 2017; Ponte *el al*., 2021; Santos *et al*., 2022). In this context, the concept of the circular economy (CE) can be implemented in the tourism industry to minimise negative impacts on the environment and reduce the consumption of natural resources, waste, and CO2 emissions (Gaffar *et al*., 2021; Rodríguez *et al*., 2020).

As with other economic activities, it is possible to apply circular business models to tourism companies by reconfiguring their supply chain and value system (Vargas-Sánchez, 2019). According to Rodríguez *et al*. (2020), applying CE principles can help reduce negative implications for social and environmental sustainability and this is crucial for the sustainable continuity of cultural tourism through heritage rehabilitation and conservation initiatives. The literature suggests that there are advantages for the tourism sector in adopting circular practices, which can contribute to achieving sustainability, innovation, and value creation goals (Einarsson and Sorin, 2020; Florido *et al*., 2019; Girard and Nocca, 2017; Pamfilie *et al*., 2018; Rodríguez *et al*., 2020; Sorin and Sivarajah, 2021). Einarsson and Sorin (2020) argue that a CE-inspired travel industry can lead to a more resilient and optimised industry ecosystem.

Although CE is becoming increasingly relevant, academic research is still considered insufficient and scarce by many authors, especially in the context of tourism in general and the tourist accommodation sector in particular (Florido *et al*., 2019; Gaffar *et al*., 2021; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019; Sorin and Sivarajah, 2021; Vargas-Sánchez, 2018). The few existing studies are mainly theoretical and not based on evidence provided by quantitative data. Moreover, there is a gap in the literature regarding the relationship between accommodation characteristics and the adoption of CE practices by tourist accommodation companies. This study aims to address the following question: *Do the characteristics of tourist accommodations affect the adoption of CE practices in the sector?*

The general objective of this article is to evaluate the extent to which CE practices are adopted in the tourist accommodation sector. The specific aims are to examine: (i) whether the type of accommodation, (ii) the size (number of rooms), and (iii) the year of construction or renovation influence the adoption of CE practices.

Theoretical Framework

Defining the Concept of CE

The CE concept is gaining attention among scholars and policymakers. According to Ghisellini *et al.* (2016), CE mainly arises from three main actions: reduction, reuse, and recycling. Geissdoerfer *et al.* (2017) present a more elaborated concept by proposing that CE should be seen as a regenerative system in which input and waste of resources and energy are reduced through design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling. Kirchherr *et al*. (2017) suggest that CE is an economic system based on business models that draw on the logic of reduction, reuse, recycling and recovery of materials in production, distribution, and consumption processes to achieve sustainable development, environmental quality, economic prosperity and social equity. They also conclude that the implementation of CE can be improved by a systemic design, production, and consumption approach and by developing a circular culture and governance.

The Ellen MacArthur Foundation (EMF) played a significant role in defining and promoting the CE concept. Their definition synthesises key schools of thought and is considered the most widely accepted (Sorin and Sivarajah, 2021). EMF has published multiple documents on CE,

including reports and definitions of the term, which evolved and culminated in the following definition:

> "A systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design: eliminate waste and pollution, circulate products and materials (at their highest value), and regenerate nature. It is underpinned by a transition to renewable energy and materials. Transitioning to a circular economy entails decoupling economic activity from the consumption of finite resources. This represents a systemic shift that builds long-term resilience, generates business and economic opportunities, and provides environmental and societal benefits (EMF, 2021a).

This framework aims to protect the environment, promote sustainable development and improve resource efficiency by transitioning from a linear to a circular model (Ioannidis *et al*., 2021). The EMF states that the smaller the circle, the more valuable the strategy and that a systems perspective is essential for CE to be effective (EMF, 2015b). The reduction principle involves minimising the input of resources and waste through efficiency in production and consumption processes (Ghisellini *et al*., 2016). Reuse strategies aim to use products or components that are not waste for the same purpose. At the same time, recycling involves recovering waste materials that are reprocessed into products, components, or substances (European Commission, 2008). While recycling is the most common component in CE definitions (Kirchherr *et al*., 2017), it is considered the least sustainable option regarding resource efficiency and profitability (Ghisellini *et al*., 2016; Ioannidis et al., 2021). Florido *et al*. (2019) argue that reusing is more important than recycling, as it preserves the material in its original form. Kirchherr *et al*. (2017) argue that some definitions of CE do not prioritise the three CE principles presented in the EMF definition, leading organisations only to make minimal changes in their business model.

Adoption of the CE in the accommodation sector

To-date, the hotel sector's adoption of CE principles is limited and under-researched (Manniche *et al*., 2021). Studies show that the main actions focus on energy, water, building and remodelling and waste. CE presupposes cooperation with local organisations to solve issues such as food waste, sharing economy platforms, self-sufficiency in energy, and circular synergy for self-sufficiency in local food and bio-waste as fuel and fertilisers (Manniche *et al*., 2021).

Girard and Nocca (2017) argue that the hotel industry's CE initiatives are mainly focused on economic advantages, such as waste, energy, and water reduction. Vargas-Sánchez (2018) states that circularity efforts in the sector have focused on five areas: waste management, water conservation, energy conservation, sustainable purchasing, and employee engagement. Rodríguez *et al*. (2020) highlight that current literature on the subject focuses mainly on construction, energy and water consumption, reuse, new uses and less on other aspects such as business model changes, synergies with agriculture, or using the CE as a model for inclusive and sustainable tourism. According to Manniche *et al*. (2017), circular models for the construction industry in lodging are highly relevant for hotels. The EMF (2015) states that there are opportunities for circular development in various areas, such as the reuse and recycling of high-value components and materials, valorisation of residual materials, design that considers disassembly and waste prevention, and construction of buildings with non-toxic materials. Einarsson and Sorin (2020) also argue that circular and sustainable decisions during the design, construction and remodelling phases influence the potential for creating value in the operational phase of hotel assets. Manniche *et al*. (2017) also suggest that companies should

consider purchasing or renting used or refurbished furniture, utensils and equipment and depend on upstream access in the supply chain through other businesses based on circular use.

Manniche *et al*. (2017) highlight that the operational phase of a hotel presents opportunities for the application of circular strategies, particularly regarding energy and water flows. Such strategies are becoming popular as they strongly influence financial business performance (Yenidogan *et al*., 2021). The use of renewable energy is a central aspect of the CE, reducing dependence on resources and increasing system resilience (EMF, 2015b). The importance of renewable energy sources in the accommodation sector is stressed by Rodríguez *et al*. (2020), Silva (2020), and Girard and Nocca (2017). When access to these sources is not possible, the most circular approach is to reduce and optimise energy use within the company (Florido *et al*., 2019; Manniche *et al*., 2021; Santos *et al*., 2019). Florido *et al*. (2019) suggest that hotels should plan their facilities with resource management and waste elimination in mind and adopt strategic management plans with energy audits and goals for minimising consumption. Girard and Nocca (2017) also mention that energy savings in hotels can be achieved through investments in technologies such as energy-efficient lighting, refrigeration, and heating as well as through territorial management and behavioural changes.

Concerning water consumption in hotels, simple actions can be adopted, such as asking customers to reuse towels, installing water-efficient bathroom fixtures, storing rainwater, and installing low-flow showerheads and aerators on all faucets. Additionally, water reuse is a key aspect for hotels that want to move towards more circular business models, as it is common for potable water to be used for all water needs. An alternative is outsourcing hotel laundry, particularly towels and bed linen, to supply chain companies that adopt circular initiatives or renting bed linen, where the quality of the linens determines its potential for reuse instead of recycling (Santos *et al*., 2019).

Large hotels have used strategies such as separating greywater from wastewater, as the former can be recycled and used together with rainwater (Rodríguez-Antón & Alonso-Almeida, 2019). While measures that promote the direct use of untreated wastewater can be relatively easy to implement, the cost of developing treatment systems for wastewater recovery can sometimes be prohibitive (Manniche *et al*., 2017). Another possibility is to establish a synergy with the industrial sector, creating a business model in which the local industry uses the recovered wastewater. Industrial reuse is highly cost-effective when the process does not require potable water quality and when industries are located near sources of wastewater (Manniche *et al*., 2017).

In the operation of hospitality companies, the facility design has an impact on resource management and waste generation prevention (Manniche *et al*., 2017). Hotels can reduce waste by implementing strategies such as composting organic materials, which can contribute to soil regeneration, and by reducing food waste, for example, by offering set menus in their restaurants (Manniche *et al*., 2017). The reduction of food waste is a significant point of attention, as it is the main lever of value creation in the supply chain of hotel operators, with short-term return on investment, the potential for scale, and a direct positive effect on operational margins (Sorin and Sivarajah, 2021). Manniche *et al*. (2017) suggest that such financial benefits are applicable even if the company has not implemented circular policies but is simply attempting to reduce waste in its existing business model. Additionally, major hotel companies are also implementing measures to decrease their plastic consumption, such as eliminating single-use plastic straws and replacing plastic water bottles with reusable glass bottles (Rodríguez-Antón and Alonso-Almeida, 2019).

The "zero km menu" is also an important strategy for hotels as it supports the local/regional economy, minimises the ecological footprint and aligns with CE principles (Fernández-Gámez *et al*., 2020; Girard & Nocca, 2017; Santos *et al*., 2020). Additionally, separating food waste for

composting and offering more plant-based menu options can contribute to the CE (Manniche *et al*., 2017). The hotel industry can significantly reduce waste and support sustainable practices by implementing CE principles.

Additionally, the strategies for material reuse are also relevant as they align with the principles of the CE. Each prolonged cycle of use helps avoid the consumption of resources, energy, and labour required to create new products or components (EMF, 2015b). CE must retain non-renewable products in constant usage by establishing technical and economic cycles, reducing energy loss and de-materialising production and consumption. Additionally, adopting reusable container systems, reusing bottles and cups, and procuring drinks in barrels or containers intended for reuse instead of disposable bottles are all strategies that align with CE principles and contribute to reducing waste in the hotel industry (Manniche *et al*., 2017). Finally, waste that cannot be avoided should be appropriately separated and directed for recycling. Although reduction and reuse are considered more circular and sustainable than recycling in terms of resource efficiency and profitability (Ghisellini *et al*., 2016), the latter is easier to implement.

The literature on the intersection of the CE and the hospitality sector focuses on five main dimensions: management, construction and renovation, energy, water, and waste (see Table 1).

Table 1. Dimensions of CE in the hospitality sector

Variables	Sources
Management	
Servitisation of expenses with high-value assets / Suppliers with commercial models based on leases	Einarsson and Sorin, 2020 ; Florido *et al*., 2019 ; Manniche *et al*., 2017.
Suppliers with quality and environmental certifications	Einarsson and Sorin, 2020; Florido *et al*., 2019; Rodríguez Antón and Alonso-Almeida, 2019.
Collaborative trade	Florido *et al*., 2019.
Option for guests to reduce and offset the carbon footprint	Rodríguez-Antón and Alonso Almeida, 2019.
Team involvement in EC practices	Einarsson and Sorin, 2020.
Internal environmental management system	Einarsson and Sorin, 2020; Florido *et al*., 2019; Rodríguez Antón and Alonso-Almeida, 2019.
Construction and Renovation	
Construction design for waste prevention	Einarsson and Sorin, 2020; Florido *et al*., 2019; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Use of reused and recycled materials in construction	Einarsson and Sorin, 2020; Florido *et al*., 2019; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Use of non-toxic materials	Florido *et al*., 2019 ; Manniche *et al*., 2017.
Shared economy platforms/space sharing/resource mutualisation	Einarsson and Sorin, 2020; Florido *et al*., 2019; Girard and Nocca, 2017; Manniche *et al*., 2017.
Use of "smart" construction technologies	Manniche *et al*., 2017; Rodríguez Antón and Alonso-Almeida, 2019.
Building elements that generate a reduction in energy consumption in the operation phase	Rodríguez-Antón and Alonso Almeida, 2019.
Use of second-hand furniture, utensils and decoration (used), remanufactured or recycled material	Einarsson and Sorin, 2020; Florido *et al*., 2019; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Use of local material and labour	Einarsson and Sorin, 2020.
Energy	
Water heating	Manniche *et al*., 2017.
Energy management and monitoring	Florido *et al*., 2019 ; Manniche *et al*., 2017.
Use of renewable energy	Florido *et al*., 2019; Girard and Nocca, 2017; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019; Silva, 2022.
Own production of electricity	Manniche *et al*., 2017; Silva, 2022.
Energy-efficient cooling and heating of the environment	Girard and Nocca, 2017; Rodríguez-Antón and Alonso Almeida, 2019.
Energy-efficient appliances and systems	Rodríguez-Antón and Alonso Almeida, 2019.
Energy-efficient lighting	Girard and Nocca, 2017; Rodríguez-Antón and Alonso Almeida, 2019.
Water	
Water management and monitoring systems	Manniche *et al*., 2017; Rodríguez Antón and Alonso-Almeida, 2019.
Actions to reduce water consumption	Manniche *et al*., 2017; Rodríguez Antón and Alonso-Almeida, 2019.
Environmentally responsible laundry	Manniche *et al*., 2017.

Treatment/reuse of gray water	Florido *et al*., 2019; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Use of rainwater	Rodríguez-Antón and Alonso Almeida, 2019.
Waste	
Reduce the quantity and volume of the most important categories of waste: food, plastics and paper	Manniche *et al*., 2017; Rodríguez Antón and Alonso-Almeida, 2019.
Correct disposal of specific waste – food oil, electronic materials, stopper, batteries, textiles, computer consumables	Florido *et al*., 2019; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Waste management and separation for recycling - paper, glass, metal, plastics	Girard and Nocca, 2017; Rodríguez-Antón and Alonso Almeida, 2019.
Measures to reduce and prevent food waste - monitoring of waste, reduction of menus, individual dishes instead of buffets, seasonal foods grown in their vegetable gardens or local producers	Florido *et al*., 2019; Girard and Nocca, 2017; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Environmentally friendly, eco-certified bath and cleaning products	Girard and Nocca, 2017; Manniche *et al*., 2017; Rodríguez Antón and Alonso-Almeida, 2019.
Food waste composted or processed in anaerobic digesters / Synergy with local agriculture	Florido *et al*., 2019; Girard and Nocca, 2017; Manniche *et al*., 2017; Rodríguez-Antón and Alonso-Almeida, 2019.
Sharing excess food - food distribution networks or sharing platforms	Manniche *et al*., 2017.
Reuse of textiles	Florido *et al*., 2019 ; Manniche *et al*., 2017.

Source(s): Authors

Methodology

Survey instrument

The survey was developed based on an extensive literature review and consists of four sections. The first section includes an introduction to the study, information on the time required for a response, and an assurance of data confidentiality. The second section focuses on the respondents' self-perception of their knowledge regarding the concepts of sustainability and CE and the application of practices within their organisation. The third section inquires about the adoption of practices and actions. Finally, the fourth section considers the characterisation of the respondents, both in terms of the respondents themselves and their organisations. The questionnaire was pre-tested on a convenience sample of academics and hotel managers to assess the clarity and appropriateness of the questions, allowing for minor adjustments to be made.

Sample and data collection

The strategy chosen for sample selection was the non-probabilistic technique of convenience sampling. The databases of Turismo de Portugal and data from the Autonomous Regions of the Azores and Madeira were used to cover all existing tourist accommodation in Portugal. In the first phase of data collection, 4,571 emails were sent directly to establishments, with a request that managers respond to the questionnaire. In the second phase, the research team contacted the nine existing hotel associations in Portugal, asking them to share the research link among their members. In the third phase, a new link was disseminated via email to the same initial database to reinforce the earlier request. Throughout the three stages in which the survey remained open, a total of 199 responses were received. However, 24.1% of the respondents did not consent to the use of personal data, resulting in 151 valid responses.

Data analysis

Descriptive data analysis was conducted to determine the characteristics of the respondents. To deepen the analysis, nonparametric tests were conducted to determine the existence of significant statistical differences between groups of respondents. The Kruskal-Wallis test was

chosen to investigate potential differences and compare the distribution among multiple independent groups (Field, 2009).

Findings

Characteristics of the sample

Characterisation of respondents

Regarding the respondents' characterisation, 55.6% are male, 43.0% are female, and two chose not to disclose their gender (1.4%). Concerning the age of the respondents, the average age was 49.1 years. The age range of 40 to 49 years had the highest frequency, with 31.3% of the responses, followed by the age range of 50 to 59 years (26.5%). Considering the level of education, the results show that the majority, 76.2%, have a higher education degree, followed by 14.6% with a secondary education degree and 9.3% with vocational education.

Of the 114 respondents with higher education qualifications, 25.4% indicated management and economics, followed by tourism and hospitality (21.9%) and engineering (17.5%). As for the position held by the respondent in the accommodation company, most respondents hold management and executive positions (58.3%) or are owners (23.3%). Only 18.5% do not perform functions directly related to the organisation's management and 9.9% are in support functions (such as marketing and assistant management) with 5.3% in direct customer service (see Table 2)

Table 2. Characteristics of respondents

Characteristic of respondents	(%)
Gender	
Male	55,6
Female	43,0
I wish not to say	1,4
Age	
<29	9,5
30-39	12,2
40-49	31,3
50-59	26,5
60-69	13,3
>70	6,9
Mean	49,1 years
Education	
Professional education	9,3
Secondary education	14,6
Higher education	76,2
Training area	
Management/Economy	25,4
Tourism/Hospitality	21,9
Engineering	17,5
Marketing/Communication	7,0
Health	4,4
Other	23,7
Position held in the company	
Manager/Director	58,3
Owner	23,3
Management support	9,9
Other	8,6

Source(s): Authors

Characterisation of the accommodation establishments

Regarding tourist accommodation, 51.0% are classified as rural tourism accommodation, 33.1% are hotels, 9.9% are camping parks, and 6.0% correspond to self-catering units. The sample presents a similar profile to that of the population of registered establishments in the tourism authority in Portugal (Turismo de Portugal, 2022). Regarding the number of rooms, the average is 43.6 rooms, and the category with the highest frequency was up to 10 rooms, with 51.0% of the responses, followed by the category of 11 to 50 rooms, with 25.2%. Most establishments (60.0%) indicated that the year of construction or remodelling occurred less than eight years ago. Only 12.7% of the accommodation units had constructed or remodelled their facilities twenty or more years ago (see Table 3).

Table 3. Characteristics of the accommodation establishments

sample	(%)
Type of tourist accommodation	
Rural Tourism Accommodation	51,0
Hotel	33,1
Camping	9,9
Self-catering	6,0
Number of rooms	
Up to 10	51,0
11-50	25,2
51-100	12,6
101-200	6,3
> 200	4,9
Year of construction/remodelling	
2020-2022	27,3
2015-2019	32,7
2010-2014	18,0
2005-2009	9,3
2000-2004	6,7
< 1999	6,0

Source(s): Authors

Descriptive statistics

In this section, statistical analysis is performed on sustainability and CE practices in relation to five dimensions: management practices, waste management, construction and remodelling of buildings, energy, and water efficiency.

Each of the five dimensions integrates a combination of more basic and more circular practices. Regarding the dimension of energy efficiency, the most adopted practices are the more basic ones, such as *efficient lighting* ($\bar{x}$: 3,82) and *thermal insulation* ($\bar{x}$: 3,75), and *class A or higher equipment* ($\bar{x}$: 3,53). Regarding the dimension of water efficiency, the results obtained point in the same direction, with the most used measures referring to the reduction of water consumption, which translates into cost reductions for the company, namely, *changing towels upon request* ($\bar{x}$: 4,62), *low-consumption flush toilets* ($\bar{x}$: 4,19), and *guests invited to report water loss* ($\bar{x}$: 4,02). Conversely, one of the practices characterised as more circular, *lower quality water used for irrigation* ($\bar{x}$: 3,41) is the third least implemented measure. Concerning waste management, adopting more circular practices is even less regularly implemented, as three of these practices are the most poorly evaluated. In terms of management practices, the adoption of asset rental (*the company prioritises renting* - $\bar{x}$: 2,50), and resource sharing (*underutilisation of spaces is evaluated* $\bar{x}$: 3,69; *Actions are taken to share underutilised spaces* $\bar{x}$: 3,41) is not yet widely implemented, although these practices are relevant for CE. Finally, the practices integrated into the construction and remodelling dimension received the lowest ratings, with all items scoring below 4. Two of the measures characterised as more circular scored

below 3 (*project with disassembly possibility* $\bar{x}$: 2,76; *Spaces designed in a modular way* $\bar{x}$: 2,58) (see Table 4).

Table 4. Sustainability and CE dimensions

Management practices	$\bar{\chi}$	s.d.
Energy efficiency is a concern	4,49	0,701
Water efficiency is a concern	4,42	0,743
Waste management is a concern	4,36	0,796
Sustainability is a frequent topic in meetings	4,03	1,006
The goal system includes sustainability actions	3,93	1,020
The goal system includes CE actions	3,81	1,124
Internal environmental management system	3,74	1,104
CE is a frequent topic in meetings	3,72	1,109
Underutilisation of spaces is evaluated	3,69	1,040
Internal environmental management system	3,60	1,189
Actions are taken to share underutilised spaces	3,41	1,168
Prioritise renting	2,50	1,361
Waste management	$\bar{\chi}$	**s.d.**
Separation of waste for recycling	4,56	0,717
Proper disposal of specific waste	4,26	0,964
Elimination of unnecessary disposable items	4,19	0,998
Reusing damaged textiles	3,85	1,320
Choosing products in refillable packaging	3,78	1,154
Monitor food waste	3,74	1,354
Minimise the use of packaging in restaurants	3,73	1,291
Using foods grown locally (less packaging)	3,73	1,428
Providing rechargeable amenities in rooms	3,72	1,476
Ecologically friendly bath and cleaning products	3,66	1,306
Redirect organic waste for composting	3,50	1,540
Reducing menus and providing individual dishes	3,30	1,621
Opting for textiles made with recycled materials	3,01	1,296
Donating left-over food	2,75	1,520
Composting organic waste	2,32	1,363

Construction phase	$\bar{\chi}$	s.d.
Use of local materials	3,82	1,161
Reduce energy during operation	3,75	1,229
Use of non-toxic materials	3,53	1,469
Use of second-hand furniture	3,37	1,486
Use of recycled materials	3,05	1,432
Smart construction technologies	3,03	1,400
Project with disassembly possibility	2,76	1,468
Spaces designed in a modular way	2,58	1,490
Energy efficiency	$\bar{\chi}$	**s.d.**
Use of energy-saving light bulbs	4,74	0,559
Thermal insulation of windows	4,15	1,191
Class A or higher equipment	4,02	1,122
Solar panels for water heating	3,84	1,484
Air co. regulated by the customer	3,75	1,540
Use of renewable energy	3,68	1,252
Auto. sensors public area lighting	3,64	1,359
Solar panels for energy production	3,11	1,424
Systems for managing consumption	3,05	1,288
Periodic energy audits carried	3,05	1,458
Auto. system turning off air co.	2,28	1,434
Water efficiency	$\bar{\chi}$	**s.d.**
Changing towels upon request	4,62	0,871
Low-consumption flush toilets	4,19	1,168
Guests invited to report water loss	4,02	1,267
Use of high-efficiency machines	3,63	1,364
Flow reducers in taps and showers	3,58	1,323
Low. quality water used for irrigation	3,41	1,580
Systems for managing consumption	2,99	1,407
Timers on taps	2,37	1,359

Source(s): Authors

Differences between groups

To gain deeper insights into the data, the nonparametric test Kruskal-Wallis was used to assess whether the adoption of sustainability and CE practices differed according to the type of tourist accommodation, size (number of rooms), and the year of construction or remodelling. This test is particularly useful when the assumptions of normality and equal variances are not met, and it allows for the comparison of multiple groups (Field, 2009).

The type of tourist accommodation, size (number of rooms), and the year of construction or remodelling all generate significant differences in adopting sustainability and CE practices. A total of 54 variables integrated the five dimensions - Management practices: 12; Waste management: 15; Construction and remodelling of buildings: 8; Energy efficiency: 11; Water efficiency: 8. The year of construction or remodelling is the independent variable that has a higher number of significant differences between the diverse groups, 17 in total. The size of the company seems to have the least impact on the adoption of sustainability and CE practices, as only seven significant differences between groups were observed (see Table 5). For the purposes of more in-depth analysis, only items that have shown a corrected p-value lower than 0.05 have been considered.

Table 5. Kruskal–Wallis test

Type of tourist accommodation			
Variable/Item	**N**	**H of Kruskal–Wallis Test Sig**	**p**
Management practices			
The company prioritises renting	151	10,311	0,016
Waste management			
Proper disposal of specific waste	151	8,253	0,041
Providing rechargeable amenities in rooms	151	8,562	**0,036***
Ecologically correct bath and cleaning products	151	8,445	**0,038***
Choosing products in refillable packaging	151	8,300	**0,040***
Reusing damaged textiles	151	11,901	**0,008***
Using foods grown locally (less packaging)	151	15,985	**0,001***
Donating left-over food	151	10,001	**0,019***
Redirecting organic waste for composting	151	7,972	0,047
Construction and remodelling of buildings			
Use of local materials	151	23,531	**0,000***
Use of second-hand furniture	151	15,890	**0,001***
Energy efficiency			
Periodic energy audits carried	151	14,168	**0,003***
Automatic system turning off air conditioning	151	15,771	**0,001***
Air conditioning regulated by the customer	151	16,737	**0,001***
Thermal insulation of windows	151	8,981	0,030
Water efficiency			
Low-consumption flush toilets	151	15,187	**0,002***
Timers on taps	151	20,780	**0,000***
Use of high-efficiency machines	151	8,448	0,038
Low. quality water used for irrigation	151	8,957	**0,030***
Number of rooms			
Variable/Item	**N**	**H of Kruskal–Wallis Test Sig**	**p**
Management practices			
The goal system includes sustainability actions	143	10,759	0,029
The goal system includes CE actions	143	10,098	0,039
The company prioritises renting	143	17,236	**0,002***
Waste management			
Redirect organic waste for composting	143	12,840	**0,012***
Construction and remodelling of buildings			
Use of second-hand furniture	143	19,841	**0,001***
Energy efficiency			
Periodic energy audits carried	143	15,320	**0,004***
Automatic system turning off air conditioning	143	15,452	**0,004***
Thermal insulation of windows	143	11,631	0,020
Class A or higher equipment	143	15,400	**0,004***
Solar panels for water heating	143	11,175	0,025
Solar panels for energy production	143	10,343	0,035
Water efficiency			
Timers on taps	143	22,784	**0,000***
Use of high-efficiency machines	143	10,481	0,033
Year of construction or remodelling			
Variable/Item	**N**	**H of Kruskal–Wallis Test Sig**	**p**
Management practices			
Internal environmental management system	150	12,203	0,032
The goal system includes sustainability actions	150	12,711	**0,026***
The goal system includes CE actions	150	21,131	**0,001***
CE is a frequent topic in meetings	150	11,126	0,049
Prioritise renting	150	12,859	0,025
Waste management			
Providing rechargeable amenities in rooms	150	20,448	**0,001***
Ecologically friendly bath and cleaning products	150	12,632	**0,027***
Choosing products in refillable packaging	150	13,731	0,017
Using foods grown locally (less packaging)	150	16,136	**0,006***
Redirecting organic waste for composting	150	15,411	**0,009***
Construction and remodelling of buildings			
Reduce energy consumption during operation phase	150	18,611	**0,002***
Use of non-toxic materials	150	12,785	0,025
Use of second-hand furniture	150	11,359	**0,045***
Use of recycled materials	150	20,503	**0,001***

Smart construction technologies	150	12,193	**0,032***
Project with disassembly possibility	150	18,548	**0,002***
Spaces designed in a modular way	150	14,795	**0,011***
Energy efficiency			
Systems for managing consumption	150	12,290	0,031
Air conditioning regulated by the customer	150	11,432	0,043
Thermal insulation of windows	150	26,177	**0,000***
Class A or higher equipment	150	13,002	0,023
Automatic sensors for public area lighting	150	14,758	**0,011***
Solar panels for water heating	150	16,140	**0,006***
Water efficiency			
Flow reducers in taps and showers	150	16,866	**0,005***
Low-consumption flush toilets	150	16,702	**0,005***

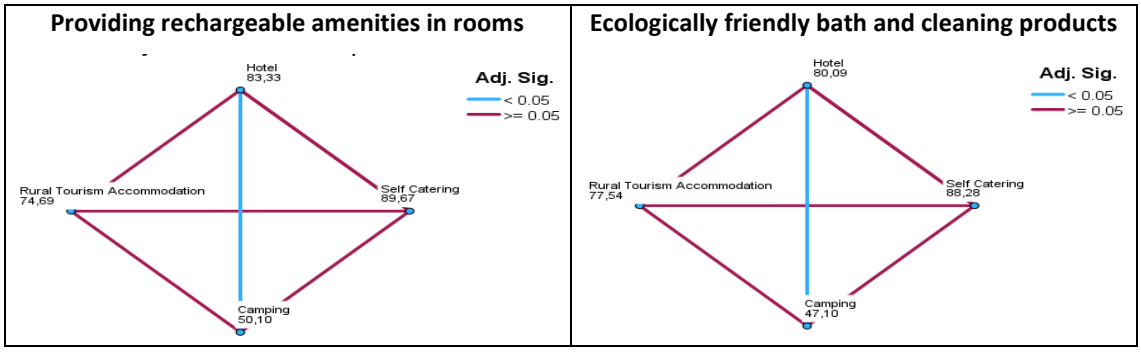
Source(s): Authors

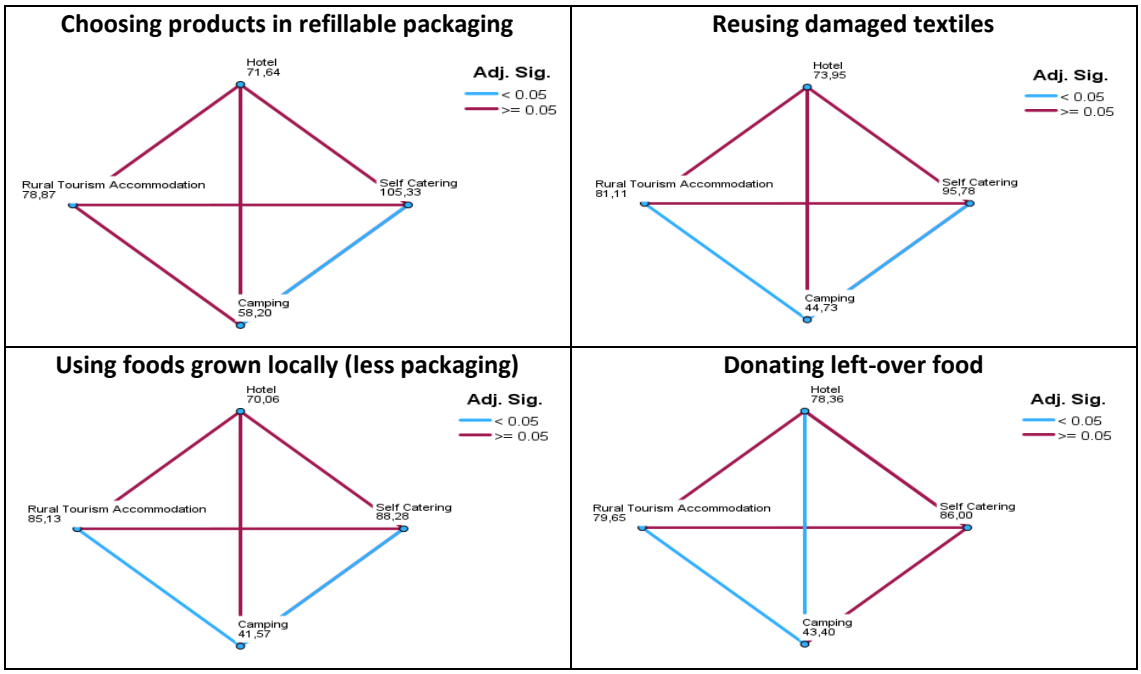
Note: * Item with a corrected p-value < 0,005 (Adj. sig).

Pairwise comparisons: Type of tourist accommodation

No differences were observed in the management practices between the types of accommodation under analysis. Regarding the waste management dimension, 4 out of 15 items showed significant differences (considering an adjusted significance level of p > 0.05) between at least two groups. The variables *Providing rechargeable amenities in rooms* and *Ecologically correct bath and cleaning products* present significant differences between hotels and camping facilities. Based on the average rank, hotels (83,33) provide rechargeable amenities in rooms and use ecologically correct bath and cleaning products (80,09) more than camping facilities (50,10 and 47,10). The item *Choosing products in refillable packaging* only records significant differences between self-catering (105,33) and camping (58,20), with the former having a higher utilisation of this practice. The more circular practice *Reusing damaged textiles for other purposes* presents significant differences between self-catering (95,78) and camping (44,73), and between rural tourism accommodation (81,11) and camping (44,73). Camping is the facility that makes less use of reusing damaged textiles. The consumption of *Foods grown locally* presents a very similar situation, as again the significant differences are between self-catering (88,28) and camping (41,57), and between rural tourism accommodation (85,13) and camping (44,73). As previously noted, camping denotes a lower frequency of *Using foods grown locally*. Finally, when it comes to *Donating left-over food*, significant differences are between hotels (78,36) and camping (43,40), and between rural tourism accommodation (79,65) and camping. In both comparisons, camping is the accommodation type that does not donate left-over food (see Figure 1).

Figure 1. Pairwise comparisons of type of tourist accommodation and waste management

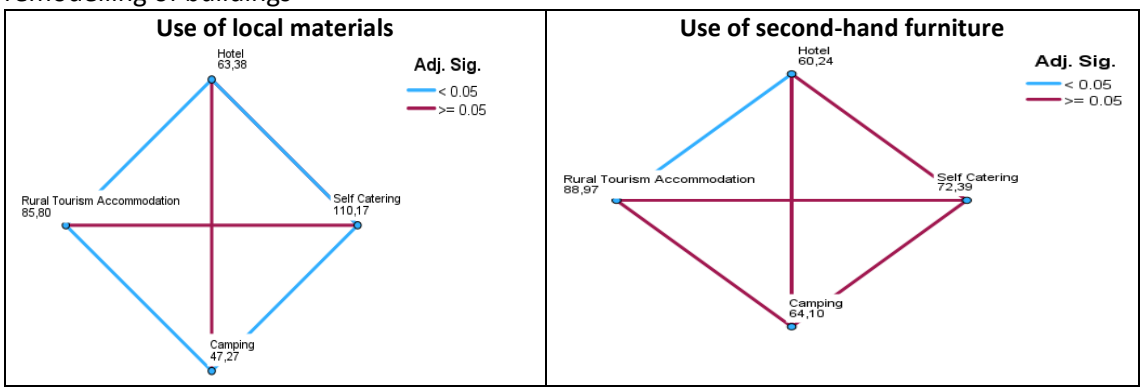




Source(s): Authors

The construction or remodelling phase presents an opportunity for companies to introduce more sustainability and circular practices. Regarding the use of local materials, self-catering (10,17) and rural tourism accommodation (85,80) tend to *Use local materials* during the construction and remodelling phase more often than hotels or camping. When it comes to the *Use of second-hand furniture*, the only significant difference is between hotel (60,24) and rural tourism accommodation (88,97), where the second mentioned has implemented measures to use second-hand furniture in the buiding or remodelling of their infrastructure (see Figure 2).

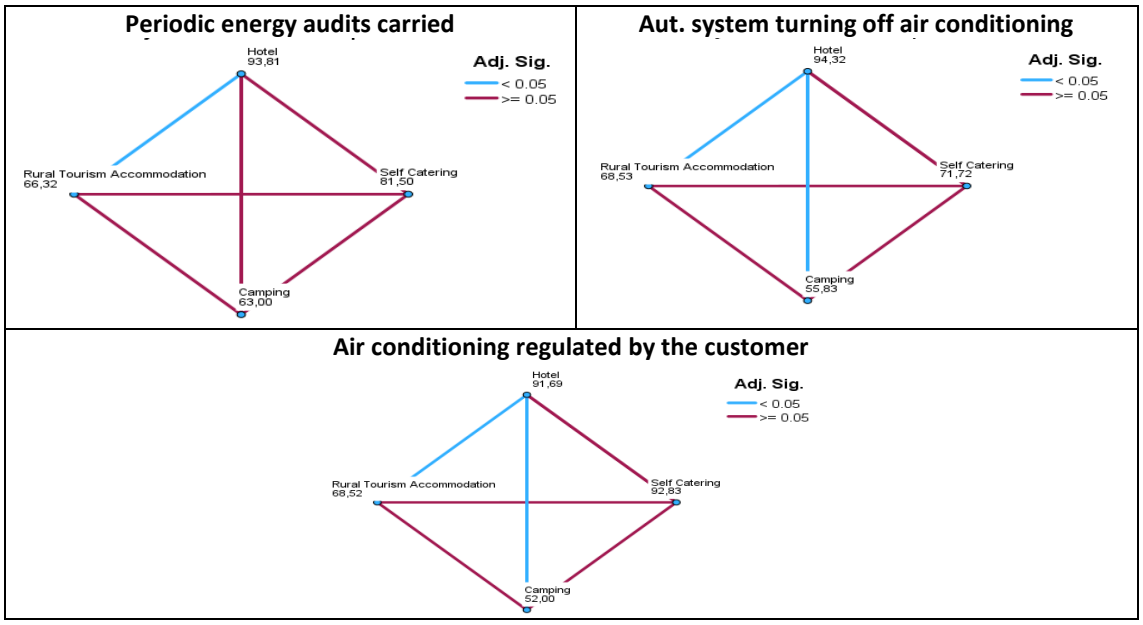
Figure 2. Pairwise comparisons of Type of tourist accommodation and Construction and remodelling of buildings



Source(s): Authors

Only three of the eleven measures to improve energy efficiency show significant differences. As shown in Figure 3, hotels (93,81) perform *Periodic energy audits* carried out by certified technicians more often than rural tourism accommodation (66,32). Also, according to the findings in Figure 3, Hotels (94,32) use more frequently *Automatic systems for turning off air conditioning* than rural tourism accommodation (68,53) and camping (55,83). Hotels have also implemented *Air Conditioning regulated by the customer* (91,69) more often than rural tourism accommodation (68,53) and camping (52,00).

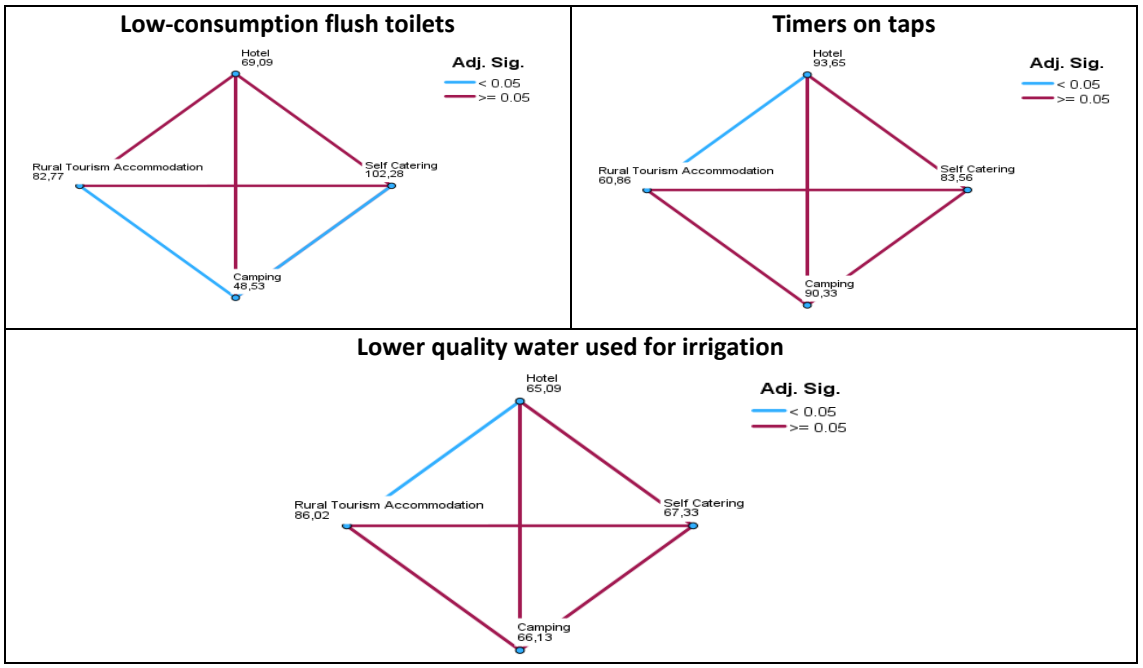
Figure 3. Pairwise comparisons of type of tourist accommodation and energy efficiency



Source(s): Authors

Regarding water efficiency, only three presented significant differences from the initially analysed eight practices. Self-catering (102.28) and rural tourism accommodation (82,77) implemented more *Low-consumption flush toilets* than camping (48.53). Hotels (93,65) also use more *Timers on taps* than rural tourism accommodation (60,86), but the second mentioned (86.02) more often use the circular practice *Lower quality water for irrigation* than hotels (65,09) (Figure 4).

Figure 4. Pairwise comparisons of type of tourist accommodation and water efficiency



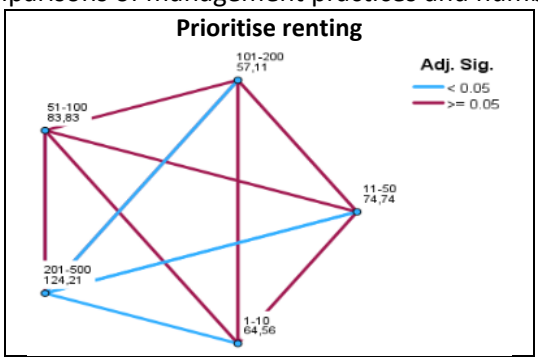
Source(s): Authors

Pairwise comparisons: Number of rooms

Considering the three independent variables used in the analysis, the size of the accommodation type produced the least significant differences. Regarding management practices, the accommodation facilities with more rooms (201-500: 124,21) more often *Prioritise renting*

equipment than smaller facilities (101-200 rooms: 57,11; 11-50 rooms: 74,74; 1-10 rooms; 64,56) (see Figure 5).

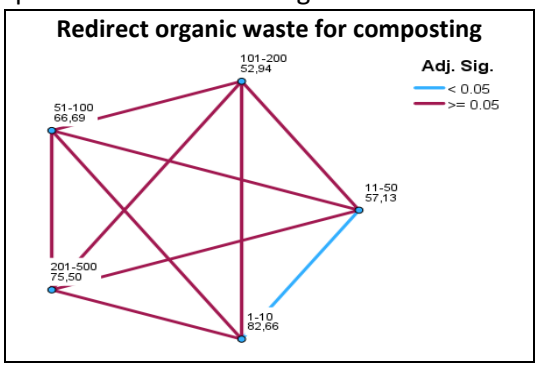
Figure 5. Pairwise comparisons of management practices and number of rooms



Source(s): Authors

According to data in Figure 6, companies with 1-10 rooms *Redirect organic waste for composting* more frequently than those with 11-50 rooms. Between the other typologies, no significant differences could be observed (see Figure 6).

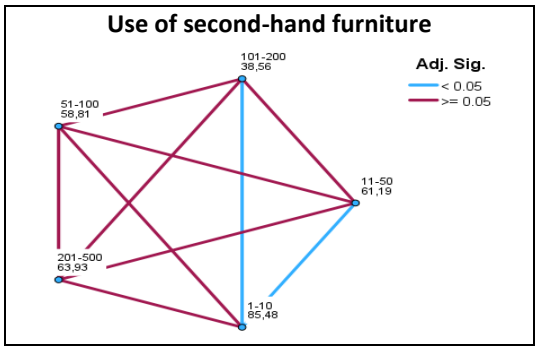
Figure 6. Pairwise comparisons of waste management and number of rooms



Source(s): Authors

Smaller accommodation facilities (1-10 rooms: 85,48) more often tend to *Use second-hand furniture* in the process of building or remodelling than those with more rooms (11-50 rooms: 61,19; 101-200 rooms: 38,56) (see Figure 7).

Figure 7. Pairwise comparisons of construction and remodelling of buildings and number of rooms

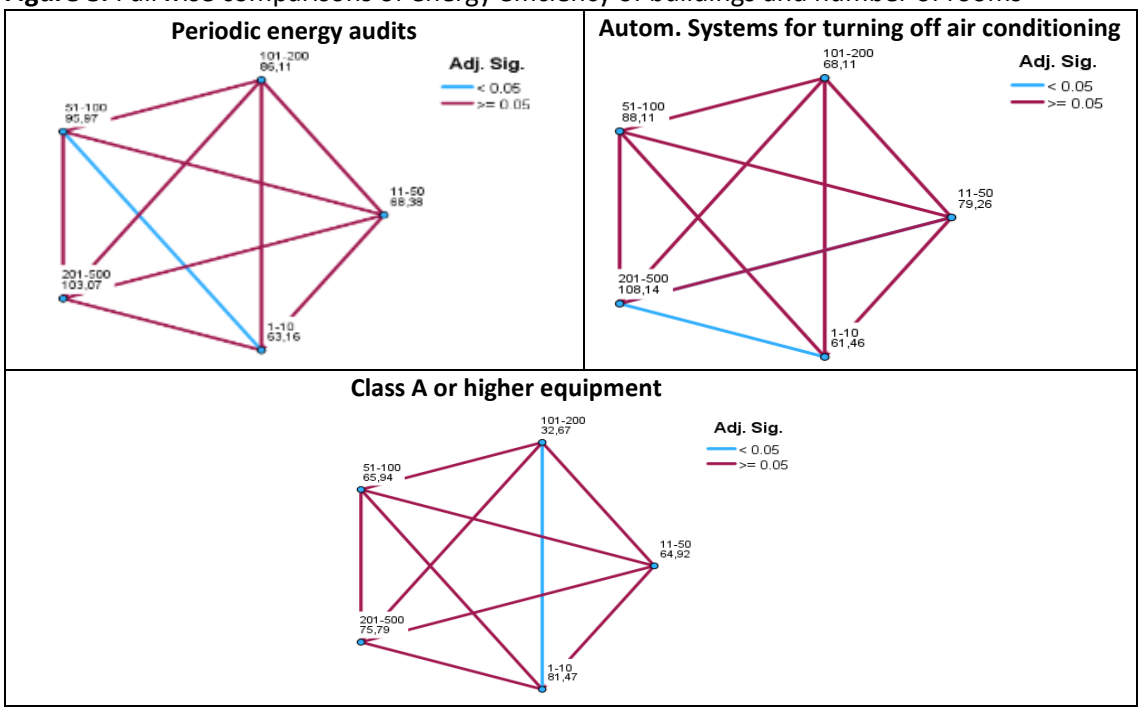


Source(s): Authors

In the comparison of energy efficiency, companies with only 1-10 rooms (63,16) implement fewer *Periodic energy audits* than companies with 51-100 rooms (95,87), and they also use

Automatic systems for turning off air conditioning less frequently than bigger accommodation facilities (201-500 rooms: 108,14), but they (1-10 rooms: 81,47) acquired more frequently *Class A or higher equipment* than companies with 101-200 rooms (32,67) (see Figure 8).

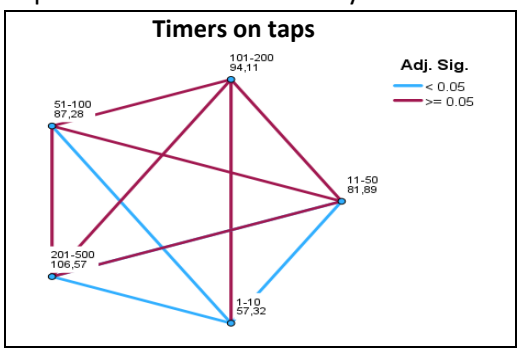
Figure 8. Pairwise comparisons of energy efficiency of buildings and number of rooms



Source(s): Authors

Regarding water efficiency, companies with 1-10 rooms (57,32) have implemented *Timers on taps* less often than companies with more rooms (11-50 rooms: 81,89; 51-100 rooms: 87,28; 201-500: 106,57) (see Figure 9).

Figure 9. Pairwise comparisons of water efficiency and number of rooms



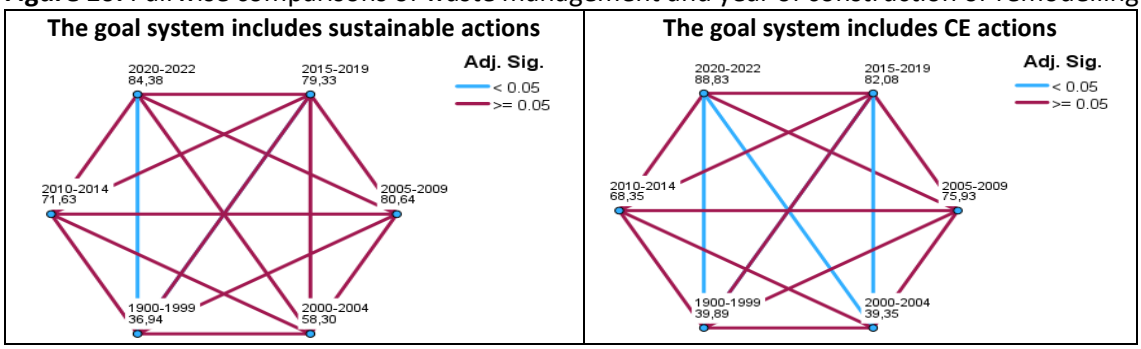
Source(s): Authors

Pairwise comparison: Year of construction or remodelling

In terms of reference to the management practices dimension, one out of twelve items demonstrated significant differences (with an adjusted significance level of $p > 0.05$) between at least two groups. The results indicate significant differences in *The goal system includes sustainable actions* within the management practices dimension and year of construction or remodelling between the periods 1900-1999 (36,94) and 2020-2022 (84,38). Concerning the item *The goal system includes CE actions*, significant differences were found between the periods 1990-1999 (39,89) and 2020-2022 (88,83). Furthermore, differences in the average

ranks were also observed between the period 2000-2004 (39,35) and the periods 2020-2022 (88,83) and 2015-2019 (82,08) (see Figure 10).

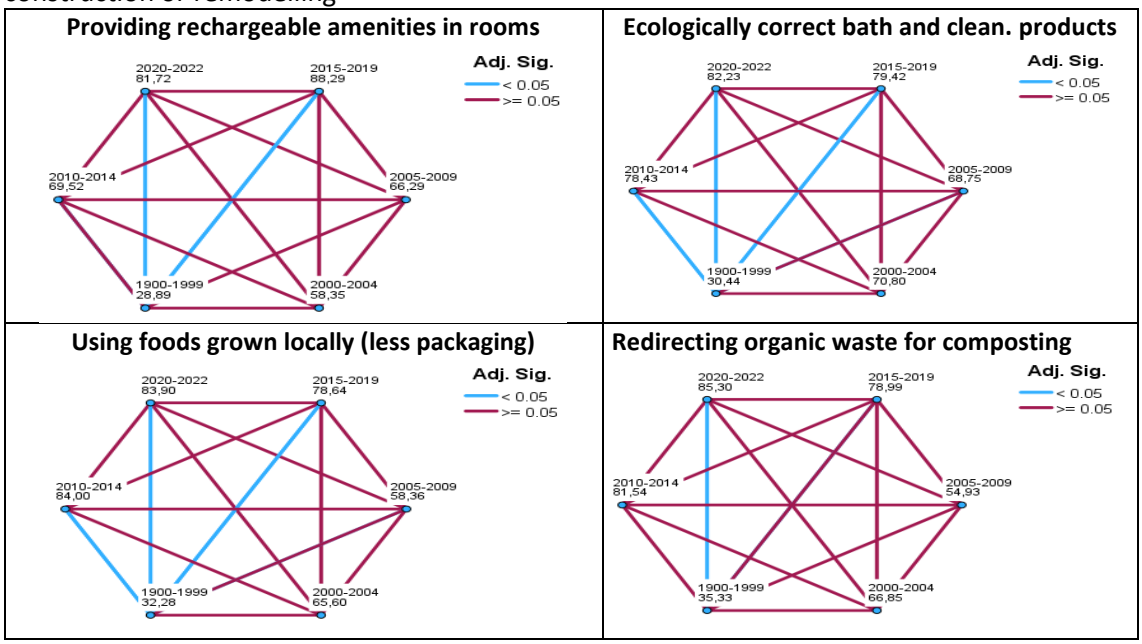
Figure 10. Pairwise comparisons of waste management and year of construction or remodelling



Source(s): Authors

Differences were found in four out of fifteen items within the waste management dimension, namely *Providing rechargeable amenities in rooms*, *Ecologically correct bath and cleaning products*, *Using foods grown locally*, and *Redirecting organic waste for composting*. In all these items, there were significant differences between the period up to 1999 and the more recent periods between 2010 and 2022. The adoption of more sustainable practices in waste management seems to have increased over time, with a higher average rank in more recent periods (see Figure 11).

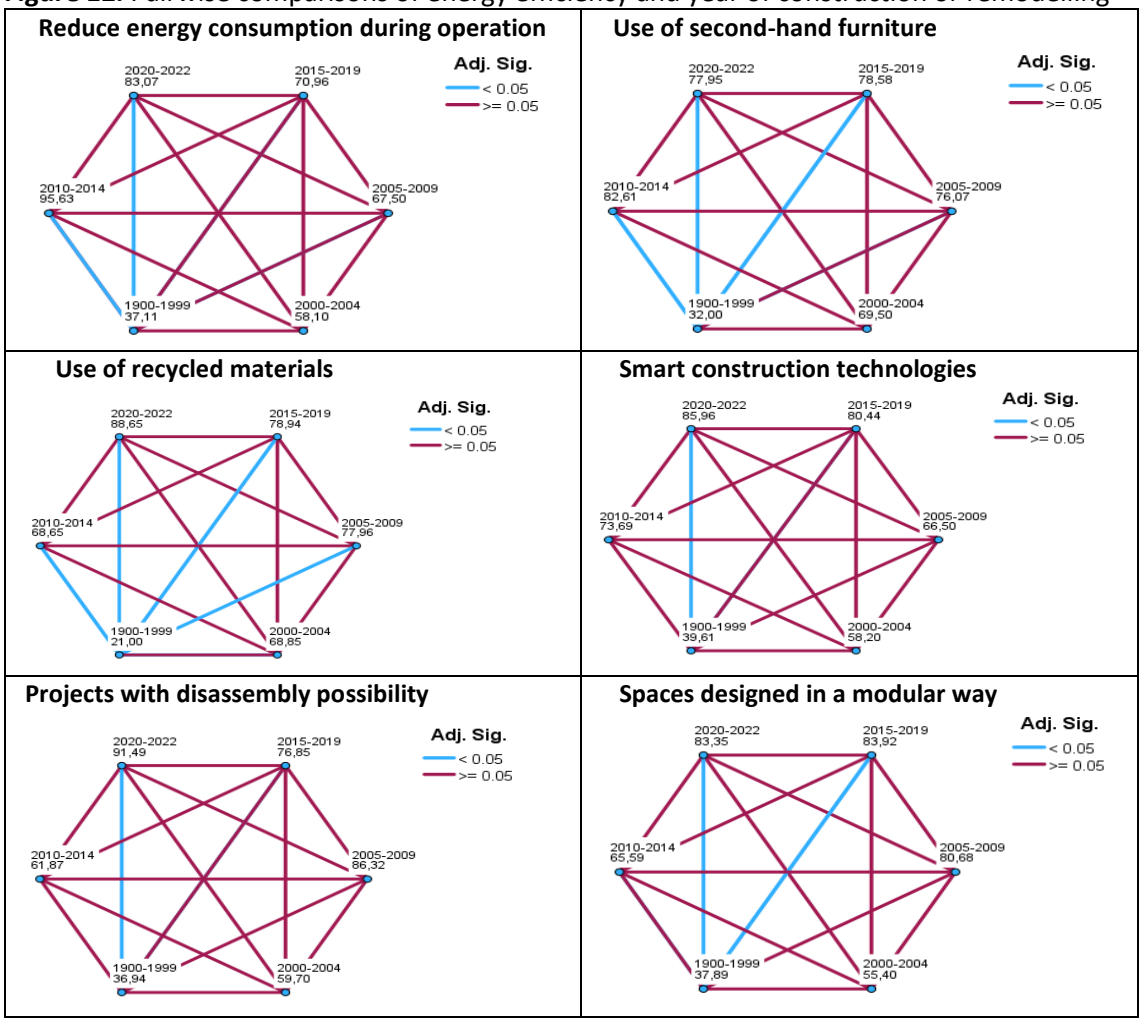
Figure 11. Pairwise comparisons of construction and remodelling of buildings and year of construction or remodelling



Source(s): Authors

In terms of the year of construction or remodelling variable, significant differences were found in six out of eight items (with an adjusted significance level of $p > 0.05$) between at least two groups within the construction and remodelling of buildings dimension. These items include: *Reduce energy consumption during operation*, *Use of second-hand furniture*, *Use of recycled materials*, *Smart construction technologies*, *Projects with disassembly possibility*, and *Spaces designed in a modular way*. All six items showed significant differences between the period up to 1999 and more recent years, specifically between 1990-1999 and 2020-2022 (see Figure 12).

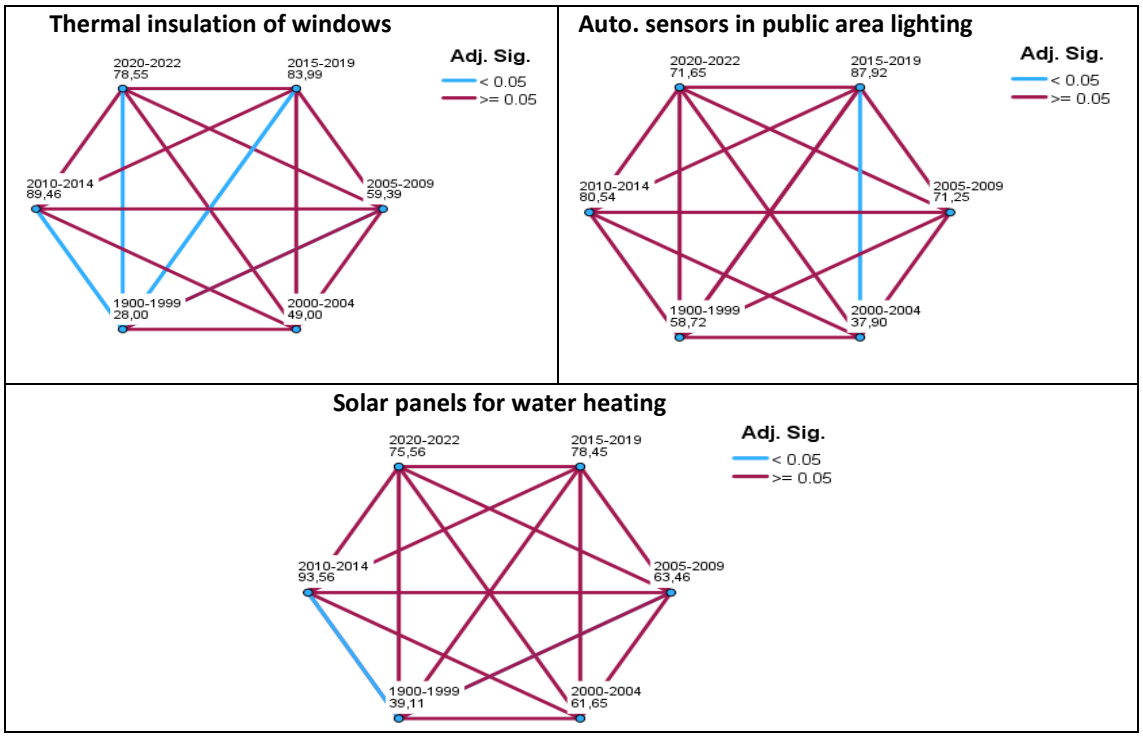
Figure 12. Pairwise comparisons of energy efficiency and year of construction or remodelling



Source(s): Authors

Significant differences were found in the dimension of energy efficiency and year of construction or remodelling for 3 out of the 11 items analysed. In terms of *Thermal insulation of windows*, the significant differences were between the older period (28,00) and the more recent years of 2010-14 (89,46), 2015-2019 (83,99) and 2020-2022 (78,55). *Solar panels for water heating* showed significant differences between the period up to 1999 (39,11) and the years 2010-2014 (93,56). On the other hand, *Automatic sensors in public area lighting* exhibited significant differences between the period of 2000-2004 (37,90) and the period of 2015-2019 (87,92) (see Figure 13).

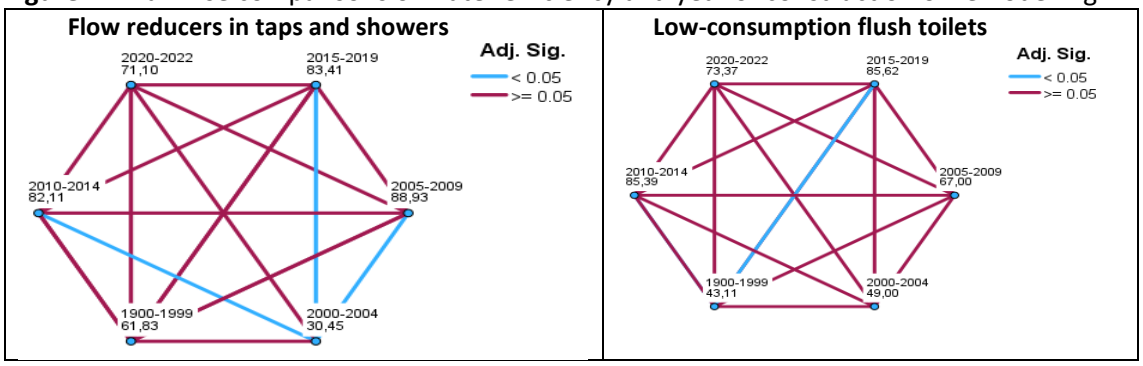
Figure 13. Pairwise comparisons of water efficiency and year of construction or remodelling



Source(s): Authors

In terms of the relationship between water efficiency and year of construction or remodelling, significant differences were found in 2 out of 8 items. Regarding the item *Flow reducers in taps and showers*, the period of 2000-2004 (30,35) showed significant differences compared to the periods of 2005-2009 (88,93), 2015-2019 (83,41), and 2010-2014 (82,11). As for the item *Low-consumption flush toilets*, differences were found between the period up to 1999 (43,11) and the period of 2015-2019 (85,62) (see Figure 14).

Figure 14. Pairwise comparisons of water efficiency and year of construction or remodelling



Source(s): Authors

Conclusions and implications

The most commonly implemented practices by accommodation companies are those that lead to cost savings. Such measures include the use of low-consumption lighting, thermal insulation, and more energy-efficient equipment to improve energy efficiency. In terms of water efficiency, practices such as changing towels upon request, low-consumption flush toilets, and urging guests to report any water loss are the most frequently implemented.

Environmental actions requiring some investment, such as automatic systems for turning off air conditioning, systems for managing water consumption, and taps timers, are not commonly implemented.

Concerning waste management, the most commonly adopted practices are separating waste for recycling, properly disposing of specific waste, and reducing unnecessary disposable items. Conversely, the least frequently implemented measures include donating left-over food and composting organic waste.

While there is no clear delineation between sustainability practices and CE practices, it is generally agreed that some practices are more circular than others. For instance, practices such as using lower-quality water for irrigation, sharing under-utilised spaces or renting, designing buildings that can be disassembled and creating modular spaces are considered more circular. Nonetheless, the study's results show that these practices are the least commonly implemented in the tourist accommodation sector.

The findings also indicate that management is mainly concerned with practices that allow the company to reduce costs and comply with legal obligations.

The three independent variables (i) type of accommodation, (ii) size (number of rooms), and (iii) year of construction and remodelling produce a different number of significant differences.

The findings suggest that the size of the accommodation facility has the least significant impact on the five dimensions analysed. Only seven out of the 54 variables analysed showed significant differences: prioritising renting, redirecting organic waste for composting, using second-hand furniture, carrying out periodic energy audits, and installing automatic systems to turn off air conditioning, class A or higher-rated equipment, and timers on taps. Larger accommodation facilities invest more in equipment to reduce consumption, such as automatic systems for turning off air conditioning and timers on taps and renting instead of purchasing. However, smaller companies have implemented more circular practices, such as using second-hand furniture and redirecting organic waste for composting. Additionally, these companies also tend to acquire more class A or higher-rated equipment.

The type of accommodation, which is the independent variable, is responsible for 14 significant differences. The waste management dimension presents 6 variables with significant differences. Hotels use rechargeable amenities in rooms and ecologically correct bath and cleaning products more than Camping facilities. Additionally, Hotels tend to donate left-over food more often than the camping sector. On the other hand, self-catering and rural tourism accommodations tend to reuse damaged textiles and purchase locally grown foods more significantly than camping companies. The data also reveal that self-catering units are more predisposed to refillable packaging products than camping facilities. Additionally, self-catering and rural tourism establishments more frequently employ the use of local materials compared to hotels and camping facilities. Regarding the use of second-hand furniture, the data indicates that rural tourism units are the ones that make the most use of these practices. Regarding energy efficiency, it is observed that hotels conduct periodic audits more often than rural tourism units. Furthermore, hotels have the most air conditioning systems with automatic shutdown and air conditioning systems regulated by customers compared to rural tourism units and campsites. Rural tourism accommodations and self-catering units have implemented low-consumption flush toilets more frequently than camping facilities. Concerning the use of timers on taps, hotels implement this measure more frequently than rural tourism accommodation. The more circular practice of using lower-quality water for irrigation is more intensively implemented in rural tourism accommodation.

The year of construction or renovation is the independent variable that exhibits the most significant differences among the various groups, with 17 groups identified. At the management level, accommodations that has been recently built or remodelled is more inclined to include

sustainability or CE actions within their goal systems. The results obtained from the analysis of the remaining dimensions confirm significant differences between older and more recent accommodation companies based on the year of construction or renovation, with the latter being more likely to implement sustainability and CE practices. This study's findings suggest a growing awareness and commitment to sustainability and CE practices in the tourist accommodation sector, particularly among the more recently constructed or renovated accommodation. Moreover, this study has confirmed that accommodation companies are still predominantly operating within a linear economy model and are only in the initial stages of transitioning to a more CE model.

To the best of our knowledge, this study is the first to evaluate the accommodation characteristics that impact the adoption of sustainability and CE practices within the tourist accommodation sector. It contributes to the literature by providing primary quantitative data supporting such practices' adoption.

Accommodation companies are yet to fully grasp the potential of the CE in targeting environmentally conscious consumers and leveraging the cost-saving benefits of repairing, reusing, and renovating existing equipment and infrastructure. They can also optimise resource usage and reduce production and consumption by renting and sharing assets rather than purchasing them outright. For the sector to address the significant impacts of its environmental footprint and move towards sustainability, a more substantial commitment from accommodation companies is needed to embrace the CE concept and model.

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