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Sustainable Operations Management in Hospitality: An Empirical Study of Energy Efficiency and Waste Reduction Strategies

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Abstract: The hospitality industry faces mounting pressure to enhance sustainability performance amid escalating environmental degradation, resource depletion, and operational costs. Hotels are resource-intensive establishments that consume substantial energy and generate considerable waste through continuous 24-hour operations and high guest turnover. This study investigates the implementation and effectiveness of integrated energy-efficiency and waste-reduction strategies within hotel operations, addressing the persistent gap between environmental intentions and operational practices today. Employing a cross-sectional design, this research utilizes Structural Equation Modeling (SEM) and multiple regression analysis on primary data from 150 hotel managers across Indonesian properties. The measurement instrument demonstrates robust validity through Confirmatory Factor Analysis (factor loadings: 0.68-0.89, AVE: 0.58-0.72) and reliability (Cronbach's α: 0.81-0.89, Composite Reliability: 0.82-0.90). Results reveal that energy-efficiency practices ($\beta=0.47$, $p<0.001$, $R^2=0.34$) and waste-reduction strategies ($\beta=0.52$, $p<0.001$, $R^2=0.41$) significantly enhance operational performance. The integrated sustainability model demonstrates superior explanatory power ($R^2=0.57$), with waste reduction exerting a more substantial effect ($\beta=0.44$) than energy efficiency ($\beta=0.31$). Hotels implementing formal sustainability policies consistently outperform non-policy hotels across all performance dimensions. This research provides empirical evidence on integrated operational frameworks, performance-based sustainability assessment, and applicability in emerging economies. Findings underscore that coordinated energy and waste management initiatives constitute essential pathways toward operational resilience and competitive advantage in hospitality operations.

Keywords: Sustainable operations management; hospitality industry; energy efficiency; waste reduction; green hotel practices; environmental sustainability

INTRODUCTION

The hospitality industry is under substantial pressure to improve its sustainability performance amid rising environmental concerns, rising operational costs, and shifting customer expectations. Hotels, in particular, are significant energy consumers and generators of solid waste due to their 24-hour operations and resource-intensive service delivery (Becken, 2013; W. Chan, 2007). The growing global emphasis on carbon reduction, climate resilience, and responsible consumption has placed energy efficiency and waste reduction practices at the center of sustainable operations management strategies. Numerous international reports indicate that hotels contribute disproportionately to urban energy use and waste streams, especially in tourist-dense destinations. (Gössling et al., 2012; Pirani & Arafat, 2014). Consequently, sustainability is no longer an optional initiative but a strategic imperative that significantly influences financial performance, competitive advantage, and long-term viability (Graci & Dodds, 2008; Molina-Azorín et al., 2009).

Despite increasing awareness of sustainability, many hotels still face persistent barriers to implementing systematic energy-saving systems, waste-minimization programs, and circular-economy approaches. Studies report substantial gaps between hotels' perceived sustainability performance and their actual operational practices (Bohdanowicz, 2006; Mensah, 2007). Energy consumption in many hotel properties continues to exceed sectoral benchmarks due to outdated equipment, inefficient climate control systems, and poor energy usage monitoring. Similarly, waste management remains reactive rather than preventive, with limited adoption of segregation, recycling, and food-waste recovery solutions. (Filimonau et al., 2020; Smyth et al., 2020). These contradictions highlight a persistent inconsistency between sustainability intentions and operational implementation across various hotel categories and regions.

To address these challenges, hotels increasingly turn toward structured sustainability frameworks, environmentally driven operational systems, and technology-enabled solutions. Energy management systems, renewable energy integration, smart HVAC controls, LED lighting, and building retrofits are among the interventions proven to reduce energy consumption significantly. (Anil, 2019; Karagiorgas et al., 2007). Similarly, waste-reduction strategies—such as on-site composting, food-waste analytics, recycling programs, green procurement, and zero-waste kitchen initiatives offer significant environmental and financial benefits (Jones et al., 2016). In addition, guest engagement strategies and green marketing initiatives further enhance operational efficiency and environmental performance (Kim et al., 2013; Yu et al., 2017).

Therefore, an empirical investigation into integrated energy-efficiency and waste-reduction strategies is essential to provide actionable insights for improving sustainable hotel operations. Prior studies have extensively examined individual components of sustainability—such as green marketing, environmental management systems (EMS), and eco-friendly guest behavior (E. S. W. Chan & Hawkins, 2010; Han et al., 2010; Tsai & Tsang, 2021). Others have explicitly focused on modeling energy consumption (Chan, 2007; Becken, 2013), assessing solid-waste generation in hotel operations (Pirani & Arafat, 2016), or evaluating the influence of green practices on guest satisfaction (Kim et al., 2013; Rahman et al., 2012).

Most studies evaluate energy efficiency and waste management separately, without integrating them within a single operational sustainability framework (Filimonau et al., 2020). The present study integrates both components into one empirical model. Studies on sustainability practices are abundant in Europe and North America but remain limited in developing economies,

where resource constraints and operational challenges differ significantly (Mensah, 2007; Njoroge & Atieno, 2017). This study focuses on emerging-economy hotel contexts to address a geographical research gap. Many publications rely on surveys of environmental attitudes rather than on measures of actual operational efficiency outcomes (Graci & Dodds, 2008). This study incorporates empirical operational data rather than only perceptual assessments.

Although technologies such as smart sensors and energy management systems are mentioned in the literature, few studies evaluate their real impact on hotel operations. This study empirically examines the influence of technological adoption on sustainability performance. While environmental practices are widely researched, the connection between sustainable operations and improved financial or service outcomes is rarely quantified (Molina-Azorín et al., 2009; Graci & Dodds, 2008). This study assesses how sustainable operations contribute not only to environmental outcomes but also to operational efficiency and competitive advantage. Together, these gaps demonstrate the need for a more holistic, data-driven understanding of how energy efficiency and waste-reduction initiatives work simultaneously within hotel operations.

This study presents several key novelties that distinguish it from prior research. First, it provides an integrated empirical framework that simultaneously examines both energy efficiency and waste reduction within a unified sustainability model, addressing the fragmentation evident in previous studies that typically examine these dimensions separately. Second, the research employs operational performance metrics rather than relying solely on perceptual or attitudinal data, thereby providing empirical evidence of sustainability effectiveness. Third, the study focuses on emerging-economy hotel contexts, where sustainability research remains limited despite distinct operational challenges and resource constraints that differ from developed markets. Fourth, it evaluates the real-world impact of technological interventions such as innovative HVAC systems and energy management platforms on hotel operations, moving beyond theoretical discussions to quantifiable outcomes. Finally, the research establishes empirical linkages between sustainability practices and competitive performance advantages, demonstrating that environmental initiatives directly contribute to operational efficiency and long-term viability in the hospitality sector.

This research aims to empirically examine the implementation and effectiveness of energy-efficiency initiatives and waste-reduction strategies in hotel operations, focusing on their environmental and operational performance impacts. Specifically, the study seeks to: (1) Assess the current level of energy-efficient operational practices in hotels. (2) Evaluate the extent and effectiveness of waste-reduction strategies implemented in hotel operations. (3) Analyze the combined impact of these sustainability practices on operational performance. The justification for conducting this study lies in the increasing need for hotels to adopt sustainable practices that enhance environmental performance, reduce operating costs, and improve competitive positioning. As global environmental pressures intensify and resource prices rise, hotels must adopt evidence-based sustainability strategies to remain operationally resilient. The findings of this research are expected to provide actionable recommendations for hotel managers, policy makers, and stakeholders who aim to strengthen sustainable operations management within the hospitality sector.

RESEARCH METHOD

This study adopted a quantitative empirical research design to examine the implementation and effectiveness of energy-efficiency and waste-reduction strategies in hotel operations. A quantitative approach is appropriate for measuring operational performance outcomes, identifying statistically significant relationships, and ensuring generalizability across different hotel categories (Creswell & Creswell, 2018). The research design aligns with prior hospitality sustainability studies that emphasize quantitative assessment to examine environmental practices and performance indicators.

1. Research Design

A cross-sectional survey method was employed to collect data from hotel managers, energy supervisors, housekeeping managers, and operational staff. Cross-sectional surveys are widely used in hospitality research to evaluate sustainability adoption and operational behaviors within a specific time period (Rahman et al., 2012). This design enables the efficient capture of diverse operational practices and facilitates comparisons of sustainability initiatives across multiple hotel types.

2. Population and Sample

The population consists of three- to five-star hotels operating in urban tourism destinations. These hotels were selected because they typically have structured operational systems and larger resource footprints, making them relevant for sustainability performance evaluation (Mensah, 2007). A purposive sampling technique was used to target respondents with direct responsibility for sustainability or operational decisions, ensuring that the data reflect informed managerial perspectives. Purposive sampling is considered valid for sustainability and environmental management research where expert input is essential (Etikan et al., 2016). A minimum sample size of 150–250 respondents was determined based on statistical power requirements for multivariate analysis, consistent with recommendations in hospitality operations research (Hair et al., 2019).

3. Data Collection Instrument

Data were collected using a structured questionnaire consisting of closed-ended Likert-scale items. The instrument measured three primary constructs:
  a. Energy-efficiency practices (e.g., lighting systems, HVAC controls, energy monitoring technologies),
  b. Waste-reduction strategies (e.g., recycling programs, food waste initiatives, green procurement), and
  c. Operational performance outcomes (e.g., cost reduction, resource efficiency, environmental performance).

The questionnaire was developed using established scales adapted from prior, validated studies. Testing with sustainability experts ensured content clarity and contextual relevance.

4. Data Analysis Techniques

Data were analyzed using descriptive statistics, correlation analysis, and multiple regression or structural equation modeling (SEM) to assess the relationships between sustainability practices and operational performance. SEM is widely used to analyze complex sustainability constructs because it allows testing direct and indirect relationships simultaneously. This method is also supported by hospitality sustainability researchers examining the impacts of environmental initiatives on performance outcomes.

a. Descriptive analysis helps identify the prevalence and implementation level of sustainability practices (Mbasera et al., 2016)
b. Correlation analysis determines preliminary associations among variables before modeling.
c. Regression/SEM quantifies the strength and significance of relationships, making it suitable for strategic operations management studies (Molina-Azorín et al., 2009).

5. Instrument Validation and Reliability

RESEARCH METHODOLOGY FLOWCHART

1 **Problem Identification**
- Identify research gap in integrated sustainability practices
- Define research problem and context

2 **Literature Review**
- Review theoretical frameworks
- Examine empirical evidence on energy efficiency and waste reduction
- Identify research gaps

3 **Research Design**
- Define variables and constructs
- Develop sampling strategy
- Design measurement instruments
- Establish research framework

4 **Data Collection**
- Administer structured questionnaires
- Target hotel managers and operational personnel across 3-5 star hotels
- Ensure data quality and validity

5 **Data Analysis**
- Descriptive statistics
- Correlation analysis
- Regression modeling (OLS & SEM)
- Comparative assessments

6 **Conclusions & Recommendations**
- Synthesize findings
- Derive practical implications
- Identify future research directions
- Formulate managerial recommendations

Figure 1. Research Methodology Flowchart

The methodology flowchart illustrates a systematic six-stage research process. Stage 1 (Problem Identification) establishes the research gap regarding integrated sustainability practices in hotel operations. Stage 2 (Literature Review) synthesizes existing theoretical frameworks and empirical evidence on energy efficiency and waste reduction. Stage 3 (Research Design) operationalizes the quantitative approach by defining variables, specifying the sampling strategy, and specifying measurement instruments. Stage 4 (Data Collection) involves administering structured questionnaires to hotel managers and operational personnel across multiple hotel categories. Stage 5 (Data Analysis) applies descriptive statistics, correlation analysis, regression modeling, and comparative assessments to examine relationships between sustainability practices and operational outcomes. Finally, Stage 6 (Conclusions and Recommendations) synthesizes findings into actionable insights for practitioners and identifies directions for future research. This structured approach ensures methodological rigor and enables replication in similar hospitality contexts.

6. Ethical Considerations

Anonymity and confidentiality were maintained in accordance with ethical research standards. Participation was voluntary, and respondents provided informed consent. Following standard guidelines enhances reliability and credibility in hospitality-focused survey research.

RESULT AND DISCUSSION

Respondent Demographics and Hotel Characteristics

Understanding the demographic and operational characteristics of respondents is essential to validating the reliability of the data collected. In hospitality sustainability research, respondents' backgrounds strongly influence the accuracy of the information they provide, mainly because sustainable operations are often handled by managers, supervisors, and operational specialists. (Teng et al., 2015)Therefore, profiling respondents ensures that the sample truly represents individuals with relevant knowledge of energy efficiency and waste-reduction practices. The characteristics of the participating hotels also play a critical role in shaping sustainability practices. Hotels in the three- to five-star category typically operate with higher resource consumption due to more extensive facilities, longer operating hours, and higher guest turnover (Chan, 2007). As such, their adoption of sustainability strategies tends to vary depending on organizational capacity, operational complexity, and strategic priorities in environmental management.

Respondent positions further indicate the level of authority and understanding regarding sustainability initiatives. Individuals in managerial and supervisory roles usually have direct involvement in operational planning, implementation of energy-efficiency measures, and monitoring of waste-reduction programs. This makes their responses highly valuable for analyzing sustainability performance within hotel operations. Additionally, identifying whether hotels have an established sustainability policy offers insight into organizational commitment toward environmental management. Hotels with documented policies such as energy-saving guidelines, waste management procedures, or green purchasing standards tend to demonstrate greater consistency and accountability in implementing sustainable practices. Finally, the descriptive profile serves as a foundation for interpreting subsequent analyses. Understanding

who the respondents are and the types of hotels they represent allows for better contextualization of the findings, particularly when evaluating differences in sustainability adoption across hotel categories or management levels.

Table 1. Profile of Respondents and Hotel Characteristics

Variable	Category	Frequency	Percentage (%)
Hotel Rating	3-Star	45	30.0%
	4-Star	68	45.3%
	5-Star	37	24.7%
Respondent Position	General Manager	22	14.7%
	Operations Manager	41	27.3%
	Engineering/Energy Supervisor	36	24.0%
	Housekeeping/Environmental Lead	51	34.0%
Years of Hotel Operation	< 5 years	29	19.3%
	5–10 years	63	42.0%
	> 10 years	58	38.7%
Has Sustainability Policy	Yes	112	74.7%
	No	38	25.3%

The descriptive results show that the majority of hotels in the sample are 4-star (45.3%) and 3-star (30%) properties, indicating a strong presence of mid-scale to upper-mid-scale hotels in the dataset. This distribution aligns with global hospitality trends, where these categories account for the largest share of operational hotels and are increasingly adopting environmental practices at moderate-to-high levels.

Regarding respondent positions, housekeeping and environmental leads (34%) and operations managers (27.3%) make up the largest groups. This is beneficial because these positions are directly involved in daily energy usage, waste handling, and operational decision-making. The presence of engineering supervisors (24%) further strengthens the validity of the responses, especially for technical aspects of energy management.

Most hotels have been operating for 5–10 years (42%), followed by over 10 years (38.7%), suggesting that the establishments included have substantial operational experience and established operational systems. This factor is important because experienced hotels are more likely to implement structured sustainability practices.

Additionally, 74.7% of hotels reported having a sustainability policy, highlighting a strong organizational commitment to environmental management across the sample. Such policies often translate into better implementation of energy-efficiency and waste-reduction strategies, which will be explored further in subsequent sections.

Implementation Level of Energy-Efficiency Practices

Energy-efficiency practices are a critical element of sustainable operations in the hospitality industry, given hotels' 24-hour service model and high-demand facilities. Because energy usage directly affects operational cost and environmental impact, understanding the extent to which hotels implement energy-saving technologies provides insight into their sustainability progress. The adoption of efficient lighting systems, smart HVAC controls, and energy-monitoring technologies reflects the hotel's strategic commitment to reducing energy consumption while maintaining service quality.

The study's results indicate that several energy-efficiency initiatives have been adopted at varying levels across the hotels surveyed. Hotels generally prioritize low-investment, high-impact measures such as LED lighting replacement and regular maintenance of electrical equipment. These measures are consistent with prior literature, noting that hotels often begin sustainability adoption with cost-efficient interventions (Mbasera et al., 2016). Meanwhile, more advanced technologies, such as digital energy-management systems and automated HVAC controls, are adopted at moderate levels, suggesting financial or technical constraints in specific hotel categories. Findings also reveal that integrating staff training into energy-efficiency programs remains uneven. Although platforms and policies exist, comprehensive training on energy-saving behavior for staff is not consistently implemented. This aligns with previous studies indicating that human-resource components in sustainability efforts are frequently underdeveloped despite their significant influence on achieving energy-reduction outcomes (Best & Thapa, 2013). This highlights a meaningful gap between technological adoption and behavioral reinforcement.

In addition, data suggest that hotels with formal sustainability policies tend to implement energy-efficiency practices more consistently than those without such policies. This indicates that organizational commitment is vital to ensuring the continuity and accountability of energy-saving initiatives. Hotels lacking structured policies may implement practices reactively rather than strategically, resulting in inconsistent performance across operational units. Overall, the descriptive findings for this point present a mixed pattern of adoption, demonstrating strong engagement in basic energy-saving measures but moderate uptake of advanced technology-based systems. These insights provide a foundational understanding for subsequent analysis of how energy-efficiency practices influence operational performance.

Table 2. Descriptive Statistics of Energy-Efficiency Practices

Energy-Efficiency Indicator	Mean	SD	Implementation Level
LED Lighting Replacement	4.32	0.61	Very High
Regular Maintenance of Electrical Equipment	4.18	0.67	High
Smart HVAC Controls	3.74	0.82	Moderate
Energy Monitoring System (EMS)	3.56	0.91	Moderate
Use of Energy-Efficient Appliances	4.05	0.72	High
Staff Training on Energy Conservation	3.48	0.89	Moderate
Renewable Energy Usage (Solar, etc.)	2.96	1.04	Low

Scale: 1 = Very Low, 5 = Very High

The descriptive results show that LED lighting replacement (Mean = 4.32) and regular electrical maintenance (Mean = 4.18) are the most widely implemented energy-efficiency practices. These findings are consistent with global hotel sustainability trends, where lighting upgrades and routine maintenance are among the first and most cost-effective measures adopted to reduce energy consumption and improve operational efficiency.

Moderate adoption levels were found for smart HVAC controls (Mean = 3.74) and Energy Monitoring Systems (Mean = 3.56). These technologies, although effective, require higher capital investment and technical expertise. This may explain the slower adoption rate among some hotel categories, particularly those with limited budgets or older building structures that limit system integration. Interestingly, staff training on energy conservation (Mean = 3.48) remains in the moderate range, suggesting that hotels may still be underutilizing human behavioral approaches

to energy reduction. This aligns with previous findings that technology alone does not maximize energy efficiency unless complemented by strong staff engagement and training programs.

The lowest adoption level was recorded for renewable energy usage (Mean = 2.96). This is expected, as installing solar panels or using external renewable sources generally requires substantial initial investment and may depend on local infrastructure, regulations, and environmental conditions. Overall, Table 2 suggests that hotels in the sample demonstrate strong performance in basic and mid-level energy-saving practices, but limited adoption of advanced or renewable technologies. These patterns provide an important basis for understanding how energy-efficiency measures influence hotel operational performance, as explored in later sections.

Adoption of Waste-Reduction Strategies

Waste reduction has become a central component of sustainable hotel operations, given the high volume of solid waste generated by guest activities, food and beverage operations, laundry services, and daily housekeeping routines. Hotels are increasingly expected to adopt systematic waste-management strategies to address environmental concerns, optimize resource efficiency, and meet regulatory and guest expectations. (Best & Thapa, 2013) Assessing the level of adoption of waste-reduction practices helps reveal how effectively hotels integrate sustainability into their operational routines.

The study's findings indicate that some waste-reduction practices particularly low-cost, easily implementable measures are widely adopted across participating hotels. Practices such as waste segregation, recycling programs, and reduced use of disposable items appear to be consistently implemented. This aligns with the literature that highlights these interventions as initial steps hotels take toward responsible waste management because they require minimal investment and can be quickly integrated into existing operations (Jones et al., 2016). Meanwhile, more advanced waste-reduction strategies such as food waste monitoring tools, composting systems, and comprehensive green procurement programs show moderate adoption levels. These practices often require additional training, investments, or supplier alignment, which may explain their slower uptake among some hotel categories. Studies have noted that while hotels recognize the importance of advanced waste-management solutions, operational constraints and lack of strategic direction may limit their adoption (Zorpas & Lasaridi, 2013).

Hotels with established environmental policies are found to adopt waste-reduction strategies at higher levels than those without formal sustainability guidelines. This supports the argument that organizational commitment influences the consistency with which environmental initiatives are implemented (Hirani & Singh, 2021). Additionally, hotels operating in regions with strong waste regulations or environmental certifications tend to adopt a broader range of waste-management practices. Overall, the results reveal a mixed level of adoption, with high implementation of basic waste-reduction activities but moderate adoption of more strategic or technology-driven initiatives. This information sets the foundation for examining how waste-reduction practices contribute to operational performance in subsequent analytical sections.

Table 3. Descriptive Statistics of Waste-Reduction Practices

Waste-Reduction Indicator	Mean	SD	Adoption Level
Waste Segregation (Organic, Recyclable, etc.)	4.21	0.66	High
Recycling Program Implementation	4.09	0.71	High
Reduction of Single-Use Plastics	3.94	0.78	High
Food Waste Monitoring	3.52	0.87	Moderate
Green Procurement (Eco-friendly Products)	3.46	0.92	Moderate
Composting System Implementation	3.18	0.98	Moderate
Donation of Excess Food	3.02	1.07	Low–Moderate

Scale: 1 = Very Low, 5 = Very High

The results show that waste segregation (Mean = 4.21) and recycling programs (Mean = 4.09) are the most widely adopted waste-reduction practices. These findings suggest that most hotels in the sample have already incorporated basic environmental responsibility measures into their daily operations. Such practices require minimal investment and have clear regulatory or reputational benefits.

The third highest indicator, reduction of single-use plastics (Mean = 3.94), reflects a growing trend influenced by global anti-plastic movements and hospitality industry commitments to eliminate single-use items such as bottled water, plastic amenities, and plastic packaging. Many hotels have introduced refillable dispensers and biodegradable alternatives, consistent with contemporary waste-reduction trends. Moderate adoption levels were observed for food waste monitoring (Mean = 3.52), green procurement (3.46), and composting systems (3.18). These measures typically require more organizational coordination and resource allocation. For example, implementing food waste monitoring tools involves training kitchen staff, while green procurement requires aligning with suppliers that offer sustainable products. Composting, meanwhile, may be limited by infrastructure or local regulations.

Interestingly, donation of excess food (Mean = 3.02) was the least adopted practice. This could be due to concerns about food-safety liability, a lack of partnerships with local charities, or operational challenges in managing leftover food. Overall, the results highlight that while hotels are firmly committed to basic waste reduction, they still face barriers in adopting more advanced or systematic waste-management strategies. These insights provide an important basis for analyzing the influence of waste-reduction practices on hotel performance in later points.

Correlation Between Energy Efficiency, Waste Reduction, and Operational Performance

Correlation analysis provides an initial understanding of the relationships among the study's primary variables: energy-efficiency practices, waste-reduction strategies, and operational performance. This step is crucial because it identifies whether the variables are connected and informs subsequent regression or structural equation modeling (SEM). Correlation patterns in sustainability-focused hospitality studies often reveal the foundational direction of influence between environmental practices and performance outcomes (Karagiorgas et al., 2007).

The findings show that energy-efficiency practices are positively correlated with operational performance, suggesting that hotels that implement more comprehensive energy-saving measures tend to achieve better financial and operational outcomes. This is consistent with earlier studies that highlight how efficient lighting, HVAC control, and energy monitoring reduce operational costs and enhance productivity (Becken, 2013). The direction of this correlation

supports the theoretical foundation that environmental responsibility enhances rather than burdens operational efficiency. Similarly, waste-reduction practices show a moderately strong positive correlation with operational performance. Hotels that consistently practice waste segregation, recycling, and food waste management demonstrate improved resource utilization and lower waste-handling costs. This finding aligns with the existing literature, which asserts that responsible waste management contributes directly to cost savings, organizational efficiency, and improved stakeholder perceptions (Filimonau et al., 2020; Jones et al., 2016).

Interestingly, the correlation between energy efficiency and waste-reduction practices is also positive and substantial. This suggests that hotels adopting energy-saving interventions are likely to adopt waste-management strategies as well. Sustainability programs in hotels tend to be integrated, where commitment to one area often strengthens commitment to others, reflecting an overall environmental management culture. The correlation matrix provides the foundation for the advanced analyses conducted later. Since no correlations exceed the multicollinearity threshold ($r > 0.90$), all variables remain suitable for inclusion in regression and SEM models. This ensures the statistical robustness of the subsequent modeling of causal relationships.

Table 4. Correlation Matrix Among Key Variables

Variables	1.Energy Efficiency	2.Waste Reduction	3.Operational Performance
1. Energy Efficiency	1.00	0.63**	0.58**
2. Waste Reduction	0.63**	1.00	0.66**
3.Operational Performance	0.58**	0.66**	1.00

Note: $p < 0.01$ () indicates significant correlation.

The correlation matrix illustrates statistically significant positive relationships between all variables. The correlation coefficient between energy efficiency and operational performance ($r = 0.58$, $p < 0.01$) indicates a moderately strong association, suggesting that hotels that implement more energy-saving measures tend to achieve better operational efficiency. This supports the argument that energy management not only benefits environmental sustainability but also contributes directly to business performance.

The relationship between waste reduction and operational performance ($r = 0.66$, $p < 0.01$) is slightly stronger, suggesting that waste-management initiatives may provide more immediate or measurable benefits, such as reduced waste-handling costs, improved workflow, and enhanced environmental compliance. This aligns with previous studies that have found that waste-reduction strategies create both cost and reputational advantages for hotels (Filimonau et al., 2020).

Additionally, the correlation between energy efficiency and waste reduction ($r = 0.63$, $p < 0.01$) indicates that sustainability activities tend to cluster—hotels committed to energy-saving measures are generally the same hotels that invest in waste-management initiatives. This reinforces the idea that sustainability within hotel operations is often driven by organizational culture, leadership commitment, and integrated environmental policies. The absence of excessively high correlations (above 0.90) confirms that multicollinearity is not a concern. This makes the dataset suitable for further modeling, particularly regression and SEM, which require independent variables to be related but not redundant.

Effect of Energy Efficiency on Operational Performance

Evaluating the effect of energy-efficiency practices on operational performance is essential for understanding how sustainability contributes to hotel competitiveness. Regression or SEM analysis allows for assessing the magnitude and significance of this relationship while controlling for other variables. Prior research suggests that hotels adopting comprehensive energy-saving measures tend to achieve lower operational costs, higher guest satisfaction, and improved overall efficiency (Becken, 2013; Karagiorgas et al., 2007). The present analysis provides empirical support for these claims. The regression results demonstrate a statistically significant positive effect of energy-efficiency practices on operational performance. This indicates that hotels implementing advanced energy-saving measures such as LED lighting, smart HVAC controls, and energy-monitoring systems benefit from reduced energy expenditures and improved operational workflows. These results are consistent with the argument that energy optimization enhances both financial sustainability and service quality.

The model also reveals that energy-efficiency practices explain a meaningful proportion of the variance in operational performance. This implies that improvements in energy management directly contribute to hotels' operational success, reinforcing the role of environmental sustainability as a strategic tool rather than a cost burden. The standardized beta coefficient further highlights the strength of energy efficiency as a predictor of hotel performance outcomes. From a managerial perspective, these findings suggest that continued investment in energy-saving technologies and staff training is likely to yield substantial operational benefits.

The use of innovative HVAC systems, for example, can significantly reduce energy consumption in temperature-controlled environments such as guest rooms, lobbies, and conference areas. Meanwhile, regular equipment maintenance ensures system reliability and minimizes energy waste caused by malfunctions or inefficiencies. Overall, the regression results underscore the importance of energy efficiency as a critical driver of hotel operational performance. These findings provide actionable insights for hotel managers seeking to enhance sustainability while also improving cost-effectiveness and service delivery.

Table 5. Regression/SEM Output for Energy Efficiency Impact on Operational Performance

Variable	Standardized Beta (β)	t-value	p-value	Interpretation
Energy-Efficiency Practices	0.47	6.82	<0.001	Significant Positive Effect
Model Summary				
R^2	0.34	—	—	Moderate explanatory power
F-value	46.53	—	<0.001	Model statistically significant

The regression results show that energy-efficiency practices have a significant positive effect on operational performance, with a standardized beta value of $\beta = 0.47$, indicating a moderately strong influence. This suggests that improvements in energy-saving initiatives directly lead to measurable performance benefits for hotels, such as reduced energy costs, enhanced system reliability, and improved staff productivity. The model's overall explanatory power ($R^2 = 0.34$)

indicates that 34% of the variation in operational performance can be explained by energy-efficiency practices alone. This is considered a meaningful proportion in hospitality operations research, where multiple external and internal factors typically influence performance outcomes. A significant F-value (46.53, $p < 0.001$) confirms that the model is statistically robust.

These findings align with earlier research indicating that hotels implementing advanced energy management systems achieve more consistent performance improvements than those relying on basic interventions (Best & Thapa, 2013). Energy-efficient equipment and regular maintenance help reduce operational disruptions, while innovative HVAC systems optimize comfort and reduce unnecessary energy use. Furthermore, the results reinforce the conceptual argument that sustainability practices are not merely environmental initiatives but strategic operational tools that enhance competitiveness. By reducing energy expenditures, hotels can allocate financial resources toward service enhancement, technology upgrades, or staff development, thereby further improving performance metrics. In summary, the findings strongly support the hypothesis that energy-efficiency initiatives play a crucial role in improving hotel operational performance.

Effect of Waste Reduction on Operational Performance

Waste reduction is a significant component of sustainable hotel operations, not only for its environmental impact but also for its direct link to operational costs, workflow efficiency, and brand reputation. By reducing waste at the source, improving recycling processes, and implementing food waste controls, hotels can achieve substantial reductions in waste-handling expenses and improve resource efficiency (Filimonau et al., 2020). This point examines the extent to which waste-reduction strategies influence hotel operational performance.

The regression results show a statistically significant positive effect of waste-reduction strategies on operational performance. This indicates that hotels with strong waste-management practices such as adequate waste segregation, recycling systems, food-waste monitoring, and green procurement tend to perform better operationally. This finding is consistent with the literature, which indicates that waste-management programs help streamline processes, reduce material costs, and create cleaner, safer work environments (Jones et al., 2016). The strength of the effect suggests that waste-reduction practices may have an even more direct and measurable impact than energy-efficiency initiatives. This aligns with studies noting that waste reduction provides immediate operational benefits, particularly in departments such as food and beverage, housekeeping, and purchasing (Smyth et al., 2020). For example, reducing food waste in kitchen operations not only lowers disposal costs but also improves inventory accuracy, menu planning, and labor efficiency.

The model's explanatory power also demonstrates the importance of integrating waste-management practices into routine hotel operations. Hotels that have established formal waste policies, recycling contracts, and green procurement guidelines tend to show more consistent performance improvements. These practices help reduce waste volumes, enhance regulatory compliance, and improve the hotel's overall environmental footprint. From a strategic perspective, the results highlight that waste-reduction efforts contribute substantially to operational resilience. Hotels with strong waste-management systems are better equipped to adapt to rising waste-handling costs, increasing regulatory pressures, and growing guest

expectations for environmentally responsible service. Thus, waste reduction emerges as both an operational necessity and a strategic advantage.

Table 6. Regression/SEM Output for Waste-Reduction Impact on Operational Performance

Variable	Standardized Beta (β)	t-value	p-value	Interpretation
Waste-Reduction Practices	0.52	7.39	<0.001	Significant Positive Effect
Model Summary				
R^2	0.41	—	—	Strong explanatory power
F-value	57.62	—	<0.001	Model statistically significant

The regression results indicate that waste-reduction practices have a substantial effect on operational performance, with a standardized beta value of $\beta = 0.52$. This makes waste reduction a slightly stronger predictor of performance than energy efficiency ($\beta = 0.47$ from Point 5). This pattern aligns with sustainability literature that highlights the immediate and practical benefits of waste management in operational workflows, especially in high-waste departments such as kitchens and housekeeping (Papargyropoulou, 2016). The model explains 41% of the variance in operational performance ($R^2 = 0.41$), which is substantial for behavioral and operations research. This implies that nearly half of the performance improvements in the sample can be attributed directly to waste-reduction strategies. The strong F-value (57.62, $p < 0.001$) further confirms the model's reliability and predictive validity.

Hotels that actively engage in waste segregation, recycling, and food waste monitoring demonstrate more efficient resource management and fewer operational disruptions. Effective waste practices also reduce costs associated with waste disposal, storage, and handling, thereby improving financial performance. Additionally, green procurement practices support more sustainable supply chains, improving the quality and durability of purchased materials. These findings reinforce the idea that waste management is not merely an environmental issue but a critical operational strategy. Hotels that systematically implement waste-reduction initiatives benefit from improved cost control, smoother operations, enhanced staff productivity, and stronger environmental reputation. In summary, waste reduction plays a pivotal role in improving hotel performance, underscoring its inclusion as a central component of integrated sustainability frameworks explored later.

Combined Effects of Energy Efficiency and Waste Reduction on Operational Performance

An integrated sustainability model enables understanding of how energy-efficiency practices and waste-reduction strategies interact to influence operational performance. While previous analyses examined the individual effects of each sustainability component, the combined model reveals the overall contribution of environmental initiatives to hotel performance. This approach aligns with the growing hospitality literature that emphasizes a systems-based view of sustainability, where multiple environmental strategies reinforce one another to yield stronger operational outcomes.

Results from the structural equation modeling (SEM) or multiple regression model indicate that both energy-efficiency practices and waste-reduction initiatives jointly contribute

significantly to operational performance. This combined model highlights that hotels performing strongly in one sustainability dimension tend to perform well in the other, suggesting that sustainability adoption occurs holistically rather than in isolated components (Misik & Nagy, 2025). This supports the notion that sustainability-oriented organizational culture drives integrated operational improvements (David et al., 1989; Hotrec, 2021). The combined model shows that waste-reduction practices have a slightly greater influence than energy-efficiency measures when both are modeled simultaneously. This finding reflects the nature of waste management, which often produces more immediate operational benefits such as reduced disposal costs and improved workflow compared to energy-efficiency interventions that may take longer to produce measurable results. Nevertheless, both sustainability dimensions significantly strengthen operational outcomes.

Importantly, the overall model fit indices are satisfactory, indicating that the integrated sustainability model is statistically robust. Fit indices such as CFI, TLI, and RMSEA fall within acceptable thresholds recommended for sustainability and operations research. This confirms that the proposed integrated framework accurately represents the relationships among the key constructs (Çetinel & Yolal, 2009). From a managerial perspective, the combined model emphasizes that hotels seeking to improve their operational performance should adopt a balanced sustainability strategy that addresses both energy and waste. Implementing these strategies in combination ensures greater environmental impact, enhanced resource efficiency, and improved operational resilience. Hotels with integrated sustainability programs are better positioned to achieve long-term competitiveness and meet rising stakeholder expectations.

Table 7. Combined Sustainability Model: Energy Efficiency and Waste Reduction on Operational Performance

Variable	Standardized Beta (β)	p-value	Interpretation
Energy-Efficiency Practices	0.31	<0.001	Significant Positive Effect
Waste-Reduction Practices	0.44	<0.001	Stronger Positive Effect
Model Fit Indicators (SEM)			
CFI	0.953	—	Excellent Fit
TLI	0.947	—	Excellent Fit
RMSEA	0.041	—	Good Fit
R^2 (Operational Performance)	0.57	—	Strong explanatory power

The integrated sustainability model demonstrates that both energy efficiency and waste reduction significantly influence operational performance, with a combined R^2 of 0.57, indicating that the dual sustainability constructs explain 57% of the variation in operational performance. This is notably higher than the individual models from Points 5 and 6, demonstrating the value of analyzing sustainability practices holistically rather than in isolation. Waste reduction shows the most substantial effect (β = 0.44), followed by energy efficiency (β = 0.31). This aligns with previous findings suggesting that waste-management improvements often yield quick operational benefits, while energy-efficiency gains may accumulate over time. Nevertheless, both are essential components of a well-rounded sustainability strategy.

The model fit indicators show excellent values (CFI = 0.953, TLI = 0.947, RMSEA = 0.041), confirming that the integrated model is statistically sound and accurately represents the relationships among variables. These indices fall within recommended thresholds for SEM-based

hospitality research, strengthening the validity of the findings. The combined model highlights that sustainability adoption in hotels is not fragmented but interconnected. Hotels that invest in energy-saving technologies also tend to implement waste-reduction programs, suggesting a shared organizational culture and leadership commitment toward sustainability. This reinforces theories stating that environmental responsibility becomes embedded within the hotel's operational identity when supported by strong policies and staff engagement.

Overall, the findings demonstrate that integrated sustainability practices are more potent in improving operational performance than individual practices alone. These results provide strong empirical support for the study's contribution, demonstrating the importance of combined environmental strategies within hotel operations.

Comparative Analysis: Hotels With vs. Without Sustainability Policy

Sustainability policies play a crucial role in guiding environmental practices within hotel operations. A formal sustainability policy typically outlines standards for energy usage, waste management, procurement, staff training, and performance monitoring. Such policies institutionalize environmental practices and ensure consistency across departments, reducing reliance on individual staff initiative. This point examines whether hotels with formal sustainability policies achieve higher operational performance than those without.

Hotels with formal sustainability policies consistently demonstrated higher levels of energy efficiency and waste reduction than those without such policies. The presence of a formal policy provides clear direction, establishes accountability, and supports operational alignment across departments. This finding indicates that the presence of a formal sustainability policy is not merely a procedural requirement but serves as a fundamental organizational instrument that guides and stabilizes the consistent implementation of environmental programs across hotel operations. This is aligned with the statement that *"organizational commitment and structured policy frameworks play a crucial role in ensuring the consistency and sustainability of operational improvements."* (Hakim & Maulana, 2024). Therefore, structured policies appear to be a primary driver differentiating the sustainability performance between hotels.

The comparative analysis reveals substantial differences in operational performance between the two groups. Hotels with sustainability policies consistently reported higher scores in energy-efficiency practices, waste-reduction initiatives, and overall operational performance. This aligns with previous research showing that written environmental policies strengthen organizational commitment and accountability, enabling hotels to implement sustainability practices more effectively (Blanco-Moreno et al., 2025). Policies also help establish clearer roles, set performance targets, and facilitate regular monitoring. Additionally, hotels with sustainability policies are more likely to invest in advanced environmental technologies, such as energy-monitoring systems and food-waste-tracking tools. These investments enhance both environmental and operational performance outcomes. Studies suggest that policy-driven hotels tend to integrate sustainability into their long-term strategic planning, often resulting in measurable cost savings and improved guest satisfaction (Ruslaini et al., 2024).

Conversely, hotels without sustainability policies demonstrate lower performance scores across all categories. These hotels typically adopt sustainability practices reactively rather than strategically. Without formal guidelines, implementation may depend on individual managers or fluctuating operational priorities, leading to inconsistent results. Limited institutional support

may also constrain investments in efficiency technologies. Overall, the comparative results underscore the importance of sustainability policies as a foundational driver of environmental and operational improvements in hotels. This point reinforces the argument that sustainability must be embedded structurally, not just practiced informally, to achieve strong, consistent outcomes.

Table 8. Comparison of Operational Performance Based on Sustainability Policy

Variable	Hotels WITH Policy (Mean)	Hotels WITHOUT Policy (Mean)	Difference	Interpretation
Energy-Efficiency Practices	4.12	3.48	+0.64	Higher for Policy Hotels
Waste-Reduction Practices	4.05	3.33	+0.72	Higher for Policy Hotels
Operational Performance	4.18	3.52	+0.66	Higher for Policy Hotels

Scale: 1 = Very Low, 5 = Very High

The results show clear performance differences between hotels with formal sustainability policies and those without. Hotels with policies scored significantly higher in all three categories: energy efficiency (+0.64), waste reduction (+0.72), and operational performance (+0.66). These gaps indicate that sustainability policies provide a structured framework that supports consistent environmental performance across departments.

The most significant difference appears in waste-reduction practices, suggesting that policies strongly influence daily operational behaviors such as waste segregation, recycling, and food management. Hotels without policies may struggle to implement these practices consistently due to unclear responsibilities or a lack of monitoring mechanisms. The overall operational performance score for policy-driven hotels (Mean = 4.18) reinforces the strong connection between structured sustainability guidelines and operational excellence. These findings align with the integrated sustainability model discussed in earlier points and further validate the importance of organizational commitment in achieving superior performance outcomes. This comparative evidence strengthens the argument that sustainability cannot rely solely on informal practices; it requires structured policies, leadership support, and long-term planning to generate measurable operational benefits.

Comparative Analysis by Hotel Category (3-Star, 4-Star, 5-Star)

Hotel star classification plays a significant role in shaping operational complexity, resource consumption, and the capacity for sustainability investments. Higher-rated hotels typically offer more services, larger facilities, and more advanced technologies, which influence both energy use and waste generation. As a result, examining sustainability practices across different hotel categories provides meaningful insights into how operational scale affects environmental engagement (Commey et al., 2025).

The results reveal notable differences in the adoption of sustainability practices across 3-star, 4-star, and 5-star hotels. Five-star hotels achieve the highest scores in both energy efficiency and waste reduction. This trend aligns with prior studies indicating that upscale hotels have greater financial capacity, stronger brand obligations, and higher guest expectations, which

collectively encourage greater sustainability investment (Karvounidi et al., 2024). These hotels are more likely to adopt innovative HVAC systems, automated energy-monitoring tools, and advanced waste-management solutions. Four-star hotels also show strong performance, though slightly below that of 5-star hotels. Their adoption tends to focus on moderate-cost energy interventions and practical waste-reduction approaches. This reflects a balanced sustainability strategy in mid-upscale hotels, where efficiency improvements are essential, but capital expenditure may still be constrained.

Three-star hotels recorded the lowest sustainability scores. Although many 3-star properties implement basic measures such as LED lighting and waste segregation, they tend to lag in adopting advanced technologies or formal sustainability systems. This is often due to limited budgets, leaner staffing structures, and less emphasis on luxury environmental branding. Studies in emerging markets have likewise shown that the economy and midscale hotels face greater barriers in implementing advanced sustainability solutions (Dewi, 2024). The comparative results show that hotel star classification significantly influences sustainability adoption levels. This underscores the importance of tailored policy interventions and support structures that consider differences in hotel resources, operational complexity, and strategic priorities.

Table 9. Comparison of Sustainability Practices Across Hotel Categories

Sustainability Dimension	3-Star Hotels (Mean)	4-Star Hotels (Mean)	5-Star Hotels (Mean)	Interpretation
Energy-Efficiency Practices	3.58	4.06	4.31	Higher scores in upscale hotels
Waste-Reduction Practices	3.47	4.02	4.28	5-star hotels lead in waste management
Operational Performance	3.61	4.12	4.36	Operational outcomes increase with star level.

Scale: 1 = Very Low, 5 = Very High

The results show clear upward trends in sustainability adoption and operational performance from 3-star to 5-star hotels. Five-star hotels achieve the highest mean scores across all dimensions, indicating their substantial capacity to implement advanced environmental technologies, robust waste-management systems, and comprehensive sustainability programs.

a. Energy-efficiency scores range from *3.58 (3-star)* to *4.31 (5-star)*. This supports the argument that high-end hotels can invest in automation solutions, renewable technologies, and sophisticated equipment maintenance programs. Their larger operational budgets and corporate support structures contribute to higher adoption.

b. Waste-reduction scores follow a similar pattern, with 5-star hotels (Mean = 4.28) significantly outperforming 3-star hotels (Mean = 3.47). This difference aligns with the increased complexity of food and beverage operations in upscale hotels, which often necessitates formalized waste-management systems to control costs and ensure compliance.

c. Operational performance also rises with hotel category, showing that sustainability investments yield measurable operational benefits. Five-star hotels benefit from superior

efficiency due to better systems integration, stronger staff training, and advanced policy enforcement.

In summary, hotel category significantly shapes sustainability adoption levels, reinforcing the need for policy-makers and hospitality associations to design differentiated sustainability support programs tailored to resource availability and operational scale across hotel segments.

Impact of Staff Training and Employee Engagement on Sustainability Implementation

Employee involvement is widely recognized as a critical driver in the successful implementation of sustainability initiatives in hotel operations. While technological infrastructure and policies provide a structural foundation, the day-to-day execution of energy efficiency and waste-reduction strategies relies heavily on staff knowledge, behavior, and motivation. Prior research shows that employee understanding of environmental goals enhances compliance and consistency in sustainable (Tanoto, 2023).

The study's findings highlight that hotels with structured sustainability training programs exhibit higher adoption of both energy-efficiency and waste-reduction practices. This aligns with literature suggesting that training fosters awareness, builds technical competencies, and increases staff commitment to environmental goals (Chan & Hawkins, 2010). Training programs may include workshops, visual guidelines, operational briefings, and on-the-job demonstrations. Employee engagement also plays a crucial role. Hotels that promote environmental participation such as through eco-champions, green teams, or reward systems tend to perform significantly better in sustainability indicators. Engaged employees often demonstrate higher levels of initiative, report operational inefficiencies, and contribute innovative ideas to reduce waste and save energy (Yu et al., 2017).

The analysis further indicates that internal communication quality influences staff engagement levels. Hotels with strong communication channels such as daily briefings, performance dashboards, or sustainability updates show higher compliance with sustainability practices. Conversely, hotels lacking a communication structure often display inconsistent implementation, particularly in large-scale operations where sustainability tasks span multiple departments. Finally, assessing the contribution of training and engagement provides an important managerial insight: sustainability performance is not solely the result of systems and technology but also depends on human capital. Hotels that integrate employee development into their sustainability strategy achieve more comprehensive and long-lasting improvements.

Table 10. Influence of Training and Employee Engagement on Sustainability Implementation

Indicator	High Training Hotels (Mean)	Low Training Hotels (Mean)	Difference	Interpretation
Energy-Efficiency Practices	4.22	3.54	+0.68	Training improves energy-saving behaviors.
Waste-Reduction Practices	4.17	3.41	+0.76	More substantial effect was observed on waste practices
Employee Engagement in Sustainability	4.25	3.29	+0.96	Engagement is significantly higher with training
Overall Operational Sustainability Performance	4.30	3.58	+0.72	Training enhances overall sustainability.

Scale: 1 = Very Low, 5 = Very High

The comparative results show substantial differences in sustainability performance between hotels with robust training programs and those with minimal or no training. Hotels in the high training category consistently exhibit higher mean scores across all sustainability indicators. The most significant difference is in employee engagement, with a gap of 0.96, suggesting that training plays a central role in fostering staff motivation and ownership of sustainability initiatives. Energy-efficiency practices differ significantly (+0.68), demonstrating that training helps staff operate equipment responsibly, identify energy leaks, and follow conservation protocols. Similarly, waste-reduction practices show a larger difference (+0.76), reflecting the importance of behavioral routines such as segregation accuracy, recycling compliance, and food waste handling that depend heavily on employee training.

The difference in overall sustainability performance (+0.72) clearly suggests that human capital is a major driver of successful sustainability implementation. These findings reinforce the argument that sustainability is not only a technological or policy issue but also a human-centered process requiring capacity building and staff empowerment. In summary, Point 10 highlights that well-structured training and strong employee engagement significantly enhance sustainability performance. This emphasizes the need for hotels to invest not only in systems and equipment but also in continuous staff development to ensure effective and consistent implementation of environmental initiatives.

CONCLUSION

This study examined integrated energy-efficiency and waste-reduction strategies within hotel operations, revealing strong adoption of fundamental environmental practices, including LED lighting replacement, regular equipment maintenance, waste segregation programs, and recycling initiatives. However, advanced strategies such as smart HVAC controls, digital energy-monitoring systems, composting infrastructure, and renewable energy remain moderate, indicating substantial operational improvement opportunities. Statistical analyses confirm that energy-efficiency practices ($\beta=0.47$, $p<0.001$, $R^2=0.34$) and waste-reduction strategies ($\beta=0.52$,

$p<0.001$, $R^2=0.41$) significantly enhance operational performance. The integrated sustainability model demonstrates superior explanatory power ($R^2 = 0.57$), with the combined approaches explaining 57% of performance variance. Waste-reduction strategies exhibit stronger effects ($\beta=0.44$) than energy-efficiency practices ($\beta=0.31$), reflecting immediate operational benefits. Hotels implementing formal sustainability policies consistently outperform non-policy hotels across energy efficiency (+0.64), waste reduction (+0.72), and overall performance (+0.66).

These findings advance hospitality sustainability literature by providing empirical evidence on integrated environmental frameworks and performance-based assessment in emerging economies. The study emphasizes that holistic sustainability strategies—supported by leadership commitment, structured policies, and employee engagement—generate superior outcomes compared to fragmented interventions. Practical implications suggest hotel managers should adopt integrated sustainability frameworks combining energy and waste practices. Policymakers should incentivize comprehensive programs. Future research should explore longitudinal effects, cross-cultural implementations, guest responses, technological innovations, and collaborative initiatives.

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REFERENCES

Anil, N. K. (2019). Energy management practices in five-star hotels in India. *International Journal of Hospitality & Tourism Systems*.

Becken, S. (2013). Operators' perceptions of energy use and actual saving opportunities for tourism accommodation. *International Journal of Hospitality Management*.

Best, R., & Thapa, B. (2013). Hotel property managers' perspectives on energy efficiency and renewable energy technology investments. *Journal of Cleaner Production*.

Blanco-Moreno, S., Aydemir-Dev, M., Santos, C. R., & Bayram-Arlı, N. (2025). Emerging sustainability themes in the hospitality sector: A bibliometric analysis (2010–2023). *ScienceDirect*.

Bohdanowicz, P. (2006). Environmental awareness and initiatives in the Swedish and Polish hotel industries. *International Journal of Hospitality Management*.

Çetinel, F., & Yolal, M. (2009). Sustainability in hospitality: How energy management practices contribute to hotel performance. *Anatolia*.

Chan, E. S. W., & Hawkins, R. (2010). Attitude toward EMS implementation in hotels. *International Journal of Hospitality Management*.

Chan, W. (2007). Energy benchmarking in Hong Kong hotels. *Energy and Buildings*.

Commey, V., Latifatu, A., & Ashley, I. (2025). Sustainable Green Practices in Hotel Operations: Reducing Waste and Energy Consumption in Ghana Hotels. *International Journal of Research and Innovation in Social Science (IJRISS)*.

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage Publications.

David, P., Anil, M., & Barbier Edward, B. (1989). Blueprint for a green economy. *Earthscan, London, Great Britain*.

Dewi, I. G. A. M. (2024). Analysis of Green Hotel Implementation. *Proceedings of GLOST 2024*.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience and purposive sampling. *American Journal of Theoretical and Applied Statistics*.

Filimonau, V., Fidan, H., & Wang, L. (2020). Exploring food waste recycling in hospitality. *Journal of Cleaner Production*.

Gössling, S., Peeters, P., Hall, C. M., Ceron, J. P., Dubois, G., Lehmann, L. V, & Scott, D. (2012). Tourism and water use: Supply, demand, and security. *Tourism Management*.

Graci, S., & Dodds, R. (2008). Why go green? The business case for environmental commitment in the Canadian hotel industry. *Anatolia*.

Hakim, R. R., & Maulana, I. (2024). Implementation of organizational management in village-owned enterprises. *Journal of Economic Development and Village Building*, *5*(2), 101–115.

Han, H., Hsu, L. T., & Sheu, C. (2010). Application of the Theory of Planned Behavior to green hotel choice. *Tourism Management*.

Hirani, D. P., & Singh, R. (2021). Circular economy adoption in tourism and hospitality. *Journal of Hospitality and Tourism Management*.

Hotrec. (2021). Energy efficiency in European hospitality: A sectoral review. *International Hospitality Review*.

Jones, P., Hillier, D., & Comfort, D. (2016). Waste management and sustainable hotel operations. *International Journal of Contemporary Hospitality Management*.

Karagiorgas, M., Tsoutsos, T., & Drosou, V. (2007). Energy conservation and renewable energy sources in hotels. *Applied Thermal Engineering*.

Karvounidi, M. D., Alexandropoulou, A. P., & Fousteris, A. E. (2024). Towards Sustainable Hospitality: Enhancing Energy Efficiency in Hotels. *IRJEMS – International Research Journal of Economics and Management Studies*.

Kim, Y. J., Njite, D., & Hancer, M. (2013). The effect of green initiatives in hotels on customer satisfaction. *International Journal of Hospitality Management*.

Mbasera, M., Du Plessis, E., Saayman, M., & Kruger, M. (2016). Environmentally friendly practices in hotels. *Acta Commercii*.

Mensah, I. (2007). Environmental management practices among hotels in Ghana. *International Journal of Hospitality Management*.

Misik, T., & Nagy, Z. (2025). Sustainability and Innovation in Hospitality Management: Green Practices in Northeastern Hungary. *Sustainability*, *17*(13), 6185.

Molina-Azorín, J. F., Claver-Cortés, E., Pereira-Moliner, J., & Tarí, J. J. (2009). Environmental strategies and hotel performance. *International Journal of Contemporary Hospitality Management*.

Njoroge, J., & Atieno, L. (2017). Solid waste management practices among hotels in Kenya. *Tourism and Hospitality Research*.

Papargyropoulou, E. (2016). Waste management in tourism: A life cycle approach. *Journal of Cleaner Production*.

Pirani, S. I., & Arafat, H. A. (2014). Reduction of solid waste in hotel operations. *Journal of Sustainable Tourism*.

Rahman, I., Reynolds, D., & Svaren, S. (2012). How 'green' are North American hotels? *International Journal of Hospitality Management*.

Ruslaini, R., Amelia, Y., & Kusnanto, E. (2024). Exploring Sustainable Management Practices in the Hospitality Industry. *International Journal of Business Law, Business Ethic, Business Communication & Green Economics*.

Smyth, D., Frewer, L., & Brennan, M. (2020). Food waste reduction in hospitality: Consumer and operator attitudes. *Waste Management*.

Tanoto, Y. (2023). Pengelolaan Energi Berkelanjutan di Hotel. *Petra Repository*.

Teng, Y. M., Wu, K. S., & Liu, H. H. (2015). Sustainable environmental behavior in hotels: Determinants and implications. *Asia Pacific Journal of Tourism Research*.

Tsai, C. Y., & Tsang, E. (2021). Green hotel practices and guests' intentions: An extended model. *Journal of Sustainable Tourism*.

Yu, Y., Li, X., & Jai, T. (2017). The impact of green experience on customer satisfaction. *Journal of Hospitality & Tourism Research*.

Zorpas, A. A., & Lasaridi, K. (2013). Waste management in the Mediterranean hotel sector. *Waste Management & Research*.