

Combating Energy Inefficiency in the Hospitality Industry: Insights from Air Conditioning Practices and Compliance Factors

Makibane Daniel Ntlhane^{1}, Tebello Ntsiki Don Mathaba², and Jan-Harm Christiaan Pretorius³*

¹Faculty of Engineering of Engineering and the Built Environment, School of Engineering Management, University of Johannesburg, email: ntlhanemd@gmail.com

²Faculty of Engineering of Engineering and the Built Environment, School of Engineering Management, University of Johannesburg, email: tmathaba@uj.ac.za

³Faculty of Engineering of Engineering and the Built Environment, School of Engineering Management, University of Johannesburg, email: jhcpretorius@uj.ac.za

Abstract. Energy use continues to place considerable pressure on the hospitality sector. This study examines how far South African hotels have moved towards adopting energy-efficient and regulation-compliant air conditioning systems, and how hotel staff perceive the risks associated with using non-compliant units. Drawing on survey responses from 234 employees across different organisational levels, the analysis combined descriptive statistics with exploratory factor analysis and reliability testing to build a clearer picture of current practices. The results point to only moderate compliance: while many hotels have begun incorporating inverter technologies, energy labels, and appropriate refrigerants, efforts to engage guests in energy-saving behaviour remain limited. Two core patterns emerged from the factor analysis first, recognition of the environmental, economic, and operational impacts of non-compliant systems, and second, strong support for strategies such as training, regulatory enforcement, collaboration, incentives, and technology-based monitoring. Both constructs demonstrated acceptable reliability ($\alpha = 0.741$ and $\alpha = 0.844$). Overall, the findings suggest that although awareness of energy-efficient practices is growing, much work remains to translate this into consistent operational behaviour. The study adds to ongoing discussions on sustainable hospitality and offers actionable guidance for policymakers and hotel managers seeking to improve energy performance across the sector.

1 Introduction

Across global tourism markets, the hospitality industry has long been recognised for its heavy dependence on energy-intensive systems. Hotels rely extensively on controlled indoor climates, continuous lighting, and a range of electrical services to meet guest expectations, and these demands collectively place considerable strain on operational

*Corresponding author: Daniel.Ntlhane@nrsc.org.za

budgets and environmental performance [1]. Within this energy profile, air conditioning has gradually become one of the most significant contributors to overall consumption, particularly in regions characterised by warm or fluctuating climatic conditions. Empirical studies suggest that air conditioning alone may account for as much as 40 per cent of a hotel's electricity usage, a figure that underscores its centrality in conversations on sustainability and energy governance [2].

In the South African context, these challenges are compounded by structural issues within the national energy system. Years of supply instability, rising tariffs, and the escalation of load-shedding have created a difficult operating environment for hotels, many of which are required to balance guest comfort with increasingly unpredictable access to electricity [3]. As [4] note, this fragile energy landscape elevates the importance of complying with energy efficiency standards, as even modest improvements can contribute to operational continuity and cost containment.

What is the status of energy consumption of air conditioners (AC) systems in South African hotels. This study investigate the extent to which the hotels in South Africa comply with energy efficiency standards for air conditioning systems. Furthermore, how hotel staff perceive the risks associated with non-compliant air conditioners. This study also investigates the strategies which stakeholders should be considered to improve compliance. The research further contributes to a more integrated understanding of sustainability practices in the hospitality industry and highlights interventions that may support more resilient hotel operations.

2 Background

Energy efficiency has become a defining concern for hotels globally, driven not only by rising utility costs but also by growing expectations that tourism enterprises align themselves with sustainability agendas [2]. While energy consumption patterns differ across regions and hotel classes, a consistent theme in international literature is the centrality of heating, ventilation, and air conditioning (HVAC) systems in shaping energy profiles. As several authors have observed, air conditioning alone often represents the single largest category of electricity use, particularly in warm climates or in properties with expansive guest facilities [2]

The need to consider the difference ways to realise efficient alternatives become necessary, this include energy labelling program, inverter driven compressors and refrigerants with low potential of global warming. The electricity demand can be reduced by considering these innovations while ensuring the protection of the environment [5, 6]. Although these approaches are necessary, they might be difficult to implement in developing countries due to financial constraints.

South Africa, in particular, faces a paradox. Although the policy environment has gradually expanded to include mechanisms such as MEPS and SEER intended to help organisations make informed decisions and phase out inefficient appliances the country's energy crisis has simultaneously imposed severe constraints on investment decisions [4, 7]. Many hotels continue to use non-compliant systems, not because of a lack of technical solutions but due to a combination of budget limitations, staff capacity gaps, and inconsistent enforcement of regulations [8]. As a result, the hospitality sector remains entangled in high energy bills, reliability challenges, and environmental concerns.

This study is intend to close this gap by investigating the level of compliance within the hospitality industry operations. The study assess operational practices, systemic challenges, staff perceptions, establishing connections between organisational behaviour and energy policies. The results are seek not only to contribute in academic discussion but also to assist

hotel decision-makers and government policymakers in identifying appropriate approach to energy saving.

2.1 Background literature

2.1.1 Energy efficiency in the hospitality sector

In examining the literature, energy efficiency emerges as a recurring theme across hospitality studies, partly because hotels consume significantly more energy per square metre than many other commercial buildings. This heightened demand reflects the round-the-clock nature of hotel operations and the sector's obligation to deliver consistent levels of comfort to guests [9]. HVAC systems dominate this consumption profile, with several studies estimating that air conditioning alone contributes between 20 and 40 per cent of total energy use depending on climatic conditions and operational practices [10].

[1] emphasise that energy efficiency is not just a simply a technical metric but a part of broader sustainability subject. Energy performance is not only contribute in reduction of greenhouse (GHG) emissions but also financial savings, both of which are pivotal for hotels operating effectively in eco-conscious markets. Technological upgrades is necessary but should be complemented by behavioural changes at staff and managerial levels [11, 12] or else, anticipated savings may fail to materialise. The relationship between technology and behaviour becomes necessary when assessing compliance which sometimes can affected by resource-constrained environments.

2.1.2 Air conditioning and sustainable energy practices

Technologies of the air conditioners evolved with the intention of reducing energy use while the guest's comfort is maintained. Energy labelling program complement the technological advances by ensuring product information is available on the product to assist buyers to make an informed decision when buying air conditioners [13]. Refrigerant choice has also become a central sustainability concern. Older refrigerants such as hydrofluorocarbons (HFCs) possess high global warming potential, prompting international efforts to transition towards alternative substances that align with climate commitments [14]. As [6] highlight, effective energy efficiency in AC systems often requires an integrated approach that combines technological improvements, labelling transparency, and refrigerant regulation.

2.1.3 Regulatory frameworks and compliance in South Africa

South Africa's regulatory environment has gradually expanded to incorporate energy efficiency considerations, with MEPS and SEER functioning as key instruments intended to steer markets towards more sustainable practices [15]. MEPS establishes baseline performance standards for appliances sold nationally, effectively restricting the influx of low-efficiency products. SEER, on the other hand, offers a comparative measure of seasonal cooling efficiency, allowing buyers to evaluate long-term performance under varying climatic conditions [7].

These frameworks mirror the International Energy Agency's (2020) global recommendations for improving energy performance across sectors. However, compliance within the hotel industry remains inconsistent. In parallel, [4] identify weak enforcement mechanisms as a recurring impediment, arguing that regulatory provisions are only effective when they are matched by monitoring and enforcement.

2.1.4 Consequences of non-compliant air conditioning systems

Non-compliant AC systems present a multifaceted problem that extends beyond elevated electricity bills. In efficient systems draw higher power loads, thereby contributing to national energy shortages, an especially urgent issue in South Africa, where energy capacity is strained. The energy burden created by inefficient AC units directly exacerbates the frequency and severity of load-shedding events.

Environmental impacts are equally significant. Inefficient systems increase carbon emissions and often use refrigerants that accelerate climate change, undermining South Africa's climate commitments and its wider sustainability agenda. The economic consequences also warrant attention. As operational costs rise due to inefficiency, hotel profitability suffers, which in turn reduces competitiveness within a sector that already faces volatile market conditions.

2.1.5 Organisational and behavioural factors

While technology plays a critical role in improving energy efficiency, organisational dynamics often determine whether such technologies are used effectively. Scholars highlight that staff training, guest engagement, and internal policies are equally important in achieving sustainability outcomes. [5] show that staff awareness significantly influences whether AC systems are operated efficiently, emphasising the need for capacity-building initiatives.

Building a culture of compliance therefore requires multi-level engagement: managers must prioritise energy efficiency, staff must be equipped to implement relevant practices, and guests must be encouraged to participate in sustainability efforts.

2.1.6 Gap analysis

Although the literature provides a robust foundation for understanding the importance of energy efficiency in hospitality, several gaps remain apparent. Much of the existing work originates from developed economies, where energy systems, financial resources, and regulatory environments differ considerably from those in South Africa [8]. This limits the applicability of some international findings.

2.1.7 Conceptual framework

Drawing together the key strands of the literature, it became apparent that compliance with energy-efficient air conditioning practices cannot be understood through a single lens. Rather, the reviewed studies point to two intertwined dimensions that appear to shape how hotels respond to regulatory expectations and sustainability imperatives. The first concerns how hotel personnel interpret and internalise the risks linked to non-compliant AC systems, risks that manifest in higher electricity consumption, escalating greenhouse gas emissions, and broader economic repercussions for both individual establishments and the national energy grid [3]. The second dimension centres on the strategic actions that institutions can employ to strengthen compliance. These range from technical measures and monitoring tools to collaborative, regulatory, and behavioural interventions that collectively reinforce sustainable energy practices across the sector.

In constructing the conceptual framework for this study, these two dimensions were positioned as mutually reinforcing rather than sequential. Hotels that underestimate or downplay the risks associated with non-compliant air conditioning systems are, in practice, less likely to prioritise the resources, training, and decision-making necessary to meet

efficiency standards. Conversely, establishments that recognise the full environmental and economic implications of non-compliance tend to be more receptive to adopting coordinated strategies. The strategies included staff development, stakeholder collaboration, regulatory enforcement, and technological oversight that support sustainable energy management [12].

Figure 1 illustrates the way hotels' compliance with energy-efficient air conditioning standards is shaped by two interconnected dimensions. On one side, the perceived risks of non-compliance including rising energy use, environmental pressures, and economic losses create the awareness needed to motivate change.

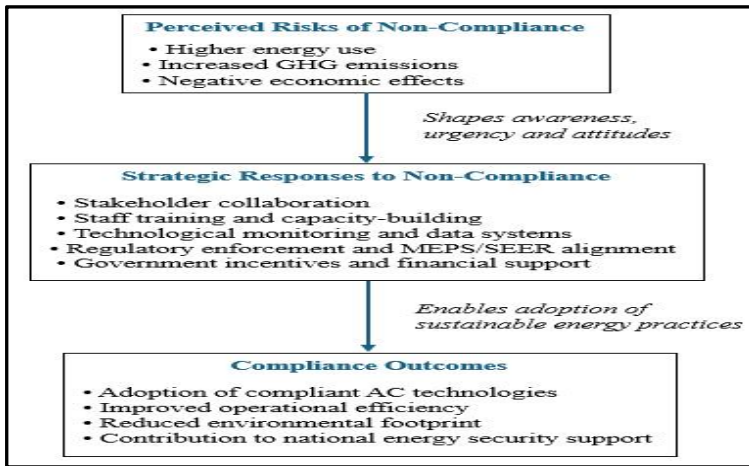


Fig. 1. Conceptual framework of compliance with energy-efficient air conditioning practices

3 Methods

3.1 Research design

This study adopted a quantitative design, to map pattern of behaviour and levels of compliance across the hotels in South Africa. The researcher deployed structured survey as the suitable mechanism for producing comparable data that could be subjected to statistical testing. This design could reflect not only to individual hotels but also to broader tendencies within the hospitality industry in South Africa.

3.2 Population and sampling

The population comprised employees working in the hotels across South Africa ranging from operational staff to senior decision-makers. The researcher took this approach because the intention was according to their organisational roles to understand the behaviour from different levels of respondents. There were 234 respondents participated in the research ranging from top management, middle management, lower management, supervisors and line employees. This diversity strengthened the study by ensuring that both strategic perspective and day-to-day operational experiences were reflected. Access constraints made probabilistic sampling impractical; therefore, the researchers combined purposive and convenience approaches. This ensured that those included had direct exposure to air conditioning system or oversight responsibilities relevant to the the study's focus.

3.3 Research instrument

To capture the necessary information, a structured questionnaire was designed, guided by the literature on energy efficiency, regulatory compliance, and organisational practice [10]. A five-point Likert scale enabled respondents to express the degree to which each statement resonated with their experience.

3.4 Data collection procedures

The distribution of the questionnaire was carried out directly within hotels settings to facilitate authentic engagement. Before completing the survey, participants were informed of the study's aims and assured that their responses would be treated confidentially. This approach was intended to promote candour, particularly because compliance-related questions may be sensitive in some organisational contexts. Data collection was undertaken over a year and targeted hotels of varying sizes and service classifications to ensure that the dataset captured the heterogeneity of the sector.

3.5 Data analysis

The data collected were transferred into SPSS for analysis. Descriptive statistics brought overview of respondent characteristics and existing practices. To explore underlying dimensions within the dataset, the researchers employed exploratory factor analysis (EFA). Prior to extraction, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used to verify whether the correlations among items were adequate for factor analysis. Principal axis factoring was selected to reveal latent constructs. Cronbach's alpha was used for reliability analysis to assess the internal consistency of each construct, with a threshold of 0.70 taken as acceptable for empirical research.

3.6 Ethical considerations

Ethical principles were considered in this research. Participation was voluntary, supported by informed consent procedures that clarified the purpose of the study and the rights of respondents. Confidentiality was upheld by reporting results in aggregate form, ensuring that no individual or hotel could be identified. The research team adhered to principles of respect, fairness, and integrity, safeguarding participants from any form of coercion and undue pressure.

4 Results

This section reflect the finding from the responses of 234 participants employed across a range of hotels in South Africa. The results are organised into two interconnected strands to provide a coherent picture of the patterns. First, the descriptive statistics offer insight into who participated in the study and how hotels currently approach air conditioning related energy practices. Second, an exploration of the underlying structures reflecting perceptions of non-compliant air conditioners by using factor analysis.

4.1 Descriptive findings

4.1.1 Demographic characteristics of respondents

Drawing from the demographic data, it became evident that respondents represented a cross-section of the staffing hierarchy within the hotel sector. This diversity proved valuable, as it enabled the researchers to bring together insights from both strategic decision-makers and those directly responsible for day-to-day operational activities. The distribution of roles is illustrated in Figure 2.

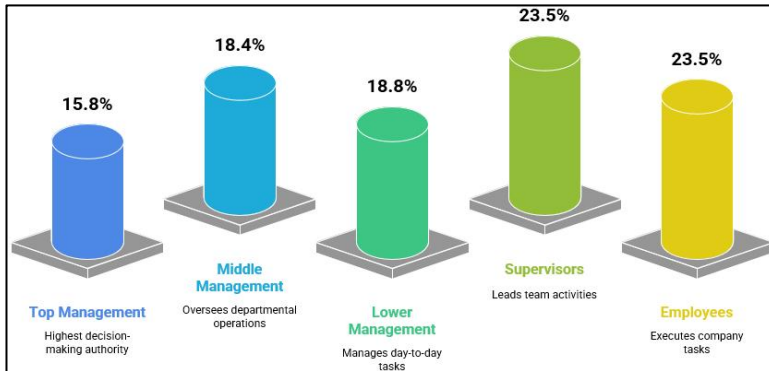


Fig 2. Distribution of respondents by position

A closer look at the distribution reveals that supervisors and line employees collectively formed almost half of the sample (47%). These groups are generally the closest to the practical aspects of energy use, frequently operating or managing AC units as part of routine duties. Their strong presence in the dataset therefore lends weight to the operational interpretations discussed later. Conversely, top management represented the smallest segment (15.8%), although their participation remains important, given their role in procurement decisions, budgeting for upgrades, and enforcing compliance with standards such as MEPS and SEER. The mix of respondents thus enabled a well-rounded appreciation of how different organisational tiers perceive and enact compliance.

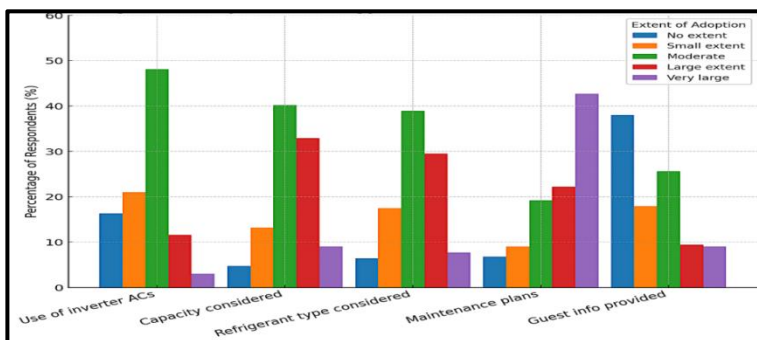


Fig. 3. Adoption of energy-efficient practices (Selected item)

Figure 3 reflect inverter air conditioners, widely recognised for reducing energy loads were used mostly to a moderate extent (48.1%). Procurement related considerations such as correct sizing (BTU/power capacity) and refrigerant choice were more encouraging. These

technical aspects were incorporated into purchasing decisions by a substantial number of respondents, with nearly a third considering capacity to a large extent (32.9%) and close to 30% doing the same for refrigerant type. Over a third of respondents (38%) reported that hotels make no effort to provide guests with information encouraging energy-efficient AC usage. This reflects a missed opportunity, given evidence that behavioural interventions can significantly reduce consumption. By contrast, maintenance practices were far stronger: 42.7% reported adopting maintenance plans to a very large extent. This suggests that while hotels manage operational upkeep reasonably well, strategic or behavioural approaches to efficiency receive less attention.

Taken together, these descriptive findings point toward an industry that recognises the importance of energy efficiency but often implements measures reactively rather than comprehensively. Maintenance is prioritised, procurement shows partial alignment with efficiency principles, and guest engagement remains notably underdeveloped. These patterns set the stage for the deeper analytical insights explored in the subsequent sections.

4.2 Exploratory factor analysis

This step of analysis include examining the underlying structure of the items assessing perceptions of non-compliant air conditioners and strategies that hotels could use to address these inefficiencies. Before extracting any factors, it was necessary to verify whether the correlation patterns within each set of items were robust enough to justify the use of factor analysis. This was achieved by applying the Kaiser-Meyer-Olkin (KMO) measure and Bartlett’s test of sphericity, both of which help determine if the observed data can be meaningfully reduced into latent dimensions.

4.2.1 Impacts of non-compliant air conditioning systems

The diagnostics are presented in Table 1.

Table 1. KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			0,675
Bartlett's Test of Sphericity	Approx. Chi-Square		157,141
	df		3
	Sig.		0,000

The KMO value of 0.675 falls within an acceptable range, signalling that shared variance among the items is sufficient for data reduction. The highly significant Bartlett’s test ($p < 0.001$) indicates that the correlation matrix differs markedly from an identity matrix, confirming that the variables are correlated enough to justify factor analysis. These statistical checks provided the basis for moving forward with factor extraction.

This analysis interpreted that higher energy usage, negative economic implications, and environmental harm are perceived not as separate concerns but as tightly linked outcomes of inefficient or outdated air conditioning systems.

A reliability assessment supported this interpretation. The Cronbach’s alpha for the factor was 0.741, demonstrates acceptable internal consistency. Although somewhat lower than that observed for the strategies construct, the reliability rating is strong enough to

confirm that participants responded coherently across all items. This reinforces the idea that respondents consistently associate inefficient AC systems with a combination of environmental and economic risks. A foundation that will inform the discussion chapter’s interpretation of organisational and sustainability implications.

4.2.2 Strategies to combat non-compliance

A similar set of tests was conducted, which examined strategies that could help hotels improve compliance with energy-efficient air conditioning practices. The results are shown in Table 2.

Table 2. KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0,831
Bartlett's Test of Sphericity	Approx. Chi-Square	449,163
	Df	10
	Sig.	0,000

The KMO value of 0.831 indicates strong sampling adequacy, far exceeding the commonly cited threshold of 0.60. Combined with the significant Bartlett’s test ($p < 0.001$), the diagnostics clearly confirm that the data are appropriate for factor analysis. What emerged from the analysis was a single, coherent factor titled “Strategies to Combat Non-Compliance,” accounting for 52.5% of the variance.

The strategies captured within this construct include stakeholder collaboration, staff training, regulatory enforcement, technological monitoring, and government incentives appear to be viewed as mutually reinforcing rather than isolated actions. The reliability score underscores this: a Cronbach’s alpha of 0.844 indicates a high level of internal consistency. This suggests that respondents perceive these strategies as collectively forming the backbone of an effective compliance approach.

4.3 Scale statistics

To gain further clarity on the strength of respondents’ views, the study summarised the mean scores for each of the two extracted factors. This is reflected in Table 3.

Table 3. Mean scores for identified factors

Factor	Mean	Median	SD	Min	Max
Impacts of Non-Compliant Systems on Energy Consumption	3.22	3.00	0.85	1.33	5.00
Strategies to Combat Non-Compliance	3.59	3.80	0.82	1.40	5.00

The factor corresponding to the impacts of non-compliant AC brought a mean score of 3.22, which suggest that respondents recognise the problems moderately. By contrast, the strategies factor had a higher mean of 3.59, which translate stronger support for measures aimed to improving compliance. This tendency is illustrated in Figure 4.

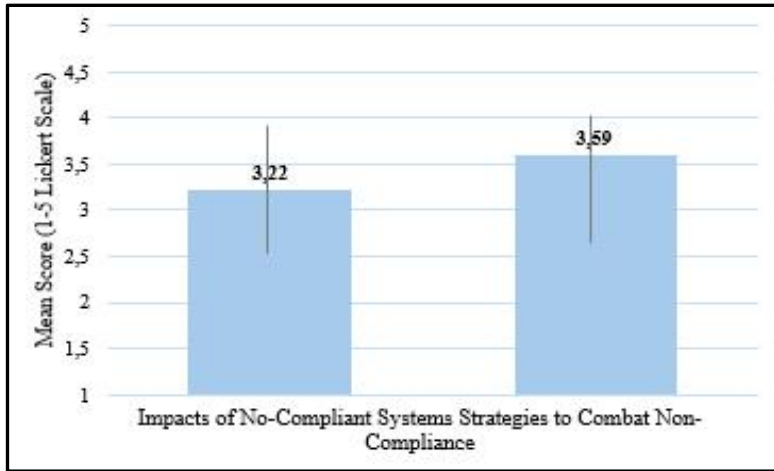


Fig 4. Comparison of mean factor scores

4.4 Summary of results

Taken together, the findings from the descriptive statistics and factor analyses paint a layered picture of how South African hotels approach energy-efficient air conditioning practices. The demographic profile demonstrated wide participation across organisational ranks, with almost half of the sample comprising supervisors and line employees, groups most directly involved in operating AC systems. The high proportion of respondents with between six and twenty years of industry experience strengthens confidence in the reliability of the insights offered.

The analysis reflect that hotels in most cases adopt moderate levels of energy-efficient measures. Also the analysis shows that guest engagement regarding energy saving is limited, but maintenance emerged is priority by the hotels.

The exploratory factor analysis confirmed two meaningful constructs. The first reflects respondents' perceptions of the risks associated with non-compliant systems, encompassing economic, environmental, and energy implications. The second consolidates a set of interrelated strategies that respondents consider effective for strengthening compliance. The higher mean score associated with the strategies factor indicates a sense of willingness among hotels to pursue solutions, even if the perceived risks are not fully internalised. These findings form the basis for the subsequent discussion, where the results are interpreted in relation to the wider literature and the overarching research objectives.

5 Discussion

Drawing together the empirical findings, this discussion section considers how the practices, perceptions, and strategic orientations of hotels collectively illustrate the state of energy-efficient air conditioning compliance in South Africa. What emerges is a picture that is neither wholly discouraging nor fully aligned with policy intentions. Instead, the evidence points to a sector making incremental progress while simultaneously grappling with structural and behavioural obstacles that impede more comprehensive compliance. Because the respondent pool represented a mix of executives, supervisors, and line employees, the responses offer both strategic and operational insights. It is an important consideration when interpreting practices influenced by policy, cost pressures, and day-to-day hotel operations.

5.1 Compliance with energy-efficient practices

From an operational standpoint, the study confirms that compliance with energy efficiency requirements remains uneven. The descriptive analysis revealed a pattern of moderate adoption across most measures, signalling that although hotels recognise the value of efficiency, full alignment with required standards remains a challenge. Respondents generally reported attentiveness to technical features including BTU capacity and the type of refrigerant used, when acquiring air conditioners. These findings correspond with earlier observations by [15], who noted that technical awareness tends to exceed regulatory compliance in many developing-country hotel markets.

At the same time, regulatory standards such as MEPS and SEER were not consistently integrated into procurement or operational decision-making. This reflects the argument advanced by [8], who suggested that South African hotels demonstrate partial rather than comprehensive compliance. Several recurring constraints shed light on this pattern: the high upfront cost of replacing outdated units, limited enforcement capacity at national and municipal levels, and uneven staff expertise [14].

5.2 Perceptions of non-compliance risks

Turning to perceptions, the analysis identified a single, coherent dimension representing how respondents conceptualised the impacts of non-compliant systems. Although the factor explained nearly half of the variance, the average level of agreement was moderate. Respondents acknowledged that inefficient systems increase energy consumption, impose financial strains on the national economy, and contribute to global warming yet the mean score of 3.22 reflects a somewhat muted sense of urgency.

This ambivalence is not unique to this study. [3] similarly observed that while awareness of South Africa's energy crisis is widespread, industry actors often underestimate the contribution of inefficient equipment to systemic energy burdens. The relatively modest perception of risk may be linked to organisational priorities centred on short-term financial pressures rather than long-term sustainability outcomes. Inefficient cooling technologies contribute to high energy demand and also have impact in rising GHG emissions and escalating operational cost.

6 Conclusion

This research set out to examine how South African hotels navigate compliance with energy-efficient air conditioning practices while also exploring their perceptions of the risks and strategies linked to non-compliance. The analysis shows a sector that understands the importance of energy efficiency but does not yet fully operationalise this understanding across all areas of practice. Routine maintenance and attention to technical specifications are well established; however, broader compliance elements remain a challenge. In particular guest engagement and adherence to regulatory standards remain inconsistent. The moderate recognition of environmental, economic, and operational risks suggests awareness without urgency. Yet the widespread support for practical strategies including regulatory enforcement, incentives, training, and monitoring. This reveals a willingness to participate in a more coordinated transition toward energy-efficient operations.

The study contributes to debates on sustainability in hospitality by demonstrating that compliance rests on a combination of technological choices, organisational behaviour, and regulatory structures. Policymakers can use these insights to refine enforcement mechanisms and develop targeted incentives. Hotel managers, meanwhile, are reminded of the need to integrate energy-efficiency awareness into both staff development and guest-facing communication. In essence, energy efficiency is not an optional concern. As [14]

argue, inefficiency imposes substantial economic and environmental costs. By contrast, hotels that embrace compliance and innovation can strengthen operational resilience and position themselves as leaders in sustainable tourism. The challenge now lies in transforming stated intentions into sustained action, ensuring that the hospitality sector contributes meaningfully to South Africa's energy security and environmental stewardship.

References

1. Raschke, N. (2025). Environmental impact assessment as a step to sustainable tourism development. *WIT Transactions on Ecology and the Environment*, *84*, 303-313. <https://www.witpress.com/Secure/elibrary/papers/SPD05/SPD05030FU1.pdf>
2. Dibene-Arriola, L. M., Carrillo-González, F. M., Quijas, S., & Rodríguez-Uribe, M. C. (2021). Energy efficiency indicators for hotel buildings. *Sustainability*, *13*(4), 1754. <https://doi.org/10.3390/su13041754>
3. Bohlmann, J. A., & Inglesi-Lotz, R. (2021). Examining the determinants of electricity demand by South African households per income level. *Energy Policy*, *148*, 111901. <https://doi.org/10.1016/j.enpol.2020.111901>
4. Sehlapelo, T., & Inglesi-Lotz, R. (2022). Examining the determinants of electricity consumption in the nine South African provinces: A panel data application. *Energy Science & Engineering*, *10*(7), 2487-2496. <https://doi.org/10.1002/ese3.1151>
5. Salehi, M., Filimonau, V., Ghaderi, Z., & Hamzehzadeh, J. (2021). Energy conservation in large-sized hotels: Insights from a developing country. *International journal of hospitality management*, *99*, 103061. <https://doi.org/10.1016/j.ijhm.2021.103061>
6. Kalefa, H., & Gado, S. (2024). Enhancing hotel sustainability through ecological and technological integration. *JES. Journal of Engineering Sciences*, *52*(1), 145-174. <https://doi.org/10.21608/JESAUN.2024.251412.1290>
7. Department of Mineral Resources and Energy (DMRE). (2019). *Post-2015 National Energy Efficiency Strategy of the Republic of South Africa*. Pretoria: Government of South Africa.
8. Singh, A. B., Mishra, Y., & Yadav, S. (2024). Toward Sustainability: Interventions for Implementing Energy-Efficient Systems into Hotel Buildings. *Engineering Proceedings*, *67*(1), 80. <https://doi.org/10.3390/engproc2024067080>
9. Marcello, J., & Rogovin, T. (2024). Sustainability and Cost Containment in the Hotel Industry: A Review of the Literature. *The Consortium*, *33*. <https://www.thefreelibrary.com/SUSTAINABILITY+AND+COST+CONTAINMENT+IN+THE+HOTEL+INDUSTRY%3a+A+REVIEW...-a0804702549>
10. Menegaki, A. (2024). Energy Consumption in Hotels Through a Policy-Driven, Case-Based and Scenario Approach. *Case-Based and Scenario Approach (November 27, 2024)*.
11. Agbajor, F. D. (2023). *Appraisal and Optimization of Energy-efficient Green Buildings in South Africa*. Masters dissertation, Durban University of Technology (South Africa).
12. Moghayedi, A., Le Jeune, K., Massyn, M., & Michell, K. (2022). Identifying the Challenges and Barriers Associated with the Adoption of Energy Efficient Innovative Technology in Warehousing Facilities in South Africa. SEEDS Conference Proceedings 2022, 386-395. <https://hdl.handle.net/10779/leedsbeckett.29381624>

13. Skourtos, M., Damigos, D., Tourkolias, C., & Kontogianni, A. (2021). Efficient energy labelling: the impact of information content and style on product choice. *Energy Efficiency*, 14(6), 58. <https://doi.org/10.1007/s12053-021-09950-3>
14. Salami, B. R., & Omonigho, O. B. (2024). Energy Efficiency in Sustainable Manufacturing: Best Practices and Technological Innovations. In *Triple Helix Nigeria SciBiz Annual Conference* (pp. 343-362). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-81619-2_21
15. Singhal, M. A., Sharma, M. S., & Garg, M. T. (2021). Transitioning to Super Energy-Efficient Room Air Conditioners: Fostering ICAP Implementation. New Delhi: Alliance for an Energy Efficient Economy (AEEE). <https://aeee.in/wp-content/uploads/2021/11/transitioning-to-Super-Energy-Efficient-Room-Air-Conditioners.pdf>