

Lighting for SDG#3 Wellness and #12 Responsible Production and Consumption via ISO 14068

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Abstract

Based on Green Curriculum Guidance of UNESCO, 2024 “this Guidance includes numerous references to curricula developed by ministries, CSOs and inter-governmental organizations. Greening education encompasses not only knowledge and intellectual skills acquisition, but also socioemotional dispositions, such as a motivation to ‘make a difference’ and skills. It is time to explore transformative ways of educating lighting issues for the hospitality industry with a pilot of lighting in sustainable hotel room to engage industry practitioners, management and graduates in the hospitality discipline for enhancing IMM and UNPRI framework measurements. This paper is to explore the concepts and expected skills development of the GEEP (Green Entrepreneurial Education Project) - an action-based experiential approach for talent development and case study with Hotels in Beijing, China on lighting design. The feasible actionable steps aligned with the SDGs, particularly SDG3 (Wellness), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 8 (Decent Work and Economic Growth), SDG 9 Innovations, and SDG 17 (Partnerships for the Goals). It is suggested to implement ISO 14068-2023 Climate Change Management System for Transition to Net Zero in design of lighting in hotels to reinforce responsible management in the hotel common areas and hotel rooms with wellness.

Introduction

Lighting Issues and Health Impacts in Hotels: An Integrative Perspective Using UNPRI, IMM, and ISO 14068

Based on a published paper of Lyytimaki (2025), light pollution is one of the burning issues in different industries. However, it has not been well addressed in SDG 2030. Lyytimaki (2025) highlighted that light pollution comes from unwanted artificial light spills, visual discomfort, confusing mix of light, and reflection of sunlight from satellites and space debris.” (p. 6). This may be an issue in the hospitality industry which is currently facing increasing pressure to enhance SDG#3 wellness for the occupants’ health and SDG#12 responsible production and consumption. In the paper of Lyytimaki (2025), there is key connections table between SDGs and light pollution. And, this paper is going to explore SDG#3 good health and well-being “harmful health effects and well being losses by light pollution, SDG#8 decent work and economic growth “occupational health and work risks from light pollution, and SDG#9 industry, innovation, and infrastructure “light pollution influencing innovativeness and growth” (p. 10)

Besides the effects of light pollution, it is time to adopt framework to measure social and economic impacts of light pollution or light innovations with financial returns, for example, the United Nations Principles for Responsible Investment (UNPRI), Impact Measurement and Management (IMM), design thinking, and ISO 14068 standards to foster sustainable and health-promoting lighting solutions in hotels. In this paper, SDG related authors, for example, Prof. Jeff Sachs has been selected to identify solutions and inter-connection between lighting issues and health impacts in hotel settings.

Lighting Design and Health in Hotels

Lyytimaki (2025) mentioned that “Light pollution is an often-overlooked global problem that increasingly affects human health and wellbeing, society, culture, and ecosystems. Despite its importance, light pollution is absent from the UN 2030 Agenda and the Sustainable Development Goals (SDGs). This study reviews how light pollution abatement directly and indirectly relates to the implementation of SDGs to identify potential trade-offs and key synergistic solutions. Implementation of SDGs can both help and hinder efforts

to curb light pollution created by excessive, careless, or poorly timed lighting. New technologies offer opportunities for designing and implementing efficient and intelligent lighting systems, but they also risk increased and more widespread light pollution. Implementation of stringent policy measures and wide-based public awareness favouring careful use of artificial light and cultural appreciation of natural darkness is needed. Transformative resilience is suggested as a useful framework capable of addressing the long-term challenges of lighting system development.” (p. 6)

In fact, lighting not only affects the human health of employees and occupants in the hotels, but also their psychological well-being. Poor lighting can affect the quality of sleep, concentration of work in the workplace, eye strain, and mood alterations. In hotels, inadequate or poorly designed lighting may bring discomfort of occupants, hence, customer satisfaction will also be reduced with minimizing the financial returns.

United Nations Principles for Responsible Investment (UNPRI) and Impacts Measurement and Management (IMM) Frameworks in Lighting Sustainability

The UNPRI advocates responsible investment practices that consider environmental, social, and governance (ESG) factors, emphasizing the integration of sustainability into decision-making processes (UNPRI, 2022). For hotels, this entails implementing lighting strategies that reduce energy consumption while there is not much research on the well being of hotel employees and occupants. Investing in adaptive lighting systems that optimize natural light and incorporate circadian lighting principles aligns with UNPRI's goals of environmental stewardship and social responsibility.

For example, Sunway Univesity adopted approach of “**Environmentally friendly and student-centric approach**”, **emphasizing** the campus design with low energy lightings, . The east and west façades of the building used **low-E glazing** as a passive design strategy to reduce cooling load. Their basement library is found with **natural lighting and greenery**. There are also two 6-metre fans that are suspended 7 metres above the ceiling, that help to supplement air flow on hotter days. The building uses low-E glass and aluminium shades to provide natural lighting and visual relief for students and staff, as well as **reduce energy costs by paying back the extra cost of glass over seven years**. The light weight of the aluminium sheets was further reduced by 40-percent perforation. Only 2-millimetre curved sheets—some measuring 3 metres by 1.5 metres—were used for the cladding of the auditorium. The double curved geometry provides rigidity and surface uniformity despite its thinness.” (<https://sunwayuniversity.edu.my/sustainability/themes/green-building/sunway-universitys-state-of-art-new-campus-future>)

The UNPRMI and IMM frameworks offer a structured approach to measure and manage impact, for example, lighting in wellness for the hotel industry. Applying IMM to hotel lighting involves assessing the social and environmental impacts—such as energy savings, occupant health outcomes, and carbon footprint reductions—through metrics or a mapping table on light design, lighting impacts on human and business financial returns . For instance, evaluating the health impact of circadian lighting interventions can inform investments that yield both financial and social returns.

Applying SERVQUAL in Hospitality for Urban Tourism

SERVQUAL (Parasuraman et al., 1988) is service quality analysis tool that can be applied from the perspectives of expectations of different layers of stakeholders and closing the loop for customer saisfaction. From here onwards, the term “Urban Tourism applications” will refer to both synchronous and asynchronous E-learning applications that an organization chooses to use. The reduced set of 5 dimensions of SERVQUAL be listed as such:

- Tangibles

- Reliability
- Responsiveness
- Assurance
- Empathy

Using the 5 dimensions of SERVQUAL, the following application of the SERVQUAL questionnaire was adapted from the article by Ernst and Tasneem (2019) to fit context of urban tourism in response to the relationship mentioned by Puri & Singh (2018) – FUNCTIONAL QUALITY, TECHNICAL QUALITY AND IMAGE with highlights on

Service Concept – Kotler & Keller (2012) “service is an elusive act that acts as a crucial medium for a company offer to attain the customers, whereit does not shift the tenure frm the service providing party to the customer” (Puri & Singh 2019, p. 746)

Quality Concept – Solomon (2009) defines it as one of the things that the buyer looks fr when they pursue an offer. (Puri & Singh 2019, p. 746)

Service Quality Concept – The earliest recorded model of service quality measurement was developed by Gronroos (1984), where service quality is explained in terms of featuresconnected with technical or outcome aspects and proces or functional related aspects (Kang & James, 2004, Balasingh, et al., 2006 & Laroche et al., 2004 in Puri & Singh, 2019, p. 746)

Service in Tourism Industry – According to Zhao & Di Benedetto (2013), some tourism scholars have recommended that the service quality role is very important when invevestigatng the problem of tourist dissatisfaction and when trying to attract new tourists or secure revisit intentions. (Puri & Singh, 2019, p. 747)

Design Thinking in Developing Health-Centric Lighting Solutions

The five steps of Design thinking— empathy, ideate, define, experiment, and validate is a human-centered approach serving as an effective methodology for innovating lighting solutions that address health and sustainability. By empathizing with hotel occupants and employees; needs, defining problem statements of lighting pollution, ideating of adopting innovative and environmental-friendly design lightings, prototyping the design into the hotel layout design, and testing lighting concepts for wellness of employees and occupants, designers of lighting uses may bring in insights for hotel practitiners to learn how to adapt health-promoting lighting devices for a wellness hotel.

Design thinking also emphasizes cross-disciplinary collaboration, integrating insights from architecture, psychology, environmental science, business, and quality management. This holistic approach enables the development of innovative lighting strategies aligned with the ISO 14068 standard, which promotes transparency and reliability in environmental and social impact reporting (ISO, 2020).

ISO 14068 and Its Role in Sustainable Lighting Management

ISO 14068 provides a framework for impact governance, emphasizing transparency, stakeholder engagement, and lifecycle assessment in environmental management (ISO, 2020). For hotel lighting, ISO 14068 encourages companies to evaluate the entire lifecycle—from sourcing lighting components to disposal—ensuring eco-friendly practices. Recent publications highlight the integration of ISO 14068 standards into hotel sustainability strategies, focusing on energy-efficient lighting systems that minimize environmental impacts (Yeung & Sachs, 2022). This involves selecting low-impact materials, utilizing renewable energy sources, and designing for recyclability. Moreover, ISO 14068 supports the development of impact metrics that quantify both environmental and social benefits, such as reduced carbon emissions

and improved guest health outcomes. Applying ISO 14068 principles in hotel lighting design aligns with the broader goals of the UNPRI and IMM, fostering transparent reporting and responsible investment. It also encourages innovation, such as integrating IoT-enabled adaptive lighting systems that optimize energy use and support circadian health.

Green Entrepreneurial Education and ISO 14068

Alexander & Yves (2010) mentioned that a business model is to show the ways of creating, delivering, and capturing the values that an organization intends to achieve.

There are nine building blocks that they have highlighted as below: (p. 16-17)

-Customer Segments (CS)

-Value Propositions (VP)

-Channels (CH)

-Customer Relationship (CR)

-Revenue Streams (RS)

-Key Resources (KR)

-Key Activities (KA)

- Key Partnership (KP)

- Cost Structure (CS)

Among the nine blocks, key resources, SDG#17 partnership and SDG#8 creation of Jobs are interrelated.

This paper examines the organizational transformation of Road Logica, as revealed in a 2020 interview conducted by Yeung with its founder, Mr. Bernard Lee. The company underwent a significant restructuring of its core team under the framework of a Decentralized Autonomous Organization (DAO). This shift replaced the traditional employer-employee model with a bridged stakeholder approach, currently spanning Hong Kong, Mainland China, Malaysia, the United Kingdom, India, and the Philippines. In response to the rise of artificial intelligence and post-COVID market dynamics, the company's core competencies have evolved from technical execution—such as coding and design—toward strategic planning, brand development, talent cultivation, and innovation. The study further explores the limitations of traditional management functions—planning, organizing, motivating, and controlling—within the context of the Green Economy. It argues for a reimagined management paradigm that aligns with sustainable development goals beyond 2030. This includes adopting a "slow thinking" mindset and integrating humanistic technology to address emerging challenges and nurture future-ready talent.

Drawing on a decade of collaborative entrepreneurial experience between the author and Yeung, the paper reflects on the inherent trade-offs between emotional stability and business prosperity. It introduces the concept of opportunity cost in innovation-driven environments, where intangible values such as peace and calmness are weighed against the tangible costs of co-designing under uncertainty.

The paper aims **to identify actionable strategies that minimize these trade-offs, offering pathways to achieve both financial viability and social impact through predictable and sustainable innovation practices.**

Case Study

Orange Hotel, previously “北京四季如春酒店”, was founded in 2006. Under the leadership of Wu Hai, co-founder of CTrip, it was renamed to Orange Hotel, to establish a friendly, easy to remember brand name which implies warmth, rejuvenated energy and health.

Lighting was an integral part of the rebranded Orange Hotel feature, with whole room lighting mode named “Paris, New York and London”. The entire system had been designed from scratch, integrated with the branding and design by renowned Asian designer Colin Seah

After Orange Hotels were sold to China Lodging Group in 2017, Wu Hai retained ownership of the smart hotel technology. My student, who had known Wu Hai before he co-founded CTrip, worked with him on the second generation of the smart hotel technology. Subsequently, it had been adopted into China Lodging Group and other hotel groups. A complete well-being focused branding and technology direction had been also submitted to Vienna Hotels, which is a part of Jinjiang Hotels, one of the top 3 hotel chains in China alongside with China Lodging Group. This is to complement and integrate into the “Vienna Good Sleep” brand, which primary selling point is well-being through a good night’s sleep.

Two videos about Philips Luminous Textile are attached. The first one is from the press kit of Philips, indicating the intention of the creation. The second features Davey Davenport-Firth, Fellow of the Royal Society for Public Health, London, who is also Head of Brain Sciences, Oglivy Health, subdivision of one of the world’s top advertising companies. They explain the role of this particular implementation of lighting towards workplace well-being. In particular, he said, **“It allowed us to bring together light and nature in a dynamic way to really support experiments”, which is a perfect playground for education.**

Recently, the author (BC) is working with Malaysia government on AI Generated Content that is culturally sensitive. National pride and mental well being is also a very important part of this variant of generative AI. This project is also well endorsed by the Cultural Bureau of Malaysia. If this generative AI technology can be combined with the accumulated technology that powered the smart hotels, it will provide an excellent teaching environment and hands-on lab for the subject of AI and Wellbeing. This teaching environment is possible under the applied funding, and it would be the first of its kind with consideration of applying ISO 14068 onto lighting design for tackling light pollution and improving wellness of employees and occupants in the hotel industry with financial returns.

Conduct a Gap Analysis with Design Plan on Lighting in Hotels in Line with ISO 14068

Based on ISO 14068 to conduct a gap analysis between requirements and existing carbon neutrality performance of the lighting design in lobby and hotel rooms that is intended to design for SDG#3 wellness and #11 sustainable cities, for example, technology and framework for carbon footprint, social elements to be included, e.g. inclusiv design, and organizational mission to measure, like coworking for carbon neutrality learning site for targeted industries with clauses of **ISO 14068 guidelines**.

Set Measurable and Achievable Targets for Carbon Neutrality Aligned with SDG#3 and 13 and ISO 14068

Based on targets on SDG #3 and 13 to set SMART (specific, measurable, achievable, realistic, and time-bound targets to ensuring the intended carbon neutrality in the lighting design for tackling light pollution and improving wellness of employees and occupants.

Design for Lighting and Lighting related Material Efficiency and Use of Product Life Cycle Concepts to Improve the Functional Purposes of a Hotel

Select environmentally friendly and efficient lighting system (e.g. LED), using renewable energy, (e.g. solar energy), applying flexible access design platforms with consideration of ventilation, and water conservation, minimizing operational impacts, creating bonding to a sustainable community with eco-friendly materials (e.g., recycled, biodegradable materials) for fixtures and furnishings, emphasizing movable and portability

for various carbon neutrality learning site demonstration and re-design activities, e.g. hotel room, common rooms, and promoting flexibility and wastes reduction.

Integrate Demonstration of Localised Environmental Materials with Upcycling and Circular Economy Principles

Create displays to show upcycling and circular economy concepts applied in the lighting design for wellness of employees and occupants to align with SDG 12 (Responsible Consumption and Production) and SDG#13 (Climate Change).

Engage Stakeholders with Educational Values and Carbon Neutrality Actions

Utilize the space to educate hotel practitioners about sustainability, carbon reduction, and health-focused SDGs, fostering behavioral change with Report Transparency. Partners to be engaged are hotels designers and practitioners and trainers in the hospitality industry with lighting and space design for continual improvement

These 5 recommended steps provide a comprehensive, standards-based approach to designing a carbon-neutrality hotel that promotes environmental awareness and sustainability within a unique urban context. Incorporating recent literature ensures the strategies are innovative, evidence-based, and aligned with current best practices. Based on the above 5 recommended steps, a checklist has been designed for implementing SDG x ESG Carbon Neutrality hotels

Establishing Governance and Policy Framework

Carbon Neutrality Policy Development

A foundational step involves formulating a comprehensive carbon neutrality policy. This policy articulates the organization's commitment to GHG reduction, aligning with ISO 14068's principles of transparency, accuracy, completeness, consistency, and relevancy. It should specify targets, responsibilities, and timelines, serving as the guiding document for all renovation and operational activities.

Stakeholder Engagement and Governance Structure

Effective governance requires forming a cross-functional team comprising management, facilities, sustainability officers, and staff. Regular stakeholder engagement ensures buy-in and collective responsibility, crucial for implementing sustainability initiatives. Establishing a Carbon Reduction Committee can facilitate oversight, reporting, and continuous improvement.

Developing Strategies for Carbon Audit and Reduction

Baseline Assessment and Data Collection

Using ISO 14068, organizations must perform a detailed GHG inventory to establish a baseline. This involves collecting data on energy consumption, waste management, procurement, and transportation over the past three years. Data should be disaggregated by scope (Scope 1: direct emissions, Scope 2: indirect emissions from electricity, Scope 3: other indirect emissions).

2.2. Carbon Footprint Quantification

Applying ISO 14068's methodologies, the coworking space quantifies its GHG emissions. This process includes selecting appropriate emission factors, calculating the total carbon footprint, and identifying major emission sources. For example, energy use in lighting and HVAC systems, furniture production, and waste management are typical contributors.

Setting Reduction Targets and Strategies

Based on the baseline, the organization sets science-based targets aligned with SDGs and global climate goals. Strategies include:

- Upgrading to energy-efficient lighting and HVAC systems.
- Incorporating renewable energy sources like solar PV.
- Designing the renovation with sustainable materials.
- Implementing waste reduction and recycling programs.
- Promoting responsible procurement policies.

Staff Engagement and Capacity Building

Education and Awareness

Staff training ensures understanding of carbon neutrality goals and their roles. Workshops can highlight the importance of sustainable practices in daily operations and event planning, fostering a culture of sustainability.

Incentivizing Participation

Incentive programs, such as recognition awards or performance-based benefits, motivate staff to contribute actively to emission reduction initiatives. Clear communication about progress and successes encourages ongoing engagement.

Designing Net-Zero Events with a Carbon Audit Checklist

Event Planning and Management

Events hosted within the coworking space should adhere to carbon neutrality principles. This involves selecting venues, catering, transportation, and materials that minimize GHG emissions.

User-Friendly Carbon Audit Checklist

A practical checklist facilitates easy assessment and planning:

This checklist, reviewed annually, ensures continuous improvement and transparency.

Implementation and Monitoring

Renovation Execution

Design renovation plans incorporating energy-efficient infrastructure, sustainable materials, and green building certifications (e.g., LEED). The goal is to reduce embodied carbon and operational emissions.

Monitoring and Reporting

Regular monitoring of energy use, waste reduction, and transportation impacts is essential. Using ISO 14068's guidance, the organization should produce annual GHG reports, verifying reductions and progress toward net-zero targets.

Conclusion and Discussion

Renovating a sustainable lighting-focused hotel for SDG#3 wellness and SDG#13 carbon neutrality is a multifaceted process grounded in robust standards like ISO 14068. It requires committed governance, strategic planning, accurate carbon accounting, staff engagement, and sustainable event management. By adopting a systematic approach—set clear policies, perform comprehensive audits, involve staff, and monitor progress—the coworking space can significantly reduce its carbon footprint, contributing to SDG #3 and SDG #12. The integration of user-friendly tools like checklists ensures ongoing commitment and facilitates transparent reporting, ultimately fostering a sustainable and health-promoting environment for all participants. Even though there are numerous design and SDG related principles and frameworks, for example, UNPRI and IMM in use today, it is crucial to instill the idea that lighting is related to pollution and wellness with financial returns. We have to recognize that the wellness of hotel employees and occupants is top priority in doing responsible business in the hospitality. Now is the time to find our way to experience environmental-friendly and wellness lightings for generating feelings of harmony and tranquility for everyone.

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