An Assessment of the Environmentally Sustainable Hotel Operation: The Case of Centara Hotels & Resorts, Thailand

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Abstract

Utilizing an in-depth qualitative longitudinal research approach, this study has a primary goal to empirically examined the environmentally sustainable hotel operations of Centara Hotels & Resorts a major hotel chain company. A second objective is to examine the annual trends in the hotel's carbon footprint, energy usage, water consumption, and wastes. A further objective is to identify the energy saving and waste management initiatives that have been implemented and underpin its ability to deliver environmentally sustainable services to its customers. The study period was from 2015 to 2020. The qualitative data was analyzed by document analysis. The company's annual Scope 1 and Scope 2 greenhouse gas emissions increased over the study period in line with its operational requirements. The case study revealed that energy consumption and wastes had displayed a downward trend over the study period, which had a favorable environmental impact. The company's water consumption remained relatively constant throughout the study period. The company has implemented a wide range of energy and water saving measures. Wherever possible wastes are re-used, recycled, or composted and only wastes not suitable for re-use, recycling or composting are disposed to landfill. Centara Hotels & Resorts has also implemented a carbon sequestration program that is assisting the company to reduce its carbon footprint.

Keywords: case study, carbon footprint, Centara Hotels & Resorts, energy consumption, waste management, water consumption,

Introduction

As a result of climate change and the adverse impact of all other harmful effects of pollution, firms need to focus and wherever possible improve their environmental performance (Sibian & Ispas, 2021). The tourism industry has been very mindful of its impact on the environment. Thus, one of the most pervasive trends in the tourism industry in recent times has been the growing focus by the

industry on becoming more environmentally friendly. This has given rise to sustainable tourism as a core strategy of the industry stakeholders.

Due to the increased volumes of tourist activity, many cities around the world now have a large number of hotel buildings (Nguyen & Rockwood, 2019). Many countries and cities are also home to tourism resorts. Hotels and resorts are key actors in the tourism industry value chain (Vatan & Yilmaz, 2020). Despite the very important role that they play in the global tourism industry, hotels and resorts have a range of adverse impacts on the environment. Hotels consume large amounts of resources, particularly energy. The major areas of environmental impact from hotel operations are indeed the large energy consumption, large water usage, and the carbon dixoide (CO_2) emissions produced from their operations (Bohdanowicz, Zientara, & Novotna, 2011). Hotel operations also produce significant greenhouse (GHG) emissions (Lai, 2015). Considering these adverse environmental impacts, many hotels and resorts have implemented sustainability policies to ensure that their operations are conducted in an environmentally friendly manner. There has also been a growing trend towards the "greening "of the accommodation sector of the travel and tourism industry (Cheyne & Barnett, 2001; Ruffolo, 2015; Verma & Chandra, 2016).

The primary goal of the study is to empirically examine how a major hotel chain company manages its operations in an environmentally sustainable manner. A second objective is to examine the annual trends in the hotel's carbon footprint, energy usage, water consumption, and wastes. A further objective is to identify the energy saving and waste management initiatives that have been implemented and underpin its ability to deliver environmentally sustainable services to its customers. The Centara Hotels & Resorts, Thailand was selected as the case company as they have historically managed their hotels in an environmentally sustainable manner. Also, the availability of a publicly available dataset covering the period 2015 to 2020 was a further factor in the selection of this company as the case company.

The remainder of the paper is organized as follows: Section 2 sets the context of the case study by providing a review of the literature on the environmental management hotels. The research method that underpinned the study is outlined in Section 3. The Centara Hotels & Resorts case study is presented in Section 4. Section 5 presents the findings of the study.

Literature Review

Environmental impact of hotels.

As previously noted, the hotel industry has a range of adverse impacts on the environment. In conducting their operations, hotels consume significant amounts of resources. It has been estimated that around 75% of hotels' environmental impacts can be directly associated with the excessive consumption of resources. The principal areas of environmental impact are energy, water, emissions (Bohdanowicz, Zientara, & Novotna, 2011), congestion and noise (Florido, Jacob & Payeras, 2019), and

waste (Parambil, 2020). Furthermore, hotels produce carbon dioxide (CO_2) emissions as a byproduct of their operations. Hotels and other types of accommodation contribute 2% of the 5% annual global carbon dioxide (CO_2) emissions by the tourism sector (Baxter & Srisaeng, 2020). Gössling, Peters, Ceron, Dubois, Patterson, and Richardson (2005) have observed that a hotel emits an average 20.6 kg of carbon dioxide (CO_2) per room night. At destinations that do not have the appropriate infrastructure and systems to manage these environmental impacts, severe degradation of the environment can occur (Parambil, 2020).

Hotel environmental assessment

In operating a hotel, the hotel's environmental impact comes principally from the energy, water, food, and other resources that are consumed in operating the hotel, by the solid and liquid wastes that are produced, by the way its grounds are managed, as well as by the direct impacts of its guests. The regular renovation and replacement of furniture, appliances and facilities can also result in adverse environmental impacts through purchasing decisions and increased waste generation. Upon closing, a hotel's environmental impacts come from the disposal of materials which are removed from the hotel to refurbish it, convert it for other uses, or through the demolition, and from the work performed during these activities (International Union for Conservation of Nature and Natural Resources, 2012; Parambil, 2020). Also, there potentially could be some toxic materials present at the property. In such an event, the chemicals could require careful handling and management (Parambil, 2020).

Carbon dioxide emissions: a brief overview

Carbon dioxide (CO_2) is a greenhouse gas. Carbon dioxide (CO_2) is naturally present in the atmosphere and is a heavy, colourless gas, which is part of the ambient air. Carbon dioxide (CO_2) is produced from the respiration and decomposition of organic substances, and from the combustion of fossil fuels and biomass (Allaby & Park, 2007). The primary human activity that produces carbon dioxide (CO_2) emissions is the combustion of fossil fuels for energy and transportation. Carbon dioxide is also produced from some other industrial processes and land-use changes (United States Environmental Protection Agency, 2021). Carbon dioxide emissions (CO_2) means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and for a given time (Organization for Economic Cooperation and Development, 2013). An increase in greenhouse gas (GHG) emissions will result in global warming as global warming has a strong correlation with climate change (Chilongola & Ahyudanari, 2019; Suryati, Indrawan & Alihta, 2018). As previously noted, accommodation is a very important part of the tourism value chain, and these establishments accounts for a substantial share of the sector's greenhouse gas (GHG) emissions (Gössling & Lund-Durlacher, 2021).

Hotel carbon footprint

Both climate change and carbon footprints are now amongst the most pressing concerns confronting society and they both have become a critical issue for corporate responsibility (Hrasky, 2012). Indeed, with the increased focus on the impact of climate change for society, the embodied carbon dioxide (CO_2) emission or "carbon footprint" is now frequently used as an environmental performance indicator for products or production activities (Laurent, Olsen & Hauschild, 2010). Carbon footprint is becoming a widely used measure of assessing a firm's contribution to climate change (De Grosbois & Fennell, 2011). According to Wiedemann and Minx (2007, p. 5), "the carbon footprint is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product". A carbon footprint is also the carbon emissions that are released by activities of humans (Jha, Soren & Deo Mehta, 2021) and from various anthropogenic activities (Ramachandra & Shwetmala, 2012). The carbon footprint is also a measure of the impact of the activities of a firm has on the environment and on climate change. The carbon footprint is a calculation of all the firm's greenhouse gases that are produced, and these emissions are measured in tonnes or kilograms of carbon dioxide (CO2) (Legrand, Sloan & Chen, 2017). Importantly, a firm's carbon footprint is an exclusive measure of the carbon dioxide (CO_2) emissions that are both directly and indirectly caused by an activity undertaken by the firm (Wiedmann & Minx, 2007). There is a close association between a hotel's energy use and its greenhouse gas (GHG) emissions, and thus, sustainable energy management can significantly decrease the carbon footprint of hotels (Hu, Huang, Chen, Kuo & Hsu, 2015).

The Greenhouse gas protocol

The Greenhouse Gas Protocol has established comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from both the private and public sectors, through value chains, and the mitigation actions taken by firms (Greenhouse Gas Protocol, 2021). The Greenhouse Gas Protocol categorizes greenhouse gases into both direct and indirect emissions. The protocol further categorizes them into Scope 1, Scope 2, and Scope 3 emissions (Jones, 2009). Scope 1, direct emissions, includes those emissions from sources that are owned or controlled by the firm (Girella, 2018; Konadu, 2017; Vásquez, Iriarte, Almeida & Villalobos, 2015). Scope 2, indirect emissions, come from the purchase of electricity, heat, steam or cooling. A firm's Scope 1 and 2 emissions are principally influenced by the physical size of the firm and secondly by the climate (Klein-Banai &Theis, 2013). Scope 3 are all the other indirect emissions that arise from the consequences of the various activities undertaken by a firm. These emissions come from sources that are not owned nor controlled by that firm (Mazhar, Bull, Lemon & Bin Saleem Ahmad, 2019). Scope 3 emissions include a firm's embodied emissions such as landfill or composted wastes emissions (Feng, Gao, Wu, Tang, He, Qi & Zhang, 2015).

Hotel energy management

Hotel buildings have been acknowledged as being energy intensive (Alkhalaf & Yan, 2017; Pieri, Tzouvadakis & Santamouris, 2015; Xuchao, Priyadarsini & Eang, 2010). This is because hotels consume very substantial amounts of energy, especially in guest rooms (Filimonau & Magklaropoulou, 2020). Hotels are indeed energy intensive building types because of their multi-usage functions and their round the clock operations (Huang, Wang & Wang, 2015). Typically, hotels normally use more energy per visitor than do residents, this is because hotels have energy intense facilities, for example, restaurants, and pools (Oleskow-Szlapka, Stachowiak & Golinska, 2011). An increase in the number of tourists or guests requires higher amounts of energy, which increases the hotel's carbon dioxide (CO_2) emissions (Sekrafi & Sghaier, 2018).

All parties associated with hotels can gain benefits from the hotel having planned energy management. There is also a benefit to the environment. A reduction in the use of non-renewable energy resources helps to conserve the energy supply and reduces some of the negative impacts associated with the use of fossil fuels, for example, air pollution (Kirk, 2011). Nowadays, renewable energy is playing a significant role in tourism, as renewable energy is more energy efficient, contributes to a firm's sustainability goals and offers firm's energy cost reductions (Ásványi, Juhász-Dóra, Jászberényi & Michalkó, 2017).

Hotel water management

Hotels like other hospitality facilities consume large amounts of water. Water is used by hotels in guest room bathrooms and for sanitary purposes. A hotel's food and beverage department use water in food preparation, cooking and for some cleaning purposes. In addition, the laundry operations of a hotel consume large amounts of water. A hotel's swimming pool(s) also requires substantial amounts of water when filled and there is also an ongoing supply of water required to replace water lost to evaporation and from other losses. Furthermore, a hotel's grounds and landscaping can consume very large amounts of water. A hotel's cooling towers can also evaporate very large volumes of water in their operation (Holt, 2010).

The water usage in a hotel can vary quite substantially. An economy-type property averages around 40,000 gallons (181, 843 litres) per room per year. A more upscale property may use 80,000 gallons (363, 687 litres) per room per year, whilst resorts can use up to 150,000 gallons (681,914 litres) per room per year (Holt, 2010).

Hotel waste management

The generation of solid wastes and their subsequent disposal is one of the most negative impacts that hotels have on the environment (Radwan, Jones & Minoli, 2012). Waste management together with the philosophy of greening their hotel operations has resulted in waste management assuming great importance within the hotel industry (Ball & Taleb, 2011). Solid waste management has therefore become a vital aspect of hotel's environmental management (Pirani & Arafat, 2014).

This is because the generation of food waste (FW) from hotel operations has a substantial negative impact on the environment (Kasavan, Mohamed & Halim, 2019).

The hotel industry can be active in establishing recycling centres and programs, using environmentally friendly cleaning supplies and techniques, and sourcing locally produced goods and services that reduce transportation costs. Furthermore, improved waste management in the hotel industry not only mitigates degradation of the environment, but it also often enriches the attractiveness of destinations as well. Costs can be reduced, and the "green" image is also favorable for the business as well (Sloan, Legrand & Chen, 2013).

Hotel wastes are categorized as biodegradable, for example, organic wastes, and non-biodegradable wastes (Borah & Sood, 2020; Sloan, Legrand & Chen, 2013). Biodegradable wastes can be further divided into simpler, non-toxic substances through the action of microorganisms. Non-biodegradable wastes are those wastes that are unable to be broken down into non-toxic substances through the actions of biological agents (Mishra, 2008). Non-biodegradable waste may also be recyclable and non-recyclable solid waste (Borah & Sood, 2020). Hotels generate both biodegradable and non-biodegradable wastes (Sloan, Legrand & Chen, 2013). The types of wastes generated in a hotel are heterogenous in nature and include food and organics, cardboard and paper, and different container wastes, for example, glass, plastic, and metal (Dasgupta, 2009). Biological wastes (human sewage) as well as ashes if the use an incineration system in their establishment are other types of wastes produced at a hotel. Hazardous wastes, for example, solvents and chemicals, are also present at hotels (Sloan, Legrand & Chen, 2013).

A hotel's food and beverage operation account for a large volume of waste. These wastes can be defined as:

- Pre-and-post food consumer food waste, packaging, and operating supplies: pre-consumer waste is defined as being of all the trimmings, spoiled food, and other products originating from a kitchen prior to the finished menu item reaching the consumer.
- Post-consumer waste is the waste that is left over once a consumer has consumed the meal; and
- Packaging waste: is anything used in the kitchen, for example, plastic, to hold food coming into and leaving the kitchen. Operating supplies comprise all other pieces of material(s) that becomes waste in a food service operation, for example, cooking oil (Sloan, Legrand & Chen, 2013, p. 73).

There are a range of measures available to hotels to help them reduce their wastes. Hotel management should collaborate closely with suppliers to purchase products that promote waste prevention. The procurement of items in bulk, using recycled products and purchasing them from suppliers who an environmental policy in place, are measures that help to reduce the volume of

wastes generated. Furthermore, purchasing products with a longer life cycle will also result in decreased waste volumes. The creation of less waste or the elimination of waste before it is produced means the hotel will produce less pollution and will be saving natural resources. This objective can be achieved from the hotel working closely together with suppliers and encouraging them to reduce their packaging, reuse packaging or alternatively change to reusable packaging wherever possible. In some instances, outsourcing cam help reduce wastes (Sloan, Legrand & Chen, 2013).

Many hoteliers dispose of their hotel waste to landfill which is the regarded as the least-preferred waste disposal option in the waste management hierarchy (Radwan, Jones & Minoli, 2012). This is not an ideal practice as wastes disposed to landfilling and open dumping, is regarded as being environmentally unsafe due to emission of greenhouse gases (GHGs) (Trabold & Nair, 2019). Wastes disposed by landfill undergo biological, chemical, and physical transformations that result in changes in solid, liquid (leachate), and gas phases. Around 90% of the carbon that is released during the decomposition of wastes disposed by landfill migrates to landfill gas in the form of methane (CH4), carbon dioxide (CO2), and various hydrocarbons, although only 10% enters the leachate. The emissions of compounds, which include methane (CH4), carbon dioxide (CO_2), nitrous oxide (NOx), and halogenated organic compounds, have the greatest extent on the landfill impact as they contribute to climate change (Pawlowska, 2014).

According to the waste management hierarchy, re-use and recycling are the optimal methods for dealing with unavoidable waste (Baxter, Srisaeng & Wild, 2018a; Pitt & Smith, 2003). Re-using waste, wherever possible, is considered preferable to recycling because the waste items do not need to be processed prior to their subsequent re-use (Güren, 2015). Reuse of wastes occurs when something that has already satisfied its original function is used once again for another purpose (Zhu, Asnani, Zurbrugg, Anapolsky & Mani, 2008).

A further waste management measure available to hotels is the composting of wastes. Composting waste is a process whereby the organic portion of solid waste is converted into a humus-like product. The final product, which is inert in nature, can be utilized as a soil conditioner or for landfill cover (Harper, 2004, p. 3). There are several advantages associated with the composting of rubbish: lower operational costs, lessened environmental pollution, as well as the beneficial use of the end products (Taiwo, 2011).

Research Methodology

Research approach

The research undertaken in the present study was underpinned by a longitudinal case study research design (Derrington, 2019; Hassett & Paavilainen-Mäntymäki, 2013; Neale, 2019). The key advantage of this research design is that it reveals change and growth in an outcome over time (Kalaian & Kasim, 2008). A qualitative case study also allows for the exploration of complex

phenomena (Remenyi, Williams, Money, & Swartz, 2010; Yin, 2018). In addition, a case study provides rich, explanatory information (Ang, 2014; Mentzer & Flint, 1997) and this research approach also enables researchers to connect with real world practice (McCutchen & Meredith, 1993).

Data collection

Data for the study was obtained from a range of documents: Centara Hotels & Resorts annual Responsible Business Reports, Centara Hotels & Resorts annual reports, and company materials available on the internet. These documents provided the sources of the study's case evidence. An exhaustive source of the leading hotel and tourism-related journals and textbooks were also conducted. The study included a search of the SCOPUS and Google Scholar databases.

The key words used in the database searches included "Centara Hotels & Resorts sustainability policy", "Centara Hotels & Resorts annual energy consumption", "Centara Hotels & Resorts annual wastes", "Centara Hotels & Resorts annual water consumption", "Centara Hotels & Resorts energy saving measures", "Centara Hotels & Resorts water saving measures", "Centara Hotels & Resorts waste management and waste reduction measures", "Centara Hotels & Resorts annual Scop1, Scope 2 and Scope 3 emissions", and "Centara Hotels & Resorts annual carbon footprint".

The study therefore used secondary data. The three principles of data collection as recommended by Yin (2018) were followed: the use of multiple sources of case evidence, creation of a database on the subject and the establishment of a chain of evidence.

Data analysis

The empirical data collected for the case studies was examined using document analysis and quantitative approaches. Document analysis is often employed in case studies (Grant, 2019; Monios, 2016) and focuses on the information and data from formal documents and company records that have been gathered by the researcher(s) (Baxter, 2021; Ramon Gil-Garcia, 2012). The documents gathered for the study were examined and assessed by four key criteria: authenticity, credibility, representativeness and meaning (Fulcher & Scott, 2011; Scott, 1990, 2014; Scott & Marshall, 2009). The data analysis in this study also included the percentage analysis and graphical analysis to provide insights on the hotel sustainable management.

The document analysis was undertaken in six discrete phases. The first phase involved planning the types and required documentation and their availability for the study. Phase two represented the data collection phase and this involved sourcing the documents and developing and implementing a scheme for the document management. In Phase 3 of the document analysis, the collected documents were examined to assess their authenticity, credibility and to identify any potential bias that may be present in the documents. During Phase 4, the contents of the collected documents was carefully examined, and the key themes and issues were identified. Phase 5 involved the deliberation and refinement to identify any difficulties associated with the documents, reviewing

sources, as well as exploring the documents content. In Phase 6, the final phase, the analysis of the data was completed, and the case study was updated accordingly (O'Leary, 2004, p. 179).

Following the recommendation of Yin (2018), all the collected documents were downloaded and stored in a case study database. The documents gathered for the study were all in English. Each document was carefully read, and key themes were coded and recorded in the case study (Baxter, 2021; Baxter & Srisaeng, 2020).

Results

1. An environmentally assessment of the sustainable management of the Centara Hotels & Resorts

Centara Hotels & Resorts origins date back to a venture that was begun late in the 1970s when the Central Group purchased a 7.5-hectare site in Bangkok's Chatuchak district. The goal of the company was to create Thailand's first integrated shopping centre, convention centre and hotel. The project opened in 1983 (Centara Hotels & Resorts, 2019b). In the 1980s, the company operated under the brand name of Central Hotels & Resorts. In 2007, the company was rebranded as Centara Hotels & Resorts. The company is a division within Thailand's largest retail conglomerate, the Central Group. The Company has been awarded a Royal Warrant of Appointment and was the first hotel company in Thailand to receive this honor. In recent times, Centara Hotels & Resorts has pursued an asset-light expansion strategy through acquiring management contracts from other property owners both in Thailand and overseas. The company has also acquired ownership of other properties when favorable opportunities arise. At the time of the present study, Centara Hotels & Resorts had 84 hotels in its portfolio both in operation and pipeline. The company's hotels are in 14 countries: Thailand, Vietnam, Indonesia, Laos, Cambodia, Sri Lanka, Maldives, China, Qatar, Oman, United Arab Emirates (UAE), Turkey, Japan, and Myanmar. Twenty-three hotels are owned outright whilst sixty-one are managed by the company (Centara Hotels & Resorts, 2019a). Centara Hotels & Resorts has 6 hotel brands: Centara, Centara Boutique Collection, Centara Grand, Centara Reserve, Centra by Centara, and Cosi (Centara Hotels & Resorts, 2019c).

Centara Hotels & Resorts sustainability policy

Centara Hotels & Resorts has defined and implemented a sustainability development policy which provides the guidelines for sustainable business growth covering economic, social, and environmental dimensions. The policy utilizes the sustainability development concept as the pillar for all the company's operating processes. The policy creates a balance between economic, social, and environmental dimensions throughout the supply chain, and achieves the goals of sustainability development, bringing the greatest benefits to all stakeholders. Importantly, the company incorporates its environmental sustainability policy and practices across all its brands. In accordance with its sustainability policy, the company is committed to conducting business in an environmentally

friendly manner. This takes into consideration all possible impacts on the environment that its operations may have, either directly or indirectly on the environment. Furthermore, the company (1) manages resources to achieve maximum effectiveness; (2) manages waste products systematically and in accordance with all applicable rules and regulations; (3) encourages all individuals to recognize the impact that climate change is having on the world and, (4) makes use of technology to develop various ways to measure and manage its progress over the course of a month, a quarter, and a calendar year. A key objective is to conduct business in an environmentally friendly way and reduce its impact on the. environment. The company also promotes and create environmental knowledge for employees and communities and seeks to improve business processes to reduce environmental impact on a regular basis.

Centara Hotels & Resorts sustainability policy has adopted many of the the United Nations Development Goals including Number 9 (Industry, Innovation, and Infrastructure), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action) (Centara Hotels & Resorts, 2021). In 2015, all United Nations Member States adopted the "2030 Agenda for Sustainable Development" and its seventeen 17 Sustainable Development Goals (SDGs). Each SDG comprises a range of targets to be achieved by 2030 (Katila, Pierce Colfer, de Jong, Galloway, Pacheco & Winkel, 2019; United Nations, 2021). The United Nations Sustainable Development Goals (SDGs) provide a framework for business and government to solve global economic, social, and environmental challenges (Air New Zealand, 2018).

The company's sustainability policy focuses on environmental conservation, energy management, greenhouse gas (GHG) reductions, freshwater management, and sustainable solid waste management. During the study period, renewable energy systems have been introduced to mitigate the level of greenhouses from the company's properties (Centara Hotels & Resorts, 2017).

2. An examination the annual trends in the hotel's carbon footprint, energy usage, water consumption, and wastes.

Centara Hotels & Resorts annual greenhouse gas emissions

Centara Hotels and Resorts annual Scope one and Scope two greenhouse gas emissions and the year-on-year change (%) from 2015 to 2020 are presented in Figure 1. Centara Hotels and Resorts annual Scope one emissions come from the combustion of fuels such as diesel, natural or liquified petroleum gas (LPG) gas, wood or from onsite wastewater treatment. The company's Scope 2 emissions generally come from the use of electricity generated off-site (for example, electricity supplied by an energy provider) (Centara Hotels and Resorts, 2019b). Prior to examining Centara Hotels and Resorts annual Scope one and Scope two carbon dioxide (CO_2) emissions, it is important to note that a carbon dioxide equivalent or CO_2 equivalent is a metric measure used to compare the emissions from various greenhouse (GHG) gases based on their global-warming potential (GWP), by

converting amounts of other gases to the equivalent amount of carbon dioxide (CO_2) with the same global warming potential (Eurostat, 2017). As can be observed in Figure 1, there was a general upward trend in Centara Hotels and Resorts annual Scope one and Scope two greenhouse gas (GHG) emissions from 2015 to 2019, when they increased from a low of 57.05 KT CO_2e in 2015 to a high of 79.44 KT CO_2e in 2019. Figure 1 shows that there was a significant decrease in these emissions in 2020, when they decreased by 23.64% on the 2019 levels. There was a small annual decrease in these emissions in 2017, when they declined by 3.64% on the 2016 levels. The largest single annual increase in the Centara Hotels and Resorts annual Scope one and two greenhouse gas emissions was recorded in 2019, when these emissions increased by 24% on the 2018 levels. It at the time of the present study, the company's annual Scope 3 emissions data was not available.

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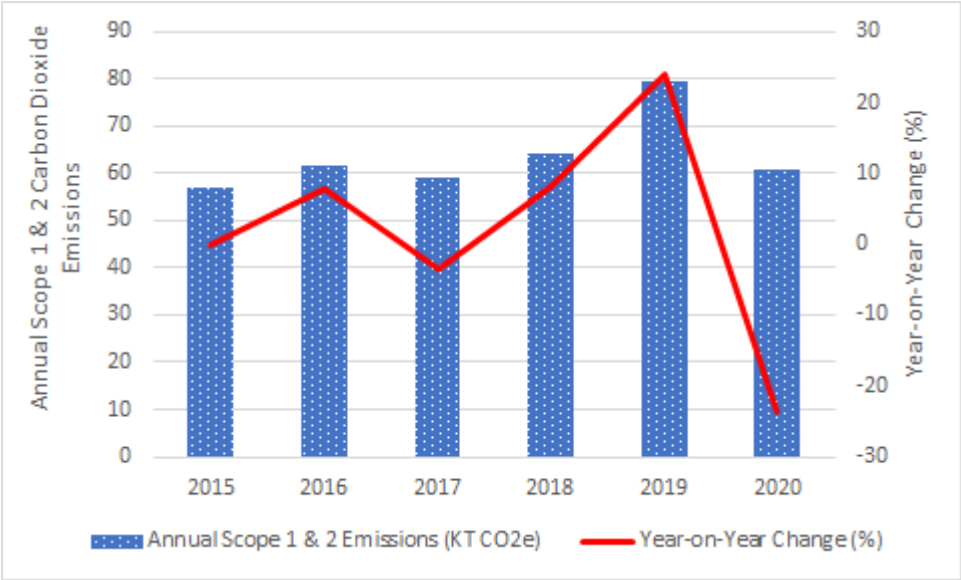

Figure 1. Centara Hotels and Resorts annual Scope one and two greenhouse gas emissions and the year-on-year change (%): 2015 to 2020.

Note: Based on the data collection online system that is used by 20 properties.

Source: Centara Hotels & Resorts (2021).

Figure 2 depicts Centara Hotels and Resorts annual Scope one and Scope two greenhouse gas emissions per guest night and the year-on-year change (%) for the period 2015 to 2020. Figure 2 shows that there was a general upward trend in Centara Hotels and Resorts annual Scope one and Scope two greenhouse gas emissions per guest night. The annual Scope one and Scope two emissions increased from 16.82 kilograms of CO_2e in 2015 to a high of 37.88 kilograms of CO_2e in 2020 (Figure 2). Figure 2 shows that there was a pronounced increase in these emissions in 2019 (+38.44%) and 2020 (+71.86%), respectively. Also, as can be observed in Figure 2, there were two years in the study

period where these emissions decreased on a year-on-year basis. These decreases occurred in 2016 (-0.23%), and 2017 (-5.36%), respectively.

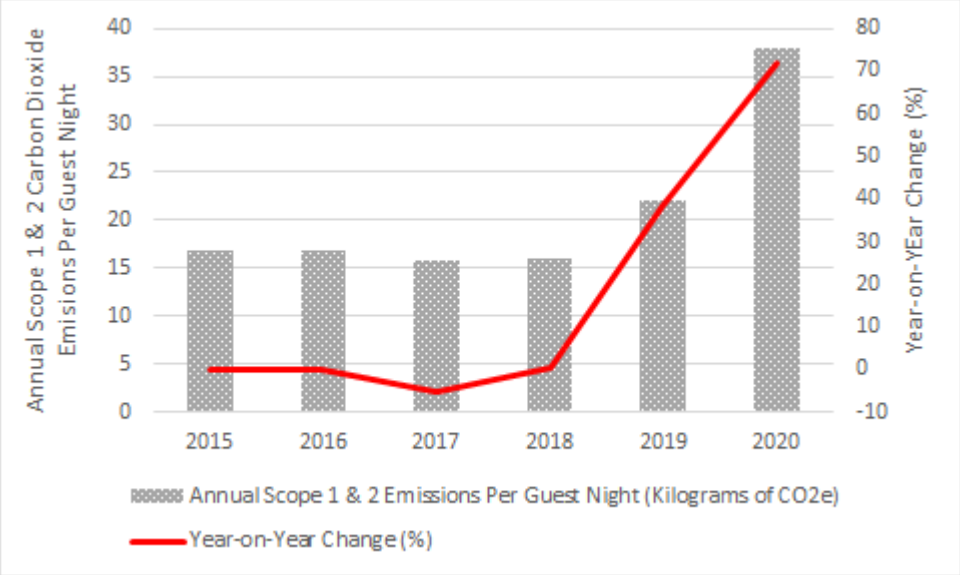

Figure 2. Centara Hotels and Resorts annual Scope one and two greenhouse gas emissions per guest night and the year-on-year change (%):2015 to 2020.

Note: Based on the data collection online system that is used by 20 properties.

Source: Centara Hotels & Resorts (2021).

Centara Hotels & Resorts energy consumption

Centara Hotels and Resorts energy consumption is dependent upon the size, components, and performance of each property that the company operates. The primary components of energy consumption are purchased electricity, stationary fuel, and mobile fuel (Centara Hotels & Resorts, 2020). Centara Hotels and Resorts total annual energy consumption and the year-on-year change (%) from 2015 to 2020 are presented in Figure 3. Figure 3 shows that Centara Hotels and Resorts annual energy consumption has largely shown a downward trend during the study period. As discussed below, Centara Hotels and Resorts have implemented a range of energy reduction measures that have played a key role in reducing the company's energy consumption over the study period. This is demonstrated by the year-on-year percentage change line graph, which is more negative than positive, that is, more values are below the line than above. Figure 3 shows that the company's annual energy consumption fell from 571.09 terajoules (TJ) in 2015 to a low of 432.37 terajoules (TJ) in 2020. There was only one year during the study period where the company's annual energy consumption increased on a year-on-year basis. This annual increase occurred in 2017, when energy consumption increased by 4.54% on the previous year's levels. The overall downward trend is very

favorable result and highlights the impact that the focus on energy efficiency is having for the company. The reduced energy consumption also helps reduce the company's carbon footprint.

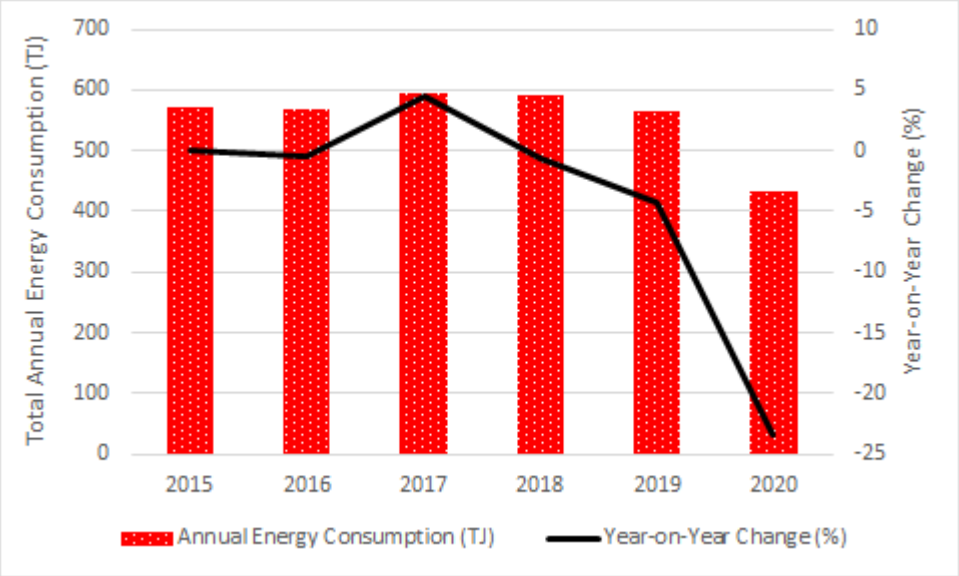

Figure 3. Centara Hotels and Resorts annual energy consumption and the year-on-year change (%): 2015 to 2020.
Source: Centara Hotels & Resorts (2021).

Figure 4 presents Centara Hotels and Resorts annual energy consumption per guest night and the year-on-year change (%) for the period 2015 to 2020. Figure 4 shows that the annual energy consumption per guest night fluctuated throughout the study period. The lowest level of energy consumption per guest level night was recorded in 2018 (145 megajoules), whilst the highest level was recorded in 2020 (270 megajoules), respectively. There were two years in the study period where the annual energy consumption per guest night declined on a year-on-year basis. These decreases occurred in 2017 (-9.44%) and 2018 (-11.04), respectively. As can be observed in Figure 4, there was a pronounced spike in the annual energy consumption per guest night in 2020 (+77.63%). This sharp increase was attributed to the fixed and variable energy usage combined with the lower number of guest nights due to the corona virus pandemic. This resulted in the higher energy use per guest night across the hotels and resorts in 2020 (Centara Hotels & Resorts, 2021). The corona virus pandemic resulted in a downturn in world tourism (Rahman, Rahim, Ahmad & Hafizuddin-Syah, 2020). Thailand also experienced a significant decline in its tourism industry in 2020, as the pandemic precipitated a sudden stop in the country's tourism flows. There was also a significant contraction in the country's economic activity (Kaendera & Leigh, 2021).

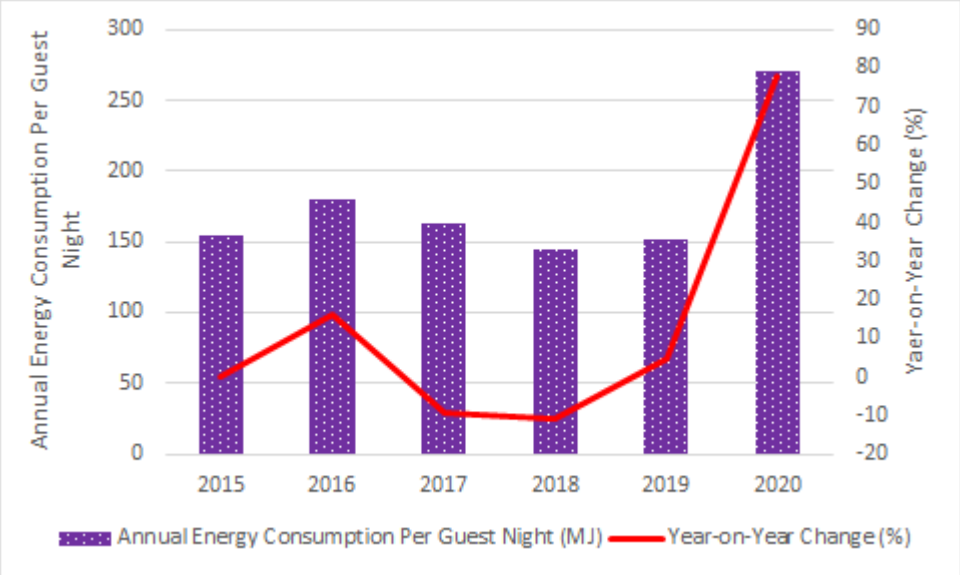

Figure 4. Centara Hotels and Resorts annual energy consumption per guest night and the year-on-year change (%): 2015 to 2020.

Source: Centara Hotels & Resorts (2021).

Centara Hotels & Resorts wastes and waste management practices

Centara Hotels and Resorts total annual wastes that were disposed to landfill and the year-on-year change (%) for the period 2015 to 2020 are presented in Figure 5. As can be observed in Figure 5, Centara Hotels and Resorts total annual wastes have largely shown a downward trend, decreasing from a high of 9001.2 cubic metres (m^3) in 2015 to a low of 1394.45 cubic metres (m^3) in 2020. This is demonstrated by the year-on-year percentage change line graph, which is more negative than positive, that is, more values are below the line than above. There was just one year in the study period where the company's annual wastes increased on a year-on-year basis. This increase occurred in 2018, when total annual wastes increased by 36.9% on the previous year levels. As can be observed in Figure 5, there was a very pronounced decrease recorded in 2020, when the total annual wastes decreased by 82.19% on the 2019 levels. This decrease could be attributed to the lower number of guests due to the corona virus pandemic. Overall, the downward trend is very favorable from an environmental perspective as lower levels of landfill disposed wastes will help reduce the emissions of greenhouse gases and other harmful pollutants. Importantly, from a waste management perspective, Centara Hotels and Resorts recycles, re-uses, or composts materials wherever possible.

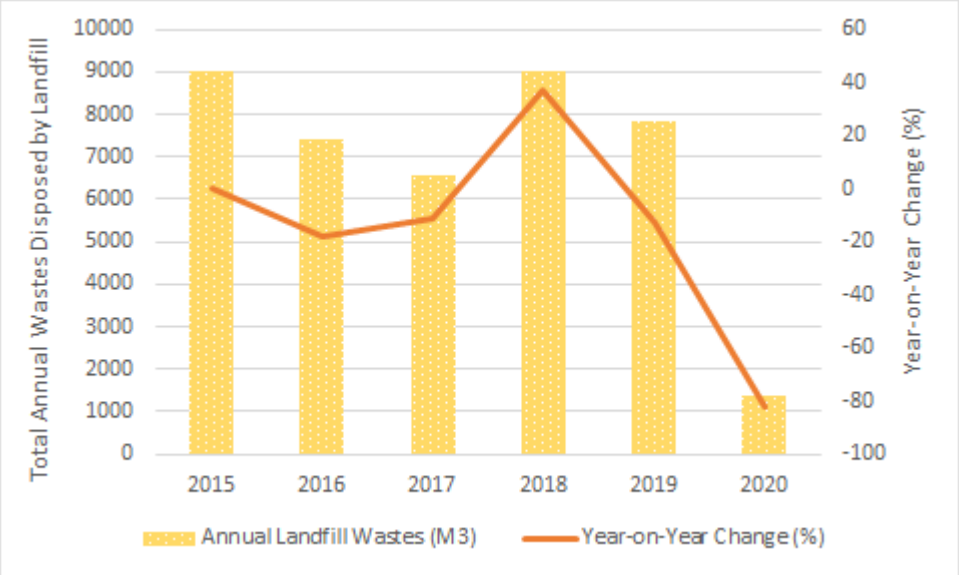

Figure 5. Centara Hotels and Resorts annual landfill disposed wastes and the year-on-year change (%): 2015 to 2020.

Source: Centara Hotels & Resorts (2021).

Figure 6 presents Centara Hotels and Resorts annual wastes per guest night and the year-on-year change (%) from 2015 to 2020. The Centara Hotels and Resorts annual generated wastes per guest night and the year-on-year change (%) from 2015 to 2020 are depicted in Figure 6. As can be observed in Figure 6, the annual wastes per guest night fluctuated throughout the study period. The highest amount of waste per guest night was recorded in 2015 (2.64 kilograms), whilst the lowest amount of waste per guest night occurred in 2020 (1.59 kilograms). Figure 6 shows that there was a spike in these wastes in 2017, when they increased by 15.66% on the 2016 levels. There were two years in the study period, where the annual wastes per guest night declined on a year-on-year basis. These annual decreases were recorded in 2016 (-17.8%), and in 2020 (-20.5), respectively. Also, Figure 6 shows that the annual wastes per guest night remained the same in 2018 and 2019 (2 kilograms per guest night).

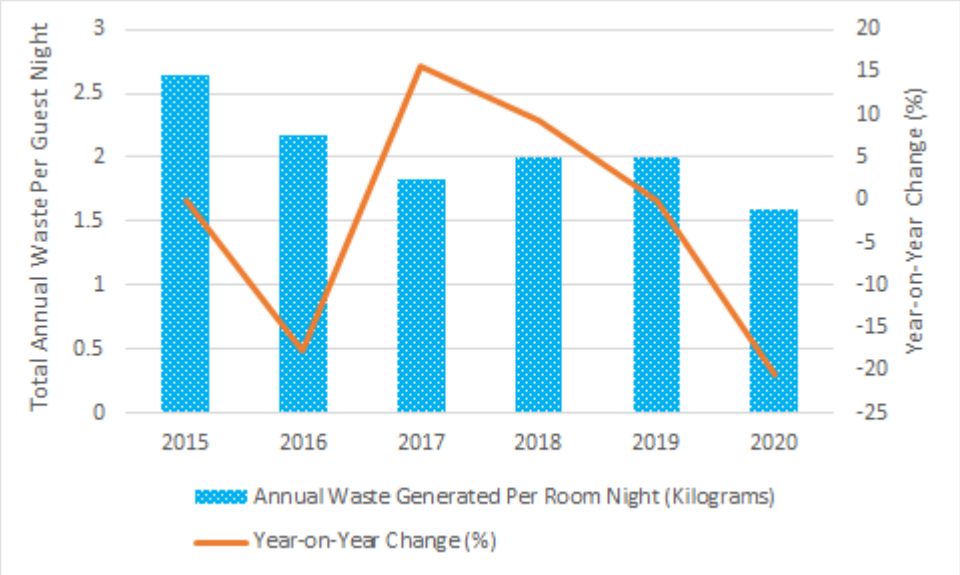

Figure 6. Centara Hotels and Resorts annual wastes per guest night and the year-on-year change (%): 2015 to 2020.

Source: Centara Hotels & Resorts (2021).

Figure 7 presents Centara Hotels and Resorts annual waste diversion rates and the year-on-year change (%) from 2015 to 2020. The company's landfill diversion rate includes recycling, re-using, or composting of materials (Centara Hotels and Resorts, 2021). As can be observed in Figure 7, there are two discernible trends in the annual trend in Centara Hotels and Resorts annual waste diversion rates. The first trend shows that from 2015 to 2017, there was an upward trend in this ratio, which increased from 55.2% in 2015 to 65.68% in 2017. From 2018 to 2020, this ratio decreased on a year-on-year basis decreasing from 58.8% in 2018 to 43.11% in 2020; this was the lowest diversion rate recorded in the study period. Figure 7 shows that there was a significant increase in the company's waste diversion rate in 2016, when it increased by 17.86% on the 2015 levels. The largest single annual decrease in the company's waste diversion ratio occurred in 2020, when this metric decreased by 19.57% on the 2019 level. As noted earlier, re-use and recycling are the optimal methods for handling unavoidable wastes (Baxter, Srisaeng & Wild, 2018; Pitt & Smith, 2003) and Centara Hotels and Resorts is re-using and recycling wastes wherever possible. This will help to mitigate the adverse impact that wastes have on their environment.

In addition, prior to the pandemic in 2020, the Centara Ao Nang Beach Resort & Spa Krabi, Centara Grand Mirage Beach Resort Pattaya, Centara Grand Beach Resort & Villas Hua Hin, Centara Hotel Hat Yai, Centara Hotel & Convention Centre Udon Thani, and Khum Phaya Resort & Spa, Centara Boutique Collection had the capability to produce natural fertilizers from food waste and dried leaves that were subsequently used in the property's herb and vegetable gardens. The natural fertilizers were in place of chemicals. Organic waste was also used to make bio-fermented water to reduce

odors and grease clogging drains, particularly in kitchen areas and toilets. Around 2,000 kilograms of organic waste can produce approximately 800 kilograms of natural fertilizers and 50 - 120 litres of bio-fermented water per month. These products are used in hotels and are also distributed to employees for their home-use (Centara Hotels & Resorts, 2021).

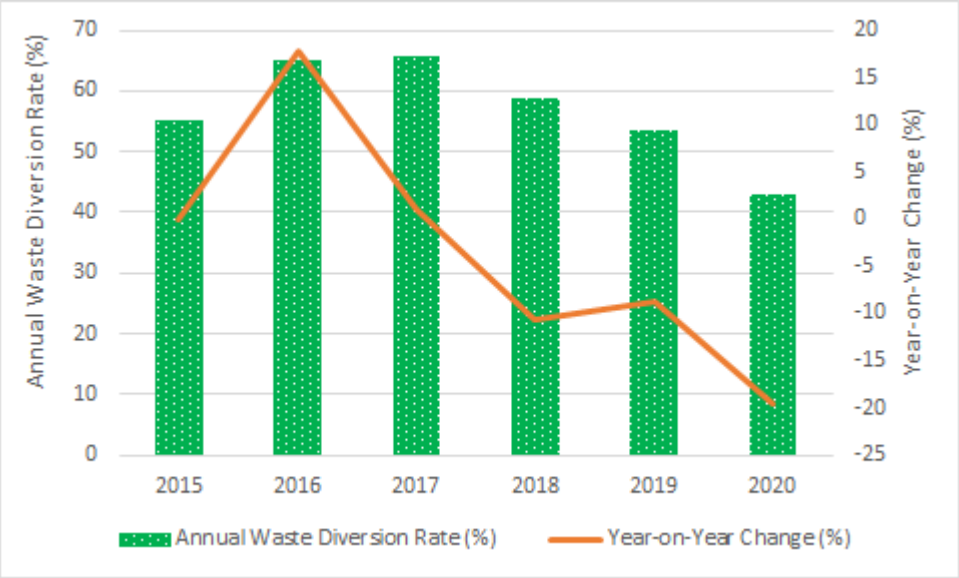

Figure 7. Centara Hotels and Resorts annual wastes diversion rate and the year-on-year change (%): 2015 to 2020.

Source: Centara Hotels & Resorts (2021).

Centara Hotels & Resorts has four distinct types of wastes: general waste, recyclable waste, organic waste, and hazardous waste (Centara Hotels & Resorts, 2016). Sustainable solid waste management is the company's principal practice and policy, and thus, the company aims to reduce the wastes disposed to landfill as well as de-composting wastes and recycling wastes where possible. In addition, the company has introduced a hazardous wastes management system to dispose of all hazardous wastes in such a way that they will not contaminate the ecosystem (Centara Hotels & Resorts, 2017). According to El-Din M. Saleh (2016, p. 4), "hazardous wastes are classified as hazardous if they exhibit one or more of ignitability, corrosivity, reactivity, or toxicity". Hazardous wastes contain harmful chemicals, and other factors that could pose a threat to public health and the environment even when properly managed (Rosenfeld & Feng, 2011). Thus, it is of critical importance that such wastes are disposed in a safe way to avoid any risk to public health and the environment. According to the Centara Hotels & Resorts Waste Management Policy, this type of waste is required to be dealt with differently to other waste and all hazardous wastes must be placed in Hazardous Waste Bin. The bin is located only at the rear of house. The Engineer Office is responsible for hazardous wastes disposal, and these are processed monthly.

All hazardous wastes are sent to licensed local supplier/ local authority. In 2019, the policy was expanded to include electronic waste management (Centara Hotels & Resorts, 2019b).

In 2015, the company adopted a campaign to Reduce, Reuse, Recycle and Disposal of its wastes. This campaign encouraged the use of environment friendly materials that are compostable and do not cause any environmental pollution. All Centara Group resorts purchase natural materials such as banana leaf or other leaves to use in serving desserts or food, to reduce the quantity of plastic plates which are difficult to be degraded. In 2015, at the Centara Karon Resort Phuket, straws made of new garden lemongrass which helped to reduce plastic use. The used lemongrass straws are reused in sauna rooms as herbal aroma for the company's customers. Furthermore, at all hotels, shopping bags, beach bags and laundry bags are now made from fabric material that can be reused. This practice replaced the use of plastic bags. In 2015, many hotels commenced the use rechargeable flashlights to reduce the use of dry cells that become hazardous waste after use. In 2015, a special project was held to sell drinking water using a bottle made of corn sugar, also known as bioplastic, which importantly is degradable in landfills (Centara Hotels & Resorts, 2016).

At Centara Grand Beach Resort & Villas Hua Hin and Centara Grand Beach Resort Samui, organic wastes are used to produce bio-extract. This is then used as a cleaning agent for drains and toilets in the company's hotels. The bio-extract is also donated to nearby temples and communities (Centara Hotels & Resorts, 2016).

Once a bottle has been used then it can subsequently be reused or alternatively recycled (Morgan, 2009). At the Centara Hotels & Resorts drinking water bottles provided to its customers in the hotel room are made of glass. The empty bottles are returned to the manufacturing company for recycling. This practice reduces the use of plastic bottles by the company (Centara Hotels & Resorts, 2016).

In 2018, the company introduced its elimination of single-use plastic items program as part of the "Centara Earth Care" program. In line with this program, Centara Hotels & Resorts began eliminating single-use plastic products in 2018, across all 39 of its operating properties. This program began in August 2018 and once fully implemented would eliminate nearly 2.2 million plastic straws per year. Phase two of the program eliminated the use of plastic laundry bags, and this began in December 2018. Phase three of the program focused on the elimination of take-away food containers, whilst Phase four eliminated plastic water bottles at fitness centres and pool sides. In Phase 5, all plastic guest room amenities were eliminated and were replaced with alternative products which are reusable and made from environmentally friendlier materials, including plant-based, compostable, and biodegradable plastics to minimize their environmental impact. In 2018, the company began to offer reusable straws and running belts that are made from recycled plastic water bottles (Centara Hotels & Resorts, 2019).

All the company's hotels need to measure garbage disposal in accordance with the applicable regulations: Wastes are disposed in a facility as prescribed by the law, such as to the related municipality or unit. Waste separation is also practiced, and the sorted wastes are sent to the collecting unit for proper disposal. All six hotels located in Phuket use the disposal service of Phuket City Municipality, and general waste is sent to be disposed at Saphanhin Disposal Facility, where it is used for electricity production (Centara Hotels & Resorts, 2016).

Since 2017, the company's properties in Bangkok have been active partners with the Scholars of Sustenance Foundation (SOS) – Thailand. In 2019, the foundation expanded their charitable service to include the Phuket area. As of the end of 2019, the company's three properties in Bangkok together with another three Phuket properties donated a total of 59,830.87 kilograms of high-quality cooked food, bakery, and fruits. These donations provided over 213,551.64 servings to the orphanages, refugees, disabilities, and low-income people. By reducing its food waste, the company saved 113,678.66 kilograms of greenhouse gas (GHG) equivalent emissions (CO2-e (kg). The Centara Grand & Bangkok Convention Centre at CentralWorld and Centara Grand at Central Plaza Ladprao are members of the Scholars of Sustenance Foundation (SOS) – Thailand composte program and in 2019 they diverted 143,064.11 kilograms of food waste from landfills, which was equivalent to 27.82 tonnes of CO_2-e emissions (Centara Hotels & Resorts, 2020).

Centara Hotels & Resorts water consumption and water management

Centara Hotels and Resorts total annual water consumption and the year-on-year change (%) from 2015 to 2020 are presented in Figure 8. As can be observed in Figure 8, Centara Hotels and Resorts total annual water consumption remained relevantly constant throughout the study period. The highest annual water consumption occurred in 2016 (1942.36 megalitres), whilst the lowest water consumption was recorded in 2020 (1638.22 megalitres), respectively. As previously noted, there was a reduction in guest nights in 2020, which could have contributed to the lower water consumption. The largest single annual increase in water consumption occurred in 2019, when the annual water consumption increased by 11.92% to 1980.6 megalitres. Figure 8 shows that there were three years during the study period, where the company was able to reduce its annual water consumption. These decreases were recorded in 2017 (-1.13%), 2018 (-7.85%), and 2020 (-17.28%), respectively. This was a very favourable outcome in these years given the growth in the business. Figure 8 shows that there were two pronounced spikes in the company's annual water consumption, which occurred in 2016 (8.39%), and 2019 (11.92), respectively.

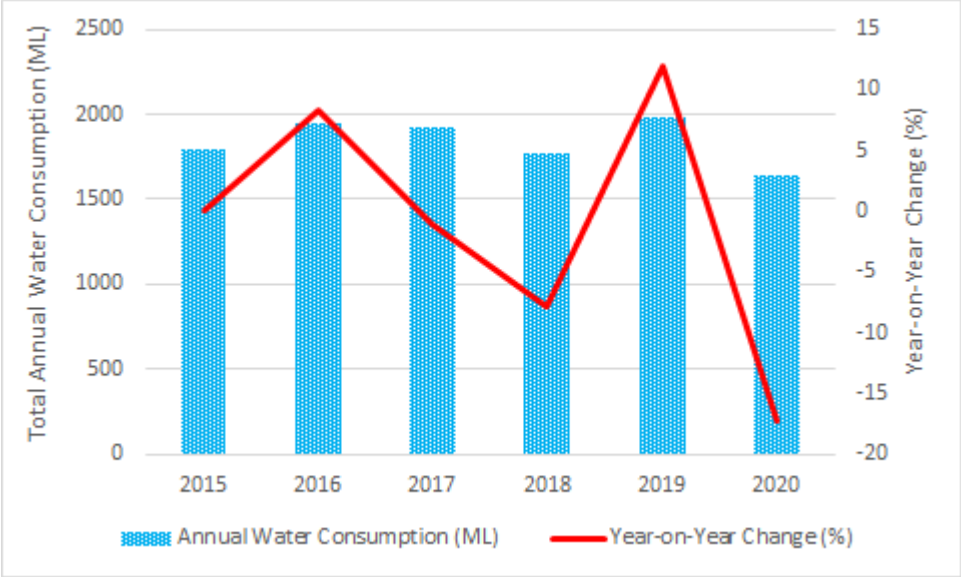

Figure 8. Centara Hotels and Resorts annual water consumption and the year-on-year change (%): 2015 to 2020.

Note: Based on the data collection online system that is used by 20 properties.

Source: Centara Hotels & Resorts (2021).

Figure 9 presents Centara Hotels and Resorts annual water consumption per guest night and the year-on-year change (%) for the period 2015 to 2020. Figure 9 shows that Centara Hotels and Resorts annual water consumption per guest night oscillated throughout the study period in line with guest patronage of the company's hotels and resorts. The lowest annual water consumption per guest night occurred in 2018 (469 litres per guest night), whilst the highest annual water consumption per guest night was recorded in 2020 (1,023 litres). As can be observed in Figure 9, there was a very pronounced annual increase in this metric in 2020, when it increased by 74.87% on the 2019 levels. Figure 9 also shows that there were two years in the study period, where the annual water consumption per guest night decreased on a year-on-year basis. These decreases were recorded in 2017 (-11.01%), and in 2018 (-12.0%), respectively.

Importantly, Centara Hotels and Resorts is carefully focusing on the company's water consumption and considering this have introduced a number of water conservation measures and policies. Most of Centara Hotels and Resorts save around 80% of their freshwater by reusing treated water for irrigation around resort green areas. Wastewaters are processed to improve the quality of water and to make it appropriate for its end-use, including being safely returned to the environment. Water-conservation and water management are a key part of the company's sustainability policy. As a result, the company aims to raise both staff and guests' awareness as part of its water conservation efforts. The use of low flow showerheads, low flow water taps, and dual flush toilets have also been installed in their properties. In cases where these system changes have not been made, the water

level in the toilet water tank is adjusted to use eight litres of water per time instead of the conventional ten liters. In addition, a new resource savings program titled "Going Greener" has been implemented in the guestrooms to reduce water consumption. This program also aims to reduce chemical use for laundry by reusing linens and towels, which helps save almost eight litres of water per room participation per day (Centara Hotels & Resorts, 2021). At the Centara Ras Fushi Resort & Spa Maldives, water meters have been installed and these monitor the hourly water usage at the areas of high-volume usage such as swimming pools, kitchens, and laundry, in order to prevent water leaks (Centara Hotels & Resorts, 2021).

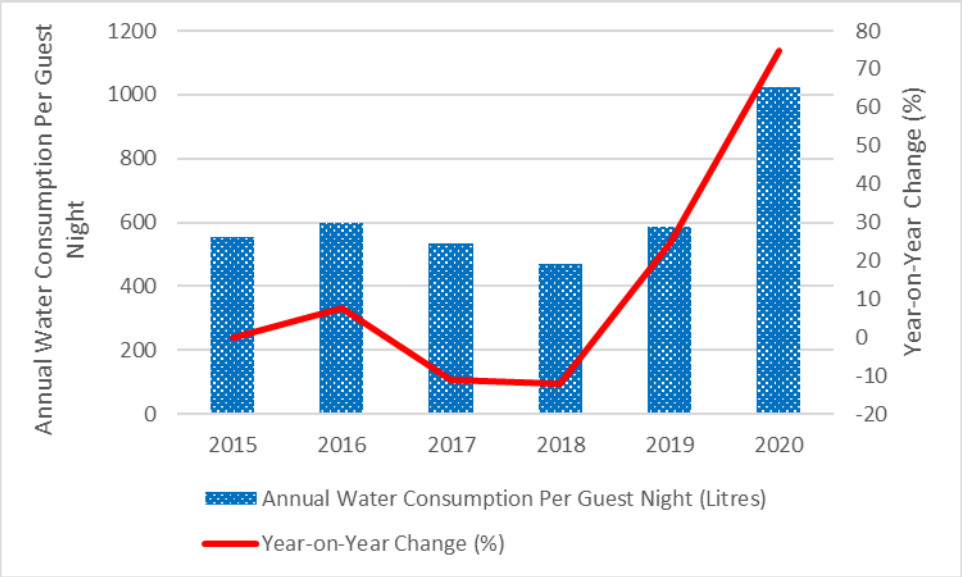

Figure 9. Centara Hotels and Resorts annual water consumption per guest night and the year-on-year change (%): 2015 to 2020.

Note: Based on the data collection online system that is used by 20 properties.

Source: Centara Hotels & Resorts (2021).

3. The energy saving and waste management initiatives

Centara Hotels & Resorts energy saving measures

Throughout the study period, Centara Hotels and Resorts has implemented a range of environmental related mitigation measures. In 2015, Centara Hotels and Resorts installed light emitting diodes (LEDs) light bulbs to replace lights in the areas of its properties where electricity was used for over six hours. Light emitting diodes (LEDs) are "very small electrical device[s] that generate light through the semi-conducting properties of its metal alloys" (Keller & Burke, 2009, p. 134). LEDs use an electroluminescent process which is much more energy efficient than legacy incandescent technologies (Baxter, Srisaeng & Wild, 2018b). LED lighting is significantly more effective than conventional lighting. The lower energy usage reduces the demand from power plants, and thus,

lowers emissions of greenhouse gases (GHGs) (Guna, Syuhaimi Ab-Rahman, Arsad, Shukor & Shaari, 2020; Pawade & Dhoble, 2019). In addition, motion sensors were installed at the Centara Kata Resort Phuket in public toilets, staff lockers and the fitness centre as another energy saving measure. In 2015, solar energy was used in 11 of the company's hotels where it generated hot water, resulting in lower electricity consumption. In the company's Maldives property, solar cells were used to generate electricity each night for lighting walking paths. In addition, solar cells were installed at the staff building. Also, in 2015, the company's major hotels with more than 500 rooms, and hotels with a seminar area, for example, the Centara Grand at Central Plaza Ladprao Bangkok, were equipped with a centralised system to control electricity and air-conditioners usage (Centara Hotels & Resorts, 2016).

In 2016, Centara Grand at Central World Hotel installed electric vehicle charging stations to help promote the use of eco-cars, which reduce air pollution from the burning of fossil fuels (Centara Hotels & Resorts, 2017).

During 2017, the company optimized its use of renewable energy using this energy source to power its boilers, and walkway lighting at most of its resorts. In 2017, the Coast Bar & Grill in the Centara Grand Beach Phuket installed solar jars to brighten up the ambience, and this measure reduced fossil fuel consumption by 720 litres, which reduced greenhouse gas (GHG) emissions by 2,038 kilograms of CO_2e. Also, in 2017, the Centara Government Complex and Convention Centre Chaeng Watthana installed a photovoltaic (PV) system on its roof top that is used to produce electricity for the convention centre. This new system provided annual electricity savings of 200,000 kWh and a reduction in carbon dioxide (CO_2) emissions of 102 2 tonnes of CO_2e. (Centara Hotels & Resorts, 2018).

In 2018, the Centara Grand Beach Resort Samui purchased a new technologically advanced and environmentally friendly boiler termed a "Once Through Boiler," which is a water-tube boiler. By using this boiler to make steam for the hotel laundry system, the hotel reduced the number of gas tanks used from 10 to 8, which provided an energy saving of 20%. This technology was also installed at Centara Grand Beach Resort & Villas Krabi and at Centara Grand & Bangkok Convention Centre at Central World. Centara Ceysands Resort & Spa Sri Lanka installed a new Variable Frequency Drive Controller in 2018 to help with electricity savings through controlling the amount of voltage and frequency available to the property's various chillers and pumps. This new equipment reduced the electricity usage of chillers and pumps by utilizing the VFD control function. This delivered energy savings from between 30% and 50%. Also, in 2018, the Centra by Centara Maris Resort Jomtien installed a "Cowtech Composting Biogas Production Machine to help handle the sustainable management of organic waste from kitchens, and staff canteens. This new machine helped reduce greenhouse gas (GHGs) emissions from food wastes. The conversion of organic waste to renewable energy, resulted in the reduction in 10.83 tonnes of CO2-e greenhouse gas emissions (Centara Hotels & Resorts, 2019b).

During 2019, more than 75% of the company's total operating properties replaced their lighting system with the LED lighting in both the Front-of-House and Back-of-House areas. The Centara Grand Mirage Beach Resort Pattaya installed an electrical backup capacitor in 2019 called the "Intelligent Electronic Capacitor Bank," that receives data from sensors, and power equipment and this machine can issue control commands if it senses voltage, current, or frequency anomalies, or raise/lower voltage levels to maintain the desired level. By installing the "Intelligent Electronic Capacitor Bank", the hotel achieved an energy saving of approximately 1.53%. Also, in 2019, the Centara Ras Fushi Resort & Spa Maldives installed a rooftop solar panel system that began producing electricity in December 2019. Following the completion of the solar panel installation atop the roofs of all the resort's main structures, the Centara Ras Fushi Resort & Spa Maldives will generate enough pollution free power to supply almost 40% of its energy requirement, resulting in an annual energy savings equivalent to 307,000 kilowatt hours (kWh) or about 83,000 litres of diesel fuel. In 2019, the Centara Grand Mirage Beach Resort Pattaya installed a heat recovery system that recovers waste heat from the compressor from the walk-in refrigerator and the exhaust pipe of steam boiler. This has provided a reduction in energy consumption of 7.39 kilowatt hours (kWh) or 74.6% of the full compressor load. The resort will be able to save approximately 373,540 kWh per year of energy, which equates to 291 tons of greenhouse gas (GHG) emissions or the associated carbon dioxide (CO_2) equivalent (Centara Hotels & Resorts, 2020)

In 2020, Centara Hotels and Resorts implemented a range of low energy saving projects during the low occupancy period of its properties. The company used the downtime to focus on room preventive maintenance and thereby improved the hotel's systems and facilities, such as air conditioning, plumbing, heating, and lighting. During the downturn in guest demand in 2020, the company kept unoccupied floors closed, and they also scheduled each pool pump to work alternately and reduced the operating hours of each pump by fifty percent. During 2020, the Centara Grand Mirage Beach Resort Pattaya disabled two transformers and transferred the load to another two transformers to reduce the resort's overall energy consumption. The Centara Karon Phuket Resort installed single air conditioning units in the chilled food storage area and they shut down the main chillers during the hotel closure period. Approximately, 80% of lighting was converted to energy-efficient LED lighting both in front-of-house and back-of-house areas during 2020. The Centara Grand at Central Plaza Ladprao Bangkok replaced an old transformer with new electric transformers in April 2020. The new electric transformer is a very-low loss model that can enables the company to reduce energy loss by 3-5% of total consumption. In 2020, the Centra by Centara Government Complex Hotel & Convention Centre Chaeng Watthana installed automatic on-off light control sensors in the staff locker area. The Centara Karon Resort Phuket installed a new heat pump in its main guest room building. The facility's old heat pump was only to work at between 50-60% of its capacity. The new heat pump reduced the electricity use for heating by around 40%. Also, in 2020, the Centara Grand

& Bangkok Convention Centre at CentralWorld upgraded its guest rooms with the installation of motion sensors to control lighting. During 2020, the Centara Grand Beach Resort Phuket, Centara Grand Beach Resort & Villas Hua Hin, Centara Grand Beach Resort & Villas Krabi, Centara Kata Resort Phuket, Centra by Centara Government Complex Hotel & Convention Centre Chaeng Watthana, Centara Grand Island Resort & Spa Maldives, Centra by Centara Avenue Hotel Pattaya, Centara Pattaya Hotel, Maikhao Dream Villa Resort & Spa, Centara Boutique Collection installed solar powered heat systems. This system has delivered annual savings of approximately 150,000 - 200,000 kWh of energy per property per year. In 2020, the Centara Grand Beach Resort and Villas Hua Hin replaced their hot water production system from one that used liquified petroleum gas (LPG) to a heat pump system. This initiative delivered annual energy savings of around 468,281.8 kWh. In addition, the property reuses air-waste from the heat pump system, which is used to cool the facility's laundry room. This measure has helped to reduce the temperature and helps to avoid the use of electricity to cool the laundry room. Also, in 2020, the Centara Grand Beach Resort Phuket installed outdoor solar light emitting diode (LED) lights on the terrace of the "COAST" restaurant. During 2020, the Centara Grand at Central Plaza Ladprao Bangkok and Centara Grand & Bangkok Convention Centre at CentralWorld were the recipients of the Low Emission Support Scheme (LESS) Award Letter of Recognition 2020 awarded by the Ministry of Natural Resources and Environment to recognize their contribution to Thailand Greenhouse Gas Management Organization (TGO)'s Low Emission Support Scheme (LESS). The greenhouse gas reduction activities included back-of-house system and equipment upgrades, LED lighting replacements, and the segregation of waste for recycling. In 2020, these two properties reduced their annual greenhouse gas (GHG) emissions by 3273.18 tonnes of carbon dioxide equivalents. In 2020, Centara Hotels and Resorts increased the number of electric vehicles charging stations at its city hotels in Bangkok and Udon Thani. This aim of this measure was to reduce the emissions from gas-powered vehicles (Centara Hotels & Resorts, 2021).

Centara Hotels & Resorts carbon sequestration

Centara Hotels and Resorts has also introduced a carbon sequestration policy. Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide (CO_2) (United States Department of Interior, 2021). Importantly, the direct link between atmospheric carbon dioxide (CO_2) levels and terrestrial ecosystems has resulted in governments and private entities to explore the possibility of increasing the rate of growth in forests as a means of converting existing carbon dioxide (CO_2) into sequestered carbon stocks (Neil Sampson & Sedjo, 1997). Centara Hotels and Resorts has adopted the practice of planting trees as a key environmental related measure. The company has planted teak and flame trees in mangroves which are prime ecosystems for reforestation and restoration. In 2017, the company's properties located in Phuket, Krabi, Hat Yu, Huahin, Udon Thani, and Pattaya, planted over 1,000 trees on Earth Day and World Environment Day. The carbon

sequestration from the planting of these trees was estimated to be 4,000 kilograms of CO_2e (Centara Hotels & Resorts, 2018). In 2018, the Centara Grand & Bangkok Convention Centre at Central World signed a Memorandum of Understanding (MOU) with the Royal Forest Department, Ministry of Natural Resources for a long-term Watershed Forest Conservation Project. This project involved the Centara Grand & Bangkok Convention Centre at Central World and the Royal Forest Department, Ministry of Natural Resources planting 400 local species of trees on 2 Rai of land in Ta-Takiab District, Chachoengsao Province. Upon completion of this project, the sequestered carbon would be 8,600 kilograms of carbon dioxide (CO_2) emissions per year (Centara Hotels & Resorts, 2019b).

Conclusion and Discussion

Underpinned by an in-depth qualitative longitudinal research approach, this study has examined the environmentally sustainable hotel operations of Thailand headquartered Centara Hotels & Resorts. The study period was from 2015 to 2020. The qualitative data was analyzed by document analysis.

The case study revealed that the Centara Hotels & Resorts annual Scope 1 and Scope 2 greenhouse gas (GHG) emissions increased over the study in line with the company's operational requirements. The company's annual Scope 1 and Scope 2 greenhouse gas (GHG) emissions displayed an upward trend, increasing from 16.82 kilograms of CO_2e in 2015 to 37.88 kilograms of CO_2e in 2020.

The annual energy consumption of the company declined over the study period. The highest recorded energy consumption occurred in 2018 (590.32 terajoules), and the lowest energy consumption was recorded in 2020 (432.37 terajoules). Throughout the study period, there was just a single year when the annual energy consumption increased on a year-on-year basis, this occurred in 2017, when the annual energy consumption increased by 4.54% on the 2016 levels.

The Centara Hotels & Resorts annual wastes displayed a downward trend, decreasing from 9001.2 cubic metres (m^3) in 2015 to 1394.45 cubic metres (m^3) in 2020. The company places a high focus on waste management and aims to re-use or recycle wastes wherever possible. Wastes that are unsuitable for re-use or recycling are disposed to landfill. Where appropriates wastes are also composted. The waste diversion rate peaked in 2017 (65.68%).

Centara Hotels and Resorts total annual water consumption remained relevantly constant throughout the study period. The highest annual water consumption occurred in 2016 (1942.36 megalitres), whilst the lowest water consumption was recorded in 2020 (1638.22 megalitres), respectively. In line with its sustainability policy, the company implemented water saving measures at its properties, which are helping to mitigate water consumption.

As previously noted, hotels are regarded as being very energy intensive. The case study found that the company has implemented a wide range of energy saving measures throughout the study

period. These include the extensive use of LED lighting, the use of photovoltaic (PV) solar systems, the provision of electric vehicle charging stations, and technologically advanced boiler and heat pump systems. These energy saving measures not only reduce the demand from power plants, but also lower emissions of greenhouse gases (GHGs) (Guna, Syuhaimi Ab-Rahman, Arsad, Shukor & Shaari, 2020; Pawade & Dhoble, 2019).

Finally, the case study found that Centara Hotels & Resorts has implemented a carbon sequestration program that is also assisting it to reduce its carbon footprint. These Centara Hotels & Resorts sustainability policies can be ensured that their operations are conducted in an environmentally friendly manner which accordance with a growing trend towards the "greening "of the accommodation sector of the travel and tourism industry (Cheyne & Barnett, 2001; Ruffolo, 2015; Verma & Chandra, 2016). Future research may conduct other data collecting techniques such as in-depth interview or focus group interview to gain primary data from experts.

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