Life Cycle Assessment of Incentive Travel: a case of Phitsanulok Province

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Abstract

The study titled “Life Cycle Assessment of Incentive Travel: A Case of Phitsanulok Province” aims to evaluate the global warming potential throughout the life cycle of tourism related activities in incentive travel of Phitsanulok Province. It also proposes guidelines for conducting incentive travel activities in Phitsanulok Province following a low-carbon tourism approach. This quantitative research primarily uses Life Cycle Assessment (LCA) as the main research tool to assess the global warming potential of incentive travel events in Phitsanulok Province. The study examines for incentive travel. The global warming potential is considered for three types of energy sources: diesel fuel, electricity, and liquefied petroleum gas (LPG). The evaluation results indicate that incentive travel events have the total global warming potential, with 23.33 kg CO_2e per person. The travel activity with diesel fuel is higher global warming potential of 11.25 kg CO_2e per person. The second highest is electrical appliance, wish global warming potential of 10.15 kg CO_2e per person. The activity with LPG has the lowest global warming potential, at 0.31 kg CO_2e per person. Based on the LCA results of the activities with major GWP contributions, the proposed guidelines for promoting low-carbon tourism in

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the incentive travel in Phitsanulok Province include reducing travel distances for incentive travel, and choosing renewable energy sources for electricity.

Keywords: Life Cycle Assessment; MICE industry; Incentive travel

Introduction

Thailand is a country with great tourism potential, rated 31st among 140 countries in the world for tourism competitiveness (The World Economic Forum, 2022). Thailand offers various forms of tourism, such as cultural tourism, ecological tourism, adventure tourism, and another trending tourism style known as business tourism, also referred to as MICE. The MICE industry consists of Meetings, Incentives, Conferences, and Exhibitions (Thailand Convention and Exhibition Bureau, 2011). Currently, there are 10 MICE cities in Thailand, including Bangkok, Chiang Mai, Pattaya, Phuket, Khon Kaen, Nakhon Ratchasima, Songkhla, Udon Thani, Surat Thani, and Phitsanulok (Thailand Convention and Exhibition Bureau, 2021).

Phitsanulok Province was designated as a MICE city by the Thailand Convention and Exhibition Bureau (TCEB) on December 3, 2020 (Phitsanulok Provincial Community Development Office, 2020). Phitsanulok is among the MICE cities with significant potential for business tourism. It is a province well-prepared to support the MICE industry, offering diverse forms of tourism. Furthermore, Phitsanulok serves as a transportation hub, connecting neighboring countries and the lower northern provinces of Thailand because of its strategic location on the East-West Economic Corridor (EWEC) (The Office of Strategy Management : Lower Northern Provincial Cluster 1, 2018). Additionally, incentive travel is a highly regarded form of MICE in Phitsanulok, evident from the selection of the MICE route named "Phitsanulok: Slow Life Imjai Mueang Song Khwae" as one of the top 10 creative MICE routes among the 95 routes available across all 10 MICE Cities (Thailand Convention and Exhibition Bureau, 2021).

Incentive travel is considered as tourism that offers rewards or compensation in the form of tourism for relax. The company will be responsible for the costs of organizing the tour for employees who succeed in achieving their goals (Chumnanchar, 2020). However, while incentive travel contributes to income growth within the MICE industry in Phitsanulok Province,

but organizing an incentive travel requires a lot of resources and energy, such as diesel fuel for travel. Electrical power for various hotel facilities as well as Liquefied Petroleum Gas (LPG) for cooking, etc. It is crucial to acknowledge its potential negative environmental impacts, including waste generation and water and air pollution. Therefore, this study aims to establish sustainable management practices for incentive travel under MICE industry in Phitsanulok, particularly by promoting the adoption of low carbon tourism. To achieve this, the study conducts the environmental impact assessment method known as Life Cycle Assessment (LCA), which is widely accepted and utilized in the tourism sector (International Organization for Standardization, 2006). The results of life cycle assessment (LCA) are used to develop recommendations for incentive travel in Phitsanulok Province. Following the guidelines for low carbon tourism. Entrepreneurs in all sectors related to the tourism business of Phitsanulok Province able to learn the managing tourism process to have the least impact on the environment. In addition, policy decision-makers can review the results and formulate policies to support low-carbon tourism projects within the MICE sector. The ultimate result of this research is to reduce global warming potential of incentive travel in Phitsanulok Province in order to develop into low-carbon tourism in the future.

Research Objective

To assessed the life cycle of global warming potential in incentive travel under MICE industry of Phitsanulok Province

To proposed a low-carbon approach for incentive travel of Phitsanulok Province

Research Scope

The population and sample of this research is the MICE industry of Thailand that is supported by Thailand Convention and Exhibition Bureau (TCEB), which consists of Meeting, Incentive, Convention, and Exhibition. In this research will study specifically in the group of incentive travel of Phitsanulok Province. That is the route name "Phitsanulok: Slow Life Imjai Mueang Song Khwae"

Review of Literature

MICE industry

MICE refers to a category of tourism that encompasses four different elements: Meetings, Incentives, Conventions, and Exhibitions. In Thailand, the MICE industry holds great importance as it generates a substantial amount of revenue, totaling 28,400 million baht for the country. For the successful implementation of MICE, it relies on both natural resources and man-made infrastructure, including lodging, conference centers, and other logistical facilities. To meet the demands of MICE, there is a need for cooperation between governmental organizations and private companies in coordinating diverse events (Suthira, 2015). The definitions of each element in MICE (Nisarut, 2016) are as follows:

1. Meeting (M) involves organizing meetings within or between organizations, such as study visits involving individuals from the same or different organizations. These meetings can be unique and pre-planned, such as association meetings, corporate meetings, or government meetings.
2. Incentive (I) refers to providing group travel experiences to employees who achieve the company's objectives. The company offering the incentive is responsible for all associated expenses.
3. Convention (C) refers to organizing professional conferences. The primary objective of these events is to provide education to the attendees. A majority of these events are arranged by international associations. They can be organized on a rotational basis among member countries or through an auction process to determine the host for events like professional organization meetings within a particular country.
4. Exhibition (E) refers to the arrangement of industry-specific trade shows that cater to various target groups. These trade shows can either focus on business-to-business (B2B) interactions, where participants engage in business-related activities, or they can be open to the general public (Business to Consumer, B2C) allowing consumers to participate. These exhibitions facilitate interactions between

entrepreneurs, consumers, and businesses, fostering mutually beneficial relationships.

Phitsanulok Province as a MICE City

In 2018, Thailand's tourism industry achieved a remarkable revenue of 3.08 trillion baht, securing the country's position as the fourth highest globally. The northern region, characterized by its abundant cultural and natural treasures, boasts diverse ethnicities and hosts captivating world heritage sites blending history and ecology, consistently attracting tourists (Northern Development Plan, 2020). Notably, Phitsanulok Province stands out as a key destination, evident in the significant tourist interest and visitation. Statistics from January to July 2020 reveal a total of 1,047,142 visitors, comprising 1,002,329 Thai tourists and 44,813 foreign tourists. The province's appeal is further underscored by the MICE industry's noteworthy contribution, generating an income of 19.78 million baht in 2021 (Phitsanulok Ministry of Tourism & Sports, 2020).

With the Thailand Convention and Exhibition Bureau (TCEB) implementing a MICE City Review/Audit project, Phitsanulok Province secured certification as a MICE City on December 3, 2020, meeting criteria in all eight areas. This strategic move aims not only to bolster the MICE industry but also to generate and equitably distribute income, invigorate the provincial economy, and align with broader regional development strategies (Phitsanulok Provincial Community Development Office, 2020). Consequently, Phitsanulok emerges as the latest province to receive support from the TCEB. As the region gains this newfound identity, it becomes important to delve into the concept of low carbon tourism, a promising and highly favored form of travel (United Nations Environment Programme, 2004). The findings of this study can serve as invaluable information for stakeholders within the exhibition industry, aiding in informed policymaking. Clear and comprehensive guidelines for sustainable environmental management should be established in adherence to the regulations governing exhibition cities, ensuring a seamless transition into a future of eco-friendly and responsible tourism practices.

Incentive Travel of Phitsanulok Province

Incentive travel, a crucial component of the MICE (Meetings, Incentives, Conferences, and Exhibitions) industry, serves as a tool for businesses and organizations to recognize and reward exceptional employee performance and contributions towards organizational objectives. The selection of incentive travelers is based on their outstanding skills and accomplishments, contributing to the cultivation of positive relationships within these entities. Beyond standard travel arrangements, incentive travel offers an elevated experience, providing exclusive accommodations, meals, transportation, and hospitality, along with tailored privileges for specific groups. This personalized approach aims to create a unique and prestigious experience, fostering enthusiasm, acknowledgment, and gratitude among recipients (Thaksina, 2017). Those who have experienced incentive travel are individuals recognized for their outstanding abilities, making them suitable candidates for this special form of recognition. The programs, including exclusive accommodations, food, travel, and hospitality, along with additional privileges for specific groups, distinguish incentive travel from ordinary tours, creating an impressive and distinctive journey (Nisachon, 2015).

The popularity of incentive travel continues to grow, serving as a productive business that contributes to the economic prosperity of high-value countries. Consequently, both public and private institutions have shown a keen interest in and commitment to this evolving business model. Additionally, incentive travel is a highly regarded form of MICE in Phitsanulok Province, evident from the selection of the MICE route named "Phitsanulok: Slow Life Imjai Mueang Song Khwae" as one of the top 10 creative MICE routes among the 95 routes available across all 10 MICE Cities (Thailand Convention and Exhibition Bureau, 2021).

Low-carbon Tourism

Low-carbon tourism is an important way for the tourism industry to achieve the United Nations Sustainable Development Goals (Rui, 2023). Also known as eco-tourism and sustainable tourism, low-carbon tourism involves minimizing the carbon footprint and environmental impact associated with travel and tourism activities (Unruan, 2017). The objective is to promote socially, economically, and environmentally sustainable tourism by implementing practices and strategies that reduce greenhouse gas emissions, preserve natural resources, and safeguard cultural and natural heritage in destinations. Key principles and strategies of low-carbon

tourism include reducing carbon footprints, promoting sustainable transportation, implementing energy and resource efficient measures in tourism facilities, conserving, and protecting natural and cultural heritage, engaging with local communities for mutual benefits, and raising education and awareness (Nicomsom, 2016).

Low-carbon tourism in Thailand yields sustainable benefits across the economic, socio cultural, and environmental dimensions. By encouraging longer stays among tourists, it reduces travel frequency and allows more spending at attractions, fostering income distribution to local communities. Socially and culturally, it promotes knowledge exchange and experiences among tourists and between tourists and locals, thereby fostering positive relationships. Environmentally, low-carbon tourism involves activities that mitigate carbon emissions, contributing to the overall environmental well-being of tourist destinations (Monrat, 2021).

Furthermore, with the active promotion of tourism by the Thai government, aligned with the ambitious goal of achieving the country's carbon neutrality by 2050 and fulfilling its Nationally Determined Contributions (NDCs) (Green Network, 2021), there is an imperative for the tourism sector in Thailand to meticulously identify processes that contribute significantly to the carbon footprint. The strategic reduction of these impacts is crucial for an effective transition towards low-carbon practices.

Life Cycle Assessment: LCA

Life cycle assessment (LCA) is a tool to quantify environmental impacts over the life cycle of product or service, from raw material acquisition, manufacturing, and use to end-of-life phase. (International Organization for Standardization, 2006). LCA consists of 4 main steps, which are 1) Goal and scope definition – a step to clearly define aims and scope of the study, including system boundary and functional unit, 2) Life cycle inventory analysis (LCI) – a step to collect, examine and analyze inventories related to the study, e.g., quantity of energy consumed, traveling distance and quantity of waste generated, 3) Life cycle impact assessment (LCIA) – a step to evaluate environmental impacts, e.g., global warming potential, based on the inventories, and 4) Interpretation and improvement – a step to provide recommendations on environmental performance improvement of the product or service based on the LCA results.

LCA stands as the unparalleled tool for quantitatively evaluating the carbon footprint within the context of low-carbon tourism. Its unique strength lies in its comprehensive approach, systematically considering the entire life cycle of a product, process, or service. Unlike other tools, LCA offers a holistic view by considering the entire life cycle of a product or service. This comprehensive approach makes it the most suitable tool for evaluating the environmental impacts of tourism activities (United Nations Environment Programme, 2004). LCA enables a precise measurement of carbon footprint, offering a nuanced understanding of the environmental effects associated with various tourism components, such as transportation and accommodation. Its applicability empowers decision-makers to make well-informed choices and implement effective strategies for promoting sustainability in the tourism industry (Lu, 2022).

Sustainable tourism should be promoted as a new system for sustainable resource management, requiring tools that can assess impacts related to this sector. To achieve the international goal of carbon neutrality by 2050, results from the research "Tourism under a life cycle thinking approach: A review of perspectives and new challenges for the tourism sector in the last decades" can identify It can be said that LCA is considered a widely used tool today (77 studies from a total of 83) (Cristina Campos, 2022).

Conceptual Framework

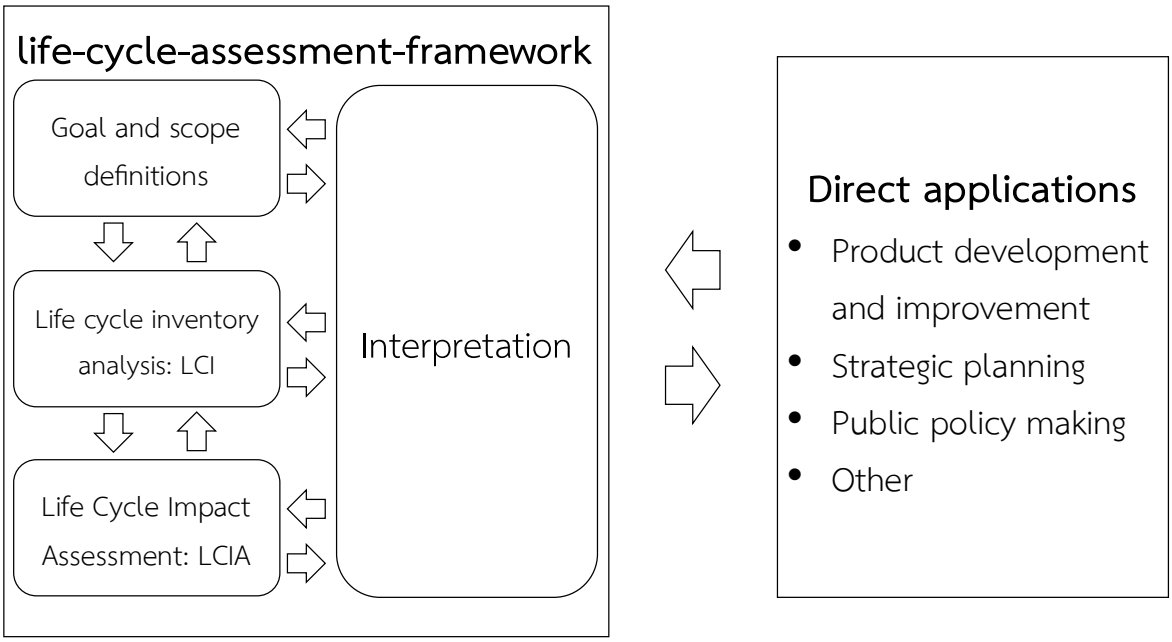

Figure 1 Conceptual Framework

Research Methodology

This study researcher collected data from Thailand Convention and Exhibition Bureau (TCEB) and two hotel operators in Phitsanulok Province. The main objective of this analysis on incentive travel is to assess the amount of energy consumed during the various activities of the trip and determine the resulting contribution to global warming. The study focuses on three specific energy sources: electricity, LPG, and diesel. The research methodology follows four main steps used in Life Cycle Assessment (LCA).

1. Goal and scope definition

The aim of this LCA is to evaluate the energy consumption associated with various stages of incentive travel. By choosing to consider organizing an event related to incentive travel held in Phitsanulok Province from December 3, 2020 which is the day Phitsanulok Province It has been designated as a MICE city by TCEB until December 3, 2022 as a case study.

The functional unit for this study is defined as one traveler participating in the incentive travel on the specified route in Phitsanulok for a duration of two days and one night. Incentive travel consists of 2 activities are transportation and accommodation.

In terms of *transportation*; two fully occupied diesel vans were used to transport a total of 20 participants during the incentive travel program. The program consisted of 9 trips spread over a span of two days. On the first day, the transportation itinerary includes transfers from the airport to Wat Phra Si Rattana Mahathat Woramahawihan, then to Wat Nang Phaya Buranathai Buddha Casting Foundry (Cha Thavi), Ban Mung Tourism Community, and finally returning to the hotel accommodation in Mueang District, Phitsanulok Province. On the second day, the journey began at the Nan River, followed by a visit to Ban Tao Hai, Rainforest Farm, and conclude with transportation to Phitsanulok Airport.

In terms of *accommodation*, this study refers to 2 individuals in deluxe room with double beds. The assessment of global warming potential contribution from lodging focused on the electricity consumption of various electrical appliances available in the room, such as air condition, light bulbs, lamps, hair dryer, water heater, kettle, refrigerator, and television.

Inputs for incentive travel include diesel fuel used in vehicles, electric power, and cooking gas (LPG). Outputs include the potential for global warming from the production of electric power and diesel fuel. and LPG cooking gas.

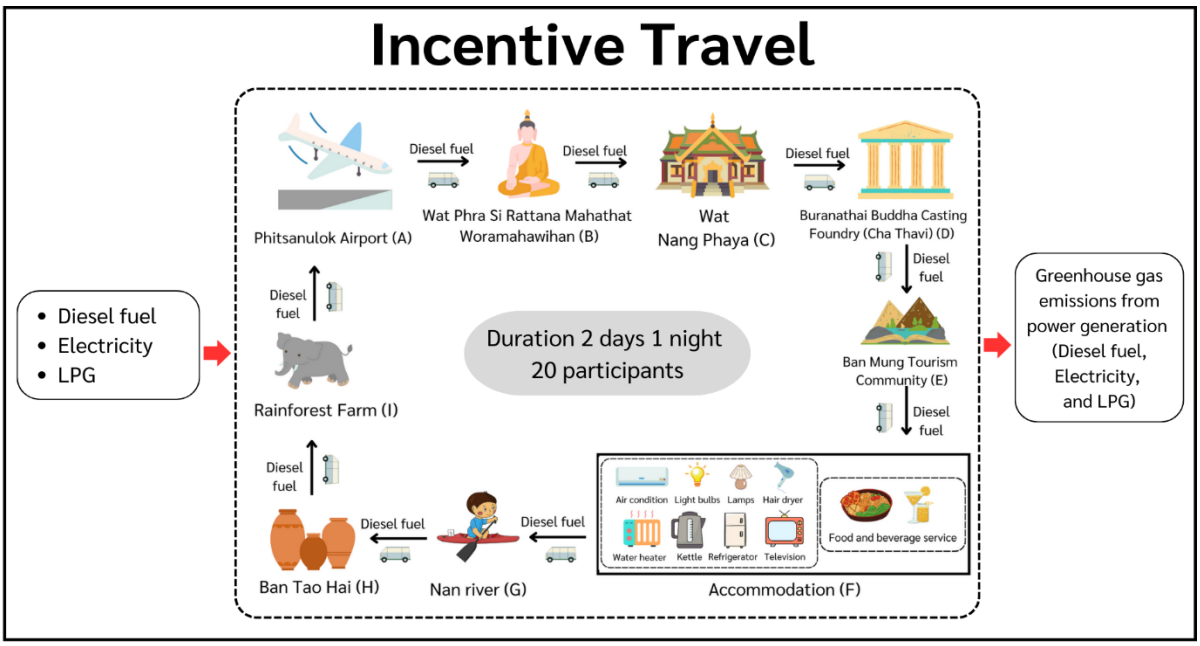

Figure 2 System boundary of the incentive travel along the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" route.

2. Life cycle inventory analysis: LCI

The data and information required for conducting the Life Cycle Assessment (LCA) in this study encompassed various inventories associated with transportation along the incentive travel route in Phitsanulok. Lodging arrangements for one night in a deluxe room and catering services provided during the stay of 20 travelers. These inventories, which were collected for the LCI analysis of the incentive travel and relevant conversion factors, are detailed in Table 1.

Table 1 Inventories of the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" incentive travel route

Activities	Details	Quantity	Energy consumption (MJ/person)	References
Transportation (Diesel)	Capacity = 10 individuals/van Speed of 80 km/hour Fuel efficiency = 7 km/L Conversion factor = 36.42 MJ/L			(Faculty of Fine and Applied Art, Prince of Songkla University, 2015) (Thailand Greenhouse Gas Management Organization, 2022)
	Routes: (*Referring to Figure 2*)			
	Destination A to B	1.1714 L	0.3210	
	Destination B to C	0.0186 L	0.0051	
	Destination C to D	0.4714 L	0.1292	
	Destination D to E	11.1429 L	3.0538	
	Destination E to F	12 L	3.2887	Assumption based on google map
	Destination F to G	0.8857 L	0.2427	
	Destination G to H	0.7857 L	0.2153	
	Destination H to I	7.4286 L	2.0359	
	Destination I to A	7.1429 L	1.9576	

Activities	Details	Quantity	Energy consumption (MJ/person)	References
Lodging (Electricity)	2 individuals/room Conversion factor = 3.6 MJ/kWh			(Thailand Greenhouse Gas Management Organization, 2022)
	Air condition 18000 BTU, 1 unit (17 hours)	24.48 kWh	44.064	Primary data
	Light bulb LED 14W, 4 units	0.448 kWh	0.8064	Primary data
	LED 18W, 2 units	0.288 kWh	0.5184	Primary data
	LED 3W, 1 unit (8 hours)	0.024 kWh	0.0432	Primary data
	Lamps LED 3W = 2 units (8 hours)	0.048 kWh	0.0864	Primary data
	Hair dryer 1200W = 1 unit (1 hour)	0.024 kWh	0.0432	Primary data
	Water heater 6000W = 1 unit (1.2 hours)	7.2 kWh	12.96	(Metropolitan Waterworks Authority, 2020)
	Kettle 2000W = 1 unit (0.17 hour)	0.204 kWh	0.3672	Primary data
	Refrigerator 42W = 1 unit (17 hours)	0.714 kWh	1.2852	Primary data

Activities	Details	Quantity	Energy consumption (MJ/person)	References
	Television 62W = 1 unit (8 hours)	0.496 kWh	0.8928	Primary data
Catering (LPG)	20 individuals/meal 4 meals/the incentive travel program Prepare food in sets for 6-7 people, 3 sets (1 set has 9 menus) Cooking duration 30 minutes/1 menu LPG consumption rate = 0.4 kg/hour (0.1 kg/meal)	7.2 kg	0.309	(Energy Policy and Planning Office (EPPO), 2013) Calculation
	Conversion factor = 49.2963 MJ/kg			(Thailand Greenhouse Gas Management Organization, 2022)

3. Life Cycle Impact Assessment: LCIA

Global warming potential was the environmental impact focused on this study. This impact was assessed by considering the energy consumption associated with activities related to the incentive travel, as well as the quantity of greenhouse gases emitted from energy sources such as diesel, electricity, and LPG. The calculation of the impact took into account emission factors specific to each type of energy. The emission factors relevant to these three energy sources are listed in Table 2.

Table 2 Emission factors of energy used in the incentive travel (Thailand Greenhouse Gas Management Organization (Public Organization), 2021)

Resource	emission factor	Database
Diesel	2.7406 kg CO_2e/L	IPCC Vol.2 table 3.2.1, 3.2.2, DEDE (With TGO electricity 2016-2018)
Electricity	0.5986 kg CO_2e/kWh	Thai National LCI Database, TIIS-MTEC-NSTDA (With TGO electricity 2016-2018)
LPG	0.8582 kg CO_2e/kg	Thai National LCI Database, TIIS-MTEC-NSTDA (with TGO electricity 2016-2018)

4. Interpretation of the results for improvement

Based on the LCA results of the incentive travel, the researchers conducted additional investigations to explore opportunities for enhancing the performance in terms of global warming potential. The aim was to identify strategies for reducing global warming potential with the activities analyzed in this study.

Research results

From the inventory analyses of the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" incentive travel route (Table 1), it was found that the total energy consumption was 228.31 MJ per person. Transportation was highest of energy consumption, accounting for a total of 149.49 MJ per person. Second was lodging arrangements for a one-night stay in a deluxe room contributed 61.07 MJ per person, representing 26.75% of the total energy consumption. While catering services was lowest, representing 26.5% of the total energy consumption. This study provides detailed breakdown of energy consumption for each activity along the incentive travel as illustrated in Figure 3.

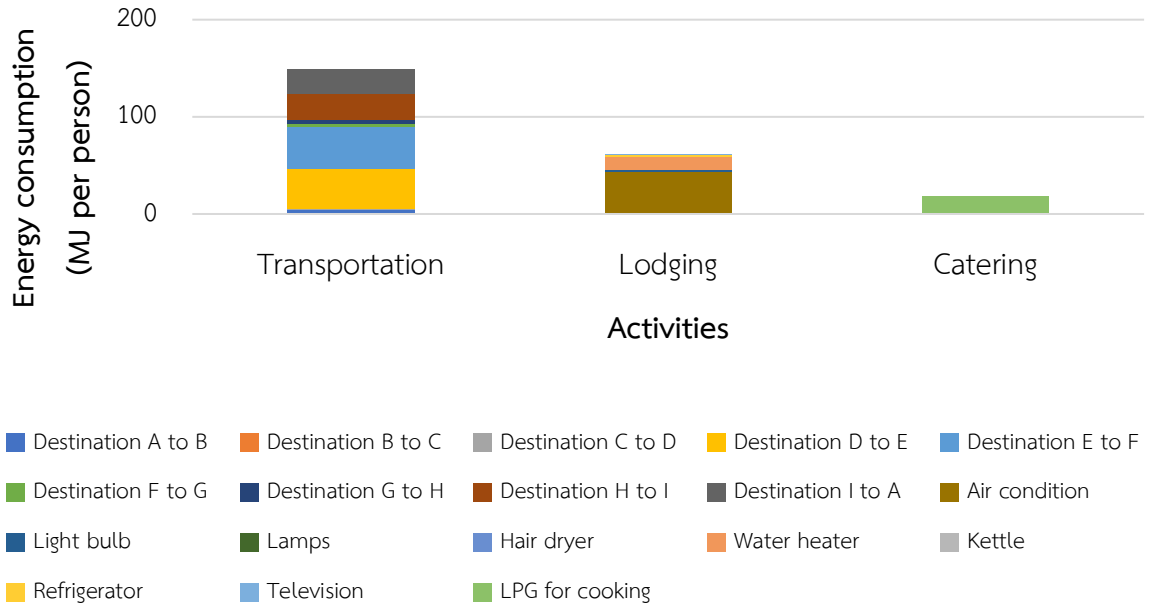

Figure 3 Energy consumption for Inventories of the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" incentive travel route.

The global warming potential (GWP) of the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" incentive travel route in this study contributes 21.71 kg CO_2e per person. This assessment is based on the energy consumption associated with activities related to the incentive travel. An examination of the global warming potential emitted by each energy source reveals, that diesel has the highest contribution to the global warming potential, with a contribution of 11.25 kg CO_2e per person. Additionally, electricity accounts for 10.15 kg CO_2e per person, while LPG accounts for 0.31 kg CO_2e per person. A detailed breakdown of the global warming potential results for this incentive travel route, categorized by type of energy and activities, is presented in Figure 4.

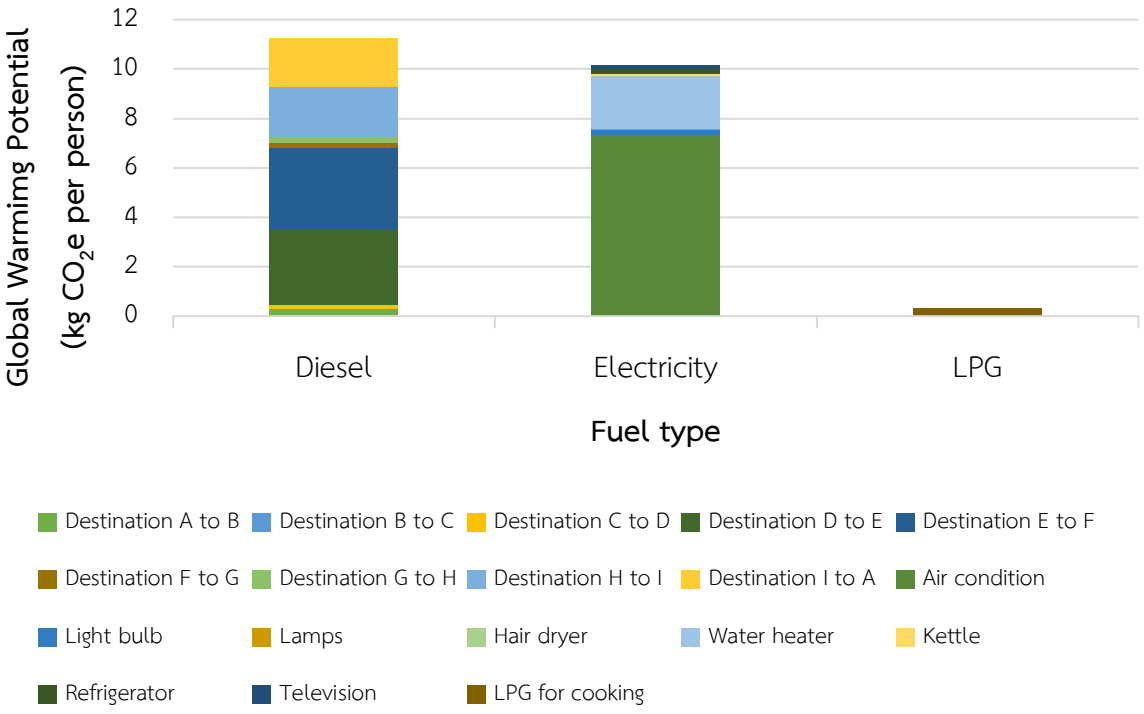

Figure 4 The global warming potential for inventories of the "Phitsanulok: Slow Life Imjai Mueang Song Khwae" incentive travel route.

Discussion

From the analysis of energy use and the global warming potential of incentive travel: a case of Phitsanulok Province. In this study, we investigated the global warming potential of travel and accommodation activities based on their energy consumption. Research has found that the total global warming potential contributed from the incentive travel is 21.71 kg CO_2e per person. Traveling is considered the activity with the greatest global warming potential contributing 11.25 kg CO_2e per person, which accounts for 51.81% of the total global warming potential of incentive travel route. Because the activities carried out in various destinations require travel, the global warming potential is mainly generated from diesel fuel combustion. This finding aligns with the study “Carbon Footprint Analysis of Tourism Life Cycle: The Case of Guilin from 2011 to 2022,” which indicates that travel constitutes the largest portion of

carbon dioxide emissions, accounting for 75% of the tourism industry's total *(*Rui, 2023*)*. Particularly, in our study, carbon dioxide emissions from travel activities accounted for 51.81% of the total emissions within the tourism industry in Phitsanulok, making it the primary source of carbon dioxide emissions. Similarly, the research on the "Carbon Footprint Evaluation of the Business Event Sector in Japan" also highlights travel as a significant contributor to greenhouse gas emissions in business activities *(*Yusuke, 2020*)*.

Conclusion and Recommendations

The significant energy consumption of transportation in our study are largely attributed to the extensive distance covered by the incentive travel route. While the necessity of traveling to multiple destinations promotes income distribution, there is an opportunity to reduce the global warming potential by strategically rearranging destination sequences in a single direction, thereby improving logistics efficiency. By adjusting the route of this tour, it will be possible to reduce the distance from the original 287.33 km to 240.63 km. By changing the hotel's location to be in an area close to the next day's tourist attractions, such as choosing accommodations in the area of Sappraiwan Subdistrict, Wang Thong District, Phitsanulok Province. By changing the location and format of water activities to water rafting activities on the Khek River, which is considered a famous water activity in Wang Thong District of Phitsanulok Province (Public Relations Office of Phitsanulok Province, 2023), tourists will possibly earn a more interesting experience. The modification can reduce the global warming potential of travel activities from 11.25 kg CO_2e per person to 9.42 kg CO_2e per person. It can reduce the global warming potential by as much as 35.57 kg CO_2e per event." Details of the newly modified route, in line with low-carbon tourism, are shown in Figure 5.

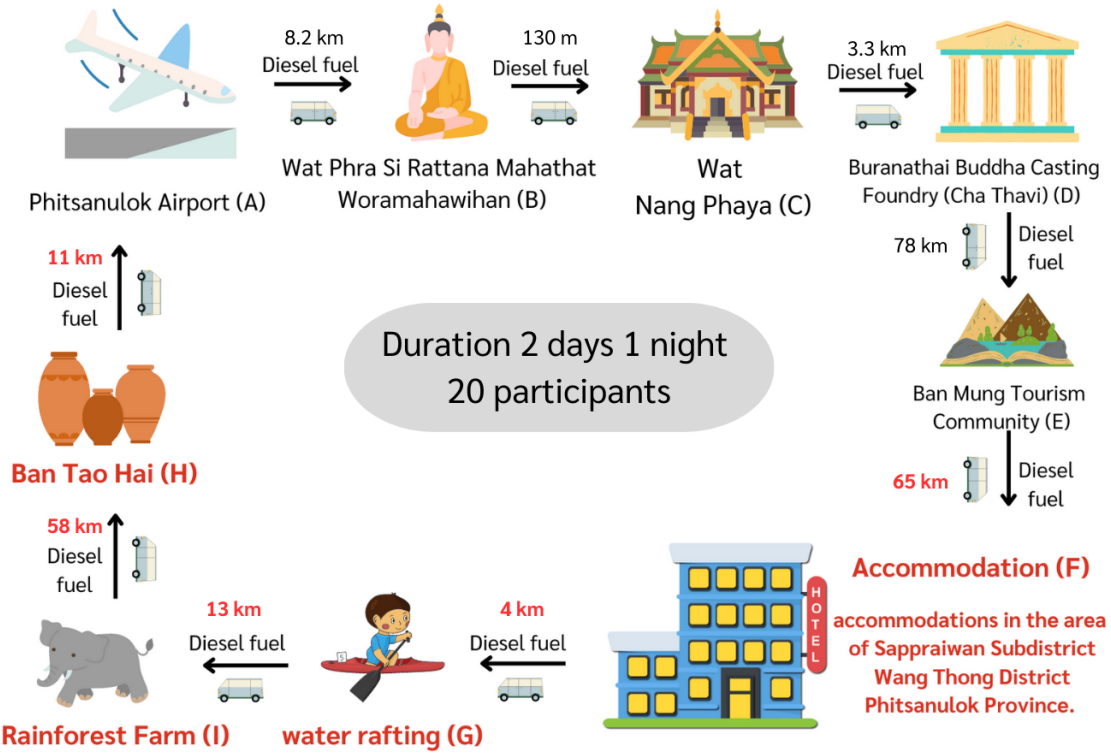

Figure 5 The newly modified route in line with low-carbon tourism

Life Cycle Assessment of Incentive Travel: a case of Phitsanulok Province, data collected and results obtained from this study, it can be used as a basis for evaluating the MICE industry in other areas or it can be applied to future studies related to the assessment of global warming potential. Both in the form of incentive travel and other formats not only in Phitsanulok Province, but also other provinces as well. In addition, the results of the study can be analyzed to support the preparation of specific policies that supports low carbon tourism. Such as developing tourism routes that reduce travel distances. Promotion of the use of renewable energy electricity by the government and improving access infrastructure for electric vehicles, etc. The study not only aims to promote sustainable practices within the tourism industry. But it also aims to cultivate other ways of operating. within the industry that takes into account the environment for sustainability and the positive impacts of low carbon tourism as well.

For future research, LCA should be conducted to cover all forms of activities in the MICE industry, including Meeting (M) Convention (C) and Exhibition (E). In addition, environmental impacts from wastes generated throughout the lifecycle of MICE industry should be conducted.

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