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The Assessment of Greenhouse Gases for Lerdsin Hospital

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Abstract

This research aimed to study an evaluation of greenhouse gases (GHG) emissions from activities of Lerdsin Hospital. The emissions were evaluated by calculating the carbon footprint as kilogram carbon dioxide equivalent ($kgCO_2e$). The GHG emissions were divided into 3 categories based on activities of the hospital as follows: Scope 1 was comprised direct GHG emissions from sources that were owned or controlled by hospital such as stationary combustion, mobile combustion, refrigerants, CH_4 emission from septic tank & wastewater and LPG consumption. Scope 2 was composed of indirect GHG emissions from purchased electricity by hospital. Scope 3 was consisted of all other indirect emissions e.g., water supply, amount of paper used and municipal solid waste. The results of GHG emissions were evaluated using Thailand Greenhouse Gas Management Organization (TGO) from January to December 2023. It was revealed that the total GHG emission was 7,060,841 $kgCO_2e$. Scope 1 had GHG emissions of 288,956 $kgCO_2e$ (providing to 4.09%). The use of electricity (Emission Scope 2) contributed most greenhouse gas emission which emitted 5,691,900 $kgCO_2e$ (accounting of 80.61%). Finally, the GHG emissions from Scope 3 were the second rank with the value of 1,079,984 $kgCO_2e$ which shared 15.3% of the total emission. The present result was in agreement with GHG emissions and share (%) in 2021 and 2022.

Keywords: Greenhouse Gases; Carbon Footprint for Organization; Global Warming; Climate Change

1. Introduction

Nowadays, all sectors in Thailand are beginning to realize more problems caused by greenhouse gases. One of the important organizations is the Thailand Greenhouse Gas Management Organization (Public Organization: TGO), which is an agency that supports assessment of greenhouse gas emission reduction and its impacts. Promote and develop potential as well as providing advice to government agencies and the private sector on greenhouse gas management. Including having a nationally recognized and reliable database for assessing greenhouse gas emissions in various industrial groups [1].

Climate change is posing threats to human health, for instance, through increased mortality in extreme weather events or by decreasing agricultural yields and rising sea levels, endangering human livelihoods. However, in the climate change discourse, health and the health sector have more nuanced roles than that. The health sector, including all organizations, institutions and resources devoted to producing health actions, will not only be impacted by climate change, but will also be key in adapting to climate change and to motivate climate-

friendly behaviors. At the same time, the health sector is also a relevant contributor to rising levels of GHG emissions and thereby to climate change [2].

According to the Kyoto Protocol, the six greenhouse gases (GHG) are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6). Emissions of these six gases are taken into account for the calculation of the carbon footprint indicator of products, which counts the total emission of GHG in CO_2 equivalents (CO_2e). Such emissions may be caused directly or indirectly by persons, organizations, events or products [3].

Greenhouse gases (GHG) emissions can be calculated by using the life cycle assessment (LCA), which is the international standard ISO 14040, 14044, used for the assessment of environmental impact throughout the life cycle. It can be calculated from the formula: CO_2 equivalent of each process = Amount of activity x CO_2 emission intensity. Total amount of every type of greenhouse gas from all activities, which were converted into units of carbon dioxide equivalents by multiply total emissions of each type of greenhouse gas with its global warming potential (GWP), is the Carbon Footprint of the organization [4].

This research aims to study an evaluation of GHG emissions from activities of Lerdsin Hospital. The emissions were evaluated by calculating the carbon footprint as kilogram carbon dioxide equivalent ($kgCO_2e$). The emissions of GHG were divided into 3 categories based on activities of the hospital as follows: 1) Direct GHG emissions and removals from the hospital's activities (Scope 1), 2) Indirect GHG emissions from imported energy of the hospital (Scope 2), and 3) Indirect GHG emissions from other sources (Scope 3).

2. Materials and Methods

2.1. Setting Organization Boundaries

Lerdsin Hospital, 190 Si Lom, Silom, Bang Rak, Bangkok 10500, consists of three buildings as follows: Kanrnchanapisek building, Promoting Services building, and Supporting Services building.

2.2. Setting Operational Boundaries

The GHG protocol was a well-established and widely used standard for GHG emissions reporting in many sectors, including the health sector. The GHG protocol distinguished three Scopes as follows:

- Scope 1 was comprised direct GHG emissions from sources that were owned or controlled by hospital such as stationary combustion, mobile combustion, refrigerants, CH_4 emission from septic tank & wastewater and LPG consumption.
- Scope 2 was composed of indirect GHG emissions from purchased electricity by hospital.
- Scope 3 was consisted of all other indirect emissions e.g., water supply, amount of paper used and municipal solid waste.

2.3. Data Inventory

The data were the collected relevant documents of both primary data (municipal solid waste occurred) and secondary data (electricity and water supply, quantity and quality of the wastewater, stationary combustion, mobile combustion and paper consumption).

2.4. Calculation of GHG Emission

GHGs can be calculated by multiplying with the emission factor, which is commonly used internationally, and in accordance with the guidelines of the Intergovernmental Panel on Climate Change (IPCC) or from a national database of each country, and so on. The example of emission factors that are used in the study are shown in Table 1. Therefore, the amount of GHG emissions from Lerdsin Hospital was calculated by Equation (1).

$$\text{GHG emissions} = \text{Activity data} \times \text{Emission factor} \quad (1)$$

Where GHG emissions = amount of greenhouse gases ($kgCO_2e$)
Activity data = Activity data (value in liter/kg/kWh/m^3)
Emission factor = greenhouse gas emission coefficient ($kgCO_2e$/unit of activity data)

Table 1. GHG sources and emission factor [5].

GHG Sources	**Unit**	**Emission Factor ($kgCO_2e$)**
Stationary Combustion		
-Diesel Oil of Generator & Fire Pump	liter	2.7078
Mobile Combustion		
-Diesel Oil	liter	2.7406
Refrigerants (R-32)	kg	677
CH_4 emission from septic tank	$kgCH_4$	-
CH_4 emission from wastewater	$kgCH_4$	-
LPG consumption	kg	3.1134
Electricity consumption	kWh	0.4999
Water supply	m^3	0.7948
Amount of paper used	kg	2.1639
Municipal solid waste		
-Landfill	kg	0.7933
-Incineration	kg	2.3200
-Organic waste	kg	2.5300

3. Results and Discussion

Resource consumption and waste generated by Lerdsin hospital in the year 2021-2023 and the emission factors were used to calculate the amount of each greenhouse gas sources are

presented in Table 2. Scope 1, Direct GHG emissions from hospital's activities were generated by stationary combustion, mobile combustion, refrigerants, CH_4 emission from septic tank & wastewater and LPG consumption. Scope 2, Indirect GHG emissions which arose from energy imports and the purchase of electricity. Scope 3 was consisted of the water supply, amount of paper used and municipal solid waste were calculated for indirect GHG emissions.

The movement of Lerdsin hospital's activities in 2023 was the main emission source category (5,691,900 $kgCO_2e$ of electricity), followed by the municipal solid waste with 821,205 $kgCO_2e$. Amount of paper used, water supply and CH_4 emission from wastewater were 130,066 $kgCO_2e$, 128,714 $kgCO_2e$ and 121,539 $kgCO_2e$, respectively. Next LPG consumption, CH_4 emission from septic tank, mobile combustion and stationary combustion were 74,123 $kgCO_2e$, 46,399 $kgCO_2e$, 44,317 $kgCO_2e$ and 2,578 $kgCO_2e$, respectively, while the share of refrigerants was limited to 0 $kgCO_2e$. As a consequence, it was consistently with GHG emissions in 2021 and 2022.

Table 2. The amount of GHG emissions that result from the activities of Lerdsin Hospital.

GHG Sources	GHG emissions ($kgCO_2e$)		
	2021	2022	2023
Scope 1			
Stationary Combustion	2,315	2,315	2,578
Mobile Combustion	56,220	41,573	44,317
Refrigerants	0	0	0
CH_4 emission from septic tank	44,415	45,932	46,399
CH_4 emission from wastewater	110,760	120,191	121,539
LPG consumption	69,939	65,755	74,123
Scope 2			
Electricity consumption	4,658,635	5,082,483	5,691,900
Scope 3			
Water Supply	124,036	125,907	128,714
Amount of paper used	134,099	130,233	130,066
Municipal solid waste	767,433	712,556	821,205

The Scope 1, 2 and 3 of GHG emissions and share (%) in 2021-2023 as shown in Table 3. The results of GHG emissions were evaluated using Thailand Greenhouse Gas Management Organization (TGO) from January to December 2023. It was revealed that the total GHG emission was 7,060,841 $kgCO_2e$. Scope 1 had GHG emissions of 288,956 $kgCO_2e$ (providing to 4.09%). The use of electricity (Emission Scope 2) contributed most greenhouse gas emission which emitted 5,691,900 $kgCO_2e$ (accounting of 80.61%). Finally, the GHG emissions from Scope 3 were the second rank with the value of 1,079,984 $kgCO_2e$ which shared 15.3% of the total emission. The present result was in agreement with GHG emissions and share (%) in 2021 and 2022 were seen in Fig. 1.

Table 3. Scope 1, 2 and 3 of GHG emissions and share (%) in 2021-2023.

Category	GHG emissions ($kgCO_2e$)					
	2021	Share (%)	2022	Share (%)	2023	Share (%)
Scope 1	283,650	4.75	275,765	4.36	288,956	4.09
Scope 2	4,658,635	78.06	5,082,483	80.33	5,691,900	80.61
Scope 3	1,025,568	17.18	968,696	15.31	1,079,984	15.30
Total	5,967,852	100.0	6,326,944	100.0	7,060,841	100.0

When compared to GHG emissions estimated using life cycle assessment principles. It was found that the values differ due to the limitations of the data in different parts, including the differences in the included sectors, completeness of information and data collection period.

It was found that the values of GHG emissions by both calculation methods were different due to the limitations of data in several parts. If more data of GHG emissions in other sectors had been added besides fuel combustion, i.e., evacuation fire drill, using of N_2O anesthesia and CO_2 for Laparoscopic Surgery to be more consistent will make the study results come out similar

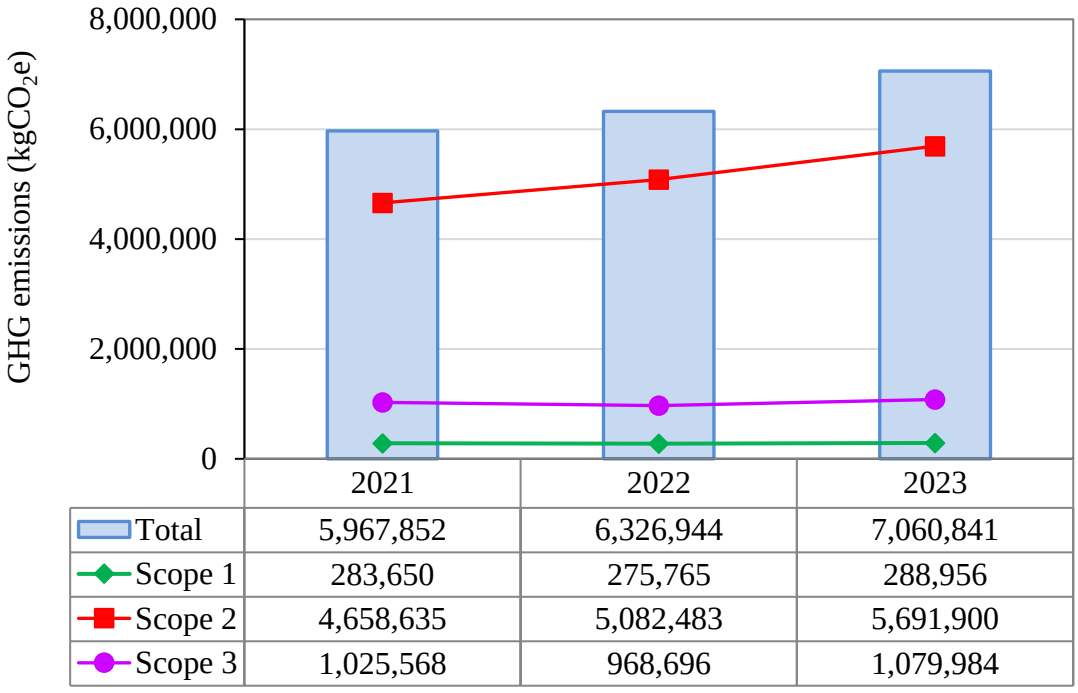

Fig. 1 Scope 1, 2 and 3 of GHG emissions and share (%) in 2021-2023.

The total of the GHG emissions 2021 to 2023 were 5,967,852 $kgCO_2e$, 6,326,944 $kgCO_2e$ and 7,060,841 $kgCO_2e$, respectively. It was revealed that significantly increased because Supporting Services building at Lerdsin Hospital was firstly opened in 2023.

The source of GHG emissions that had the highest emissions is electricity consumption, followed by the municipal solid waste. The source with the minimal release was refrigerants. Lerdsin Hospital, 190 Si Lom, Silom, Bang Rak, Bangkok 10500, consists of three buildings as follows: Kanrnchanapisek building, Promoting Services building, and Supporting Services building.

It is a medical organization that has consumption of electricity, water supply, and waste from patient and medical staff, which have activities related to healthcare institution providing patient treatment the area of the hospital. The best-known type of hospital is the general hospital, which typically has an emergency department to treat urgent health problems ranging from fire and accident victims to a sudden illness. Moreover, the best-known type of hospital is the general hospital, which typically has an emergency department to treat urgent health problems ranging from fire and accident victims to a sudden illness that causes the amount of greenhouse gases from waste to increase as well.

4. Conclusions

The GHG emissions were divided into 3 categories based on activities of the Lerdsin hospital as follows: Scope 1 was comprised direct GHG emissions from sources that were owned or controlled by hospital such as stationary combustion, mobile combustion, refrigerants, CH_4 emission from septic tank & wastewater and LPG consumption. Scope 2 was composed of indirect GHG emissions from purchased electricity by hospital. Scope 3 was consisted of all other indirect emissions e.g., water supply, amount of paper used and municipal solid waste. The results of GHG emissions were evaluated using Thailand Greenhouse Gas Management Organization (TGO) from January to December 2023. It was revealed that the total GHG emission was 7,060,841 $kgCO_2e$. Scope 1 had GHG emissions of 288,956 $kgCO_2e$ (providing to 4.09%). The use of electricity (Emission Scope 2) contributed most greenhouse gas emission which emitted 5,691,900 $kgCO_2e$ (accounting of 80.61%). Finally, the GHG emissions from Scope 3 were the second rank with the value of 1,079,984 $kgCO_2e$ which shared 15.3% of the total emission. The present result was in agreement with GHG emissions and share (%) in 2021 and 2022.

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