

Carbon Footprint Assessment and Actions to Promote Green University of Rajabhat Universities in Southern Thailand

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Abstract

This research aims to assess the carbon footprint of the organization and to study the action to promote the green university of Rajabhat Universities in Southern Thailand. Data was collected from the greenhouse gas (GHG) emission and absorption activities of the operations of the five Rajabhat Universities, namely, Surat Thani Rajabhat University, Phuket Rajabhat University, Nakhon Si Thammarat Rajabhat University, Songkhla Rajabhat University, and Yala Rajabhat University. The average results of the carbon footprint assessment of Southern Rajabhat Universities found that the amount of GHG emissions from Scope 2 was the highest, accounting for 88.70%, followed by Scope 1 and Scope 3, accounting for 7.99% and 3.31%, respectively. In addition, the results study of the implementation of green university promotion found that Southern Rajabhat Universities had included such operations in the university's master plan. The effectiveness of quantitative and qualitative operations is consistent with participation in the World Green University Ranking.

Keywords: Carbon Footprint, Organizational Footprint, Green University, Rajabhat University

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1. Introduction

It is estimated that by 2050, climate change could cause global economic losses of at least 10%. The current world value, the major contributing factor to climate change is greenhouse gases (GHG) [1]. Thus, the global community has come together to find ways and build cooperation to reduce GHG emissions and mitigate the impact of climate change. UNFCCC [2] was formed and the solution appear concrete in the Kyoto Protocol when member countries had commitments to reduce GHG emissions [3]. At the same time, to achieve such concepts, the SDGs have been set. Goal 13 is taking urgent action to combat climate change and its impacts by emphasizing policies and supporting mechanisms for coping with and adapting to climate change. This includes integrating climate change measures into national policies. Thailand has given importance to such issue. This can be seen from the inclusion of the aforementioned issue into the 20-year National Strategic Plan and the 12th National Economic, and Social Development Plan, and transmission of such plans to the provincial level. Public and private organizations in Thailand are also in the process of preparing a draft Climate Change Act to support the assessment of GHG emissions. GHG reduc-

tion and reporting can be encouraged by measuring, reporting, and verifying standards in line with international obligations [4]. Educational institutions contribute to GHG emissions from activities such as paper consumption, electricity consumption, water consumption, use of air conditioning, and traveling inside the university. As reported, the greenhouse gas emissions in the Faculty of Engineering, Kasetsart University [5], College of Energy and Environment, Phayao University [6], Department of Environmental Engineering, Chulalongkorn University [7], Faculty of Environment and Resource Studies, Mahidol University [8], and University of the Thai Chamber of Commerce [9] were equal to 3,627.53 tonCO₂e, 76.62 tonCO₂e, 138.6 tonCO₂e, 1,091.85 tonCO₂e, and 24,252.17 tonCO₂e, respectively. Valuing educational institutions as a contributor to environmental impact [10], while being a visionary and knowledgeable organization with capable role and power in reducing potential impacts on the environment to achieve sustainable development, a policy is recognized as one of the biggest social challenges of the 21st century [11]. Therefore, the source of carbon footprint assessment and action studies to promote a green university is necessary. Consequently, the aims of this study were to assess the carbon footprint and to study the operation to promote the green university status of Rajabhat Universities in Southern Thailand.

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In addition to knowing the amount of GHG emissions, it can also be used for environmental management planning and creating a policy to reduce GHG emissions, promoting the green university status of Rajabhat Universities in Southern Thailand. Furthermore, the carbon footprint can be used as information for communication and creating an atmosphere of environmental conservation. Encourage students and staff to have a sense of social and environmental responsibility as one of the organizations in the country that promote a green university. Create a low-carbon society according to national plans and policies.

2. Materials and Methods

2.1 Carbon Footprint Assessment

The organization's carbon footprint assessment has based on the methodology of Thailand Greenhouse Gas Management Organization (Public Organization) as in Figure 1 [12]. Collected data from the activities that emit and absorb GHG from the operations of the 5 Rajabhat Universities in Southern Thailand, namely, Surat Thani Rajabhat University, Phuket Rajabhat University, Nakhon Si Thammarat Rajabhat University, Songkhla Rajabhat University, and Yala Rajabhat University in the fiscal year 2020 from October 2019 to September 2020. The greenhouse gas emissions are divided to 3 categories: scope 1 direct emissions and absorption of greenhouse gases by the organization, consisting of traveling inside and outside the university by corporate vehicles, and the use of refrigerant in air conditioners within the organization (R-22); scope 2 indirect emission and absorption of greenhouse gases from energy consumption, e.g., the electricity consumption purchased from outside; and scope 3 emission and absorption of greenhouse gases includes all other indirect emissions that occur in a university's value chain, e.g., using tap water and using white A4 paper 80 gsm. The tool used for assessing the carbon footprint of the university is the "Carbon Footprint Assessment Data Collection Form", consisting of part 1 general information, i.e., area size, number of students, and number of personnel; Part 2 information, i.e., the number of activities that take place in 3 scopes of GHG emission activities, that is, traveling inside and outside the university-by-university vehicle, use of air conditioner refrigerant R-22, use of electricity purchased from outside, use of water supply, and use of paper; Part 3 activities to promote a green university, including various policies that promote a green university. The details of GHG emission and absorption sources used in this study to calculate the carbon footprint of the organization are shown in Table 1.

2.2 Actions to Promote a Green University

The purposive sampling in conjunction with Snowball Sampling was used to selected those who were



Figure 1: Carbon Footprint Assessment Process

assigned to take any action to promote the green university status in each 5 Southern Rajabhat Universities. The research tool was a "semi-structured questionnaire", constructed to collect data that can be used to analyze the current state of the organization from university policies. Questions for the interview were divided into 2 parts. Part 1: the implementation from past to present according to the components of being a green university was divided into 6 subcategories according to the criteria and indicators for the assessment of the UI Green Metric Guidelines 2020, consisting of setting and infrastructure, energy and climate change, waste, water, transportation, and education [13]. Part 2 included problems and obstacles from the implementation to reduce the number of greenhouse gases and success factors. The information obtained from the interviews is presented in a "contextual" manner, showing the current state of affairs regarding the factors involved in the implementation of green university promotion.

3. Result and Discussion

3.1 Carbon Footprint Assessment

The amount of greenhouse gas emissions of Rajabhat Universities in Southern Thailand compared according to population proportion found that Phuket Rajabhat University had the highest GHG emission rate per person, equal to 266.56 kgCO₂e/person/year, followed by Nakhon Si Thammarat Rajabhat University, Surat Thani Rajabhat University, Songkhla Rajabhat University, and Yala Rajabhat University, equal to 262.21, 236.32, 200.50 and 187.68 kgCO₂e/person/year, respectively. Yala Rajabhat University uses groundwater, while Nakhon Si Thammarat Rajabhat University uses natural water from the mountains, which does not have a meter showing the amount of water used each month. Therefore, there is no result for calculating the amount of GHG emissions from water supply activities, classified as scope 2 GHG emissions. Surat Thani Rajabhat University does not use R-22 refrigerant because it has switched to Split scope air conditioners to save energy in air conditioning systems. Therefore, there is no calculation of GHG emissions from refrigerant of R-22 air

Table 1. Source of emission and absorption of greenhouse gases and greenhouse gas emissions for the carbon footprint assessment of Rajabhat Universities in Southern Thailand.

| Scope | Activity | Unit | EF (kgCO ₂ e/unit) | Reference |
|---------|---|---|-------------------------------|-----------|
| Scope 1 | Traveling inside and outside the campus by corporate vehicle. | Diesel | liter | 2.7403 |
| | | Gasoline | liter | 2.2373 |
| | Use of refrigerants in air conditioners within the organization | Electricity from the Provincial Electricity Authority Refrigerant | kWh | 0.4999 |
| Scope 2 | Use of electrical energy purchased from outside | R-22 (HCFC-22) | kg | 1,760 |
| | Use of tap water | Tap water from the Provincial Waterworks Authority | m ³ | 0.2843 |
| Scope 3 | Use of paper | White A4 paper 80 gsm | kg | 2.1020 |
| | | | | |

conditioners within the organization, classified as a GHG emission source from activity scope 1. As the Carbon Footprint of Southern Rajabhat Universities, the amount of GHG emissions from Scope 2 was the highest, accounting for 88.70%, followed by Scope 1 and 3, accounting for 7.99% and 3.31%, respectively as shown in Table 2.

From Table 2, the results of data analysis to compare the difference in the amount of greenhouse gas emissions per year (kgCO₂e/year) classified by Universities with ANOVA statistics showed that GHG emissions per year (kgCO₂e/year) of all 5 Southern Rajabhat Universities were not significantly different as shown in Table 3.

Electrification is the activity that produces the most amount of greenhouse gas emissions. Consistent with the previous research reports on the carbon footprint assessment of educational institutions both in the country and abroad [14-20]. The use of electricity contributes to the highest carbon footprint, as every university uses electricity for teaching and administration. In addition, the increasing number of buildings in universities results in facilities that require more electricity, such as air conditioners and light bulbs, as well as changes in learning styles to use electrical devices, e.g., notebooks and tablets. The results of this research study provide information that GHG inventories will help university administrators to assess and formulate strategies for reducing GHG emissions, particularly in the electricity sector, such as converting electrical equipment to greener products and energy management according to ISO 50001.

3.2 Actions to Promote a Green University

Rajabhat Universities in Southern Thailand has a common characteristic, namely, the implementation of the Master Plan of the University, which is related to the 20-year National Strategy (2018-2037), National

Economic and Social Development Plan The 20-Year Long-Term Higher Education Plan (2018-2037), and 20-Year Strategy of Rajabhat University (2017-2036). The Strategy of Rajabhat University consists of 4 strategic issues: local development, teacher Production and Development, enhancing the quality of education, and management system development. Strategy 4 Management System Development has two goals: Rajabhat University must be recognized nationally and internationally as a local educational institution that strengthens the country, and Rajabhat University must have an efficient and flexible administrative system. Focus on building good governance readiness and ability to adapt effectively and efficiently to the status of an autonomous university, the development of such a management system resulted in the determination of issues "Developing the university to be a green university or taking action to promote the green university" is in the master plan of each university. Each Southern Rajabhat University has undertaken quantitative and qualitative aspects of the projects and activities that promote the green university status at all levels, both at the policy level and in practice by setting indicators, in line with its participation in the UI Green Metric World University ranking and participation in the Times Higher Education Impact ranking, which assesses universities against the United Nations Sustainable Development Goals (SDGs). Evidence that clearly shows the achievement of the operation can be seen from the performance reports according to the government action plans of each university. An important factor contributing to success is the importance of administrators who include the green university in the university's master plan and transform that into a concrete practice with details of how to do so and assigning any person or organization to take action to achieve the set goals. There is empirical evidence of success that can be monitored and tracked. The re-

Table 2. Comparison of greenhouse gas emissions of Rajabhat Universities in Southern Thailand

| Rajabhat University | Amount of GHG (kgCO ₂ e) | Population | GHG Emission Percentage | | | Emission Amount (kgCO ₂ e/person/year) |
|---------------------|--|------------|----------------------------|---------|---------|--|
| | | | (kgCO ₂ e/year) | | | |
| | | | Scope 1 | Scope 2 | Scope 3 | |
| Yala | 1,726,268.54 | 9,198 | 9.33 | 84.72 | 5.95 | 187.68 |
| Songkhla | 2,409,463.79 | 12,017 | 12.91 | 82.93 | 4.16 | 200.50 |
| Phuket | 2,380,104.79 | 8,929 | 4.08 | 93.98 | 1.94 | 266.56 |
| Nakhon Si Thammarat | 2,466,089.86 | 9,197 | 10.74 | 88.64 | 0.62 | 262.21 |
| Surat Thani | 3,193,408.78 | 13,513 | 2.87 | 93.25 | 3.89 | 236.32 |
| Average | 2,435,067.15 | 10,571 | 7.99 | 88.70 | 3.31 | 230.65 |

F-Test = 0.061, p = 0.992

Table 3. Comparison of greenhouse gas emissions per year (kgCO₂eq/year) classified by Rajabhat Universities in Southern Thailand

| Variance Source | df | SS | MS | F | p |
|------------------|-----------|--------------------------|------------------|-------|-------|
| Between Groups | 4 | 360705432974.93 | 90176358243.73 | 0.061 | 0.992 |
| Within the Group | 10 | 14786789016787.60 | 1478678901678.76 | | |
| SUM | 14 | 15147494449762.50 | | | |

F-Test = 0.061, p = 0.992

sults of the study of the implementation to promote the green university based on the requirements of UI Green Metric World University revealed that: 1) Setting and infrastructure are taken into consideration in increasing green areas. The guidelines for developing or increasing green areas are following the geographical location of each university. The similar activity that has been carried out continuously is having students and staff participate in planting forests and plant species in the forest or garden area of the university. If there is no forest area in the university, it is encouraged to create a garden or arrange a shady garden. There is a budget allocated for the establishment of infrastructure systems to promote a green university, including the projects or activities with the name directly or indirectly specified the implementation of the green university. For example, projects or activities that develop and improve the environment, landscape, traffic system, safety, energy, waste management, annual maintenance of water supply systems or air conditioning, etc. 2) Energy and Climate Change: Traditional equipment are replaced by energy-saving devices. It was found that every university has changed to use LED energy-saving light bulbs. Moreover, there is an effort to choose other energy-saving devices to replace traditional devices, especially inverter air conditioners. For the use of solar energy, it was found that every university had installed solar panels on the cover way. However, the unique characteristics of each place affected the suitability of installing the panels. Even though solar cells are unable to fully operate, efforts have been made to adopt such alternative energy. Air conditioner and solar cell are evidence that all of them work together with external agencies, both in the public and private sectors. There are many scopes of operations such as cooperation and knowledge support through mentoring or lecturers, survey and audit to plan for energy management in the university, electrical equipment or the budget to support the operation or instal-

lation of equipment, as well as the electrical appliance maintenance which is considered as another way to reduce energy consumption or saving electricity expenses of the university. The maintenance of electrical equipment has been included in the university's operational plan every year. 3) Waste: There is an administration to encourage students and staff to access and participate in waste management and waste separation easily and conveniently. Implementation of the 3R principle is promoted to reduce waste to zero. Announcements have been made by the university about measures to reduce and stop using plastic, foam, and paper, and campaigns have been carried out in many channels by continuously publicizing through various forms of media. Additionally, the university may request cooperation from shops within the university to refrain from using plastic or foam; encourage the organization of meetings and communication via online platform; use the e-Document system to send and receive documents; and promote the reuse of one-side used paper. In terms of waste management, organic waste should be recycled. Scraps of leaves, twigs, and grass, including waste from the cafeteria, can be decomposed into fertilizer. 4) Water: Traditional devices are being replaced by water-saving and environmentally friendly devices such as water-saving toilets and faucets. Awareness of water-saving and recognition of water value is created and promoted through various channels, e.g., putting up signs and stickers. Conventional water conservation and storage practices are implemented, for example, in some buildings, there are water tanks in the same way as household water tanks. Water conservation and storage are implemented according to the specific characteristics of each area, such as digging ponds, dredging reservoirs, and getting rid of water hyacinths, as well as exploring water resources and investing in utilization of natural water sources, e.g., water from waterfalls, water treatment to the quality close to tap water, and water storage in

concrete reservoirs in case of water supply problems. 5) Transportation: Most of the personnel and students of the Southern Rajabhat Universities travel from their residences to the university by private vehicles that use gasoline and diesel fuel. Traffic within the university is divided into 2 scopes according to the condition of the shuttle bus within the university. For university that has enough buses to shuttle students and personnel, most students and staff choose to use the university's free shuttle service, mostly electric cars. But in the case of a university that does not have a shuttle service, students generally choose to walk because every university provides covered walkways in case of short distance. As for personnel, they often use motorcycles to commute to receive and deliver documents within the university. 6) Education: Teaching and learning are organized under the name of the curriculum on the environment and set-up courses with details related to "energy conservation and the environment" included in the general education subjects that require all students to enroll. Regarding research funding, there is no specific grant for green university-related research, which is consistent with the small number of green university-related research outputs. In addition, every Southern Rajabhat Universities have established a student club related to natural resources and environmental conservation.

The research result revealed that a key factor contributing to the success of the green university promotion operation was the importance of administrators. It can be seen from the consideration to include a green university in the university's master plan and transform that plan into official action with details of implementation and the commitment of any person or unit to have a duty to achieve the clearly defined goals. Empirical evidence of success should be traced and tracked. According to the findings of Isiaka Adeyemi Abdul-Azeez et al. (2015) [21] who studied the realization of low-carbon emissions in universities for energy sustainability, a case study of Universiti Teknologi Malaysia (UTM), it is found that achieving a low carbon and sustainable university requires sustainable energy planning as well as other relevant factors, i.e., research analysis, planning, and determining policy outcomes, in particular, policy emphasis in the form of statements, strategies and plans to direct that plans or policies of such universities. In addition, the findings from the research in terms of quantity and quality of projects and activities showed that each Southern Rajabhat University has undertaken to promote a green university. This is consistent and in the same direction as participating in The UI Green Metric World University ranking and the Times Higher Education Impact ranking, which assesses the university against SDGs. If a university has participated in that ranking, it needs to follow the indicators to meet the specified criteria, which cover all factors that affect GHG reduction in both abstract terms, e.g., education

and awareness creation, as well as concrete aspects, e.g., planting trees and creating a Cover Way. This corresponds to the research results of Emad Mush-taha, et al. (2022) [22], studying the management of the infrastructure system of the University of Shar-jah, United Arab Emirates Toward a sustainable and liveable campus. The university has participated in the UI Green Metric World University Rankings since 2017 and in the last three years, it has succeeded in being among the best 150 universities in the Setting and Infrastructure category. The Sustainability Office of the university has used the results from the assessment to analyze the indicators and propose an action plan for continuous improvement. Two KPIs that can be improved: sustainability efforts and the total area covered in plants. Moreover, the research result is aligned with the results of the research of Okan Pala (2021) [23], who studied the innovative approach to sustainability, a case study of the University of Ozyegin, Turkey. The criteria and conditions of SDGs were studied and linked to the situation and context of the University of Ozyegin to develop and organize the university's structure towards sustainability. The approach that the university has taken is the establishment of Sustainability Clusters, which are structures that are unique and appropriate to the context of the university. That will be the starting point for the development of the university towards sustainability and the establishment of sustainability platform. Both of which are created by dedicated personnel to coordinate and carry out work on sustainable university development and academic efforts in promoting research and teaching, multidisciplinary, including creating co-operation and creating engagement with various departments, professors, staff, and students within the university as well as government and private agencies both nationally and internationally. The research also indicated that SDGs are productive tools. There is a clear description of criteria and conditions that the university can use for self-assessment to improve its performance toward becoming a sustainable university.

4. Conclusions

Based on the study, electrification is the major factor of university activities that emits greenhouse gases. If electricity is sustainably managed, it can significantly reduce overall greenhouse gas emissions and save university money for electricity fares. Regarding the past results of promoting the green university of Southern Rajabhat Universities and collecting data according to the indicator framework of the UI Green Metric World University in all six aspects, universities can use such data to verify the completeness of performance in each area or issues that is needed for improvement. Consequently, the university is ready to become a green university or join the UI Green Metric World University Ranking and to show the green uni-

versity identity and create a good image for the university in another way.

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