# CHAPTER I
# INTRODUCTION

## 1.1 General introduction

Global warming is the serious environmental problem facing the world over the last century. It causes by anthropogenic greenhouse gases (GHG) emissions that have been increasing rapidly in many parts of the world. They are mainly caused by burning of fossil fuels for electricity, heat, or transportation. The most abundant greenhouse gas is carbon dioxide, which is primarily released from burning fossil fuels and waste, or in chemical reactions used in industrial processes. Levels of $CO_2$ in the atmosphere are already 30% higher than those in pre-industrial times. This has led to an increase in global temperatures of 0.6°C. An increase of between 1.4°C and 5.8°C is expected by 2100. Global warming will also lead to changes in rainfall patterns, storminess and sea level rise. Issues of global warming and greenhouse gas emissions are increasingly becoming one of the major technological as well as important societal and political challenges, thus it is the problem needed to be solved urgently. A carbon footprint for organization is a type of method to represent the amount of GHG emissions which generate from organization. Recent decades, it initiate by the Greenhouse Gas Protocol. It serves as the source of knowledge on corporate GHG accounting and reporting and contributions of organizations from around the world. Therefore, an academic institute, which is considered as one type of organizations, should plays attention on its carbon footprint because the amount of GHG emissions are attributed to many people spending their long time daily life and a variety of activities in the academic institute.

There have been many studies of a carbon footprint for universities. Most of the universities in USA that audit its carbon footprint are abided by "A Corporate Accounting and Reporting Standard", which is a document prepared by the Greenhouse Gas Protocol. This standard provides organizational and reporting guidelines for organizations wishing to report their carbon emissions. The University of Pennsylvania and Purdue University reported a carbon footprint of 1.9 tC per person and 2.1 tC per person, respectively. Another study focusing on individual department instead of the whole university campus is the department of Mechanical

Engineering of Michigan State. The total annual carbon footprint due to the sum of contributions from energy, transportation and material usage was equivalent to 557 ± 53 tC and 2.73 tC per person. Its carbon footprint per person appeared to be significantly higher because it were assessed for a single academic department, rather than the entire university.

As stated previously, the methodologies and ideas for accounting and reporting organization's emissions are adopted from the greenhouse gases protocol (2004), established by a partnership between the World Resources Institute (WRI), and the World Business Council for Sustainable Development (WBCSD). Other standards include the ISO 14064 Part 1 (2006) and the national standard for organization of Thailand by TGO. It is a calculation of carbon dioxide emissions, which is generated by the staff members from all activities occurring in the organization for determination the status of carbon footprint at that time. This assists in generating strategies to reduce the GHG emissions.

The aim of this research was to evaluate the carbon footprint of the academic organization. It was then used as a key factor to develop alternative options for minimization of the environmental impacts from carbon dioxide emissions. This research was also intended to promote awareness of people in the organization about carbon dioxide emission.

**1.2 Objectives**

- To determine a carbon footprint of an academic organization using the Department of Environmental Engineering, Chulalongkorn University as a case study
- To identify sources of GHG emissions in the Department of Environmental Engineering, Chulalongkorn University
- To postulate possible options for minimization of the GHG emissions due to the activities occurring in the Department of Environmental Engineering, Chulalongkorn University

## 1.3 Hypotheses

- Carbon footprint can be used to assess environmental impacts due to greenhouse gas emissions from the Department of Environmental Engineering, Chulalongkorn University.
- Carbon footprint can be used as an indicator for development of an improvement plan for an academic organization to reduce its greenhouse gas emissions, which contribute to global warming.

## 1.4 Scopes of the study

- This study was intended to focus on a carbon footprint of the Department of Environmental Engineering, Chulalongkorn University.
- The methodology used was based on the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, which is prepared by the World Resources Institute (WRI) and the World Business Council for Sustainable development (WBCSD), and Thailand national standard for organization by TGO.
- GHG emission analysis was mainly measured from the following four categories:
    - Energy use, which included energy consumption by air-conditioning, lighting systems, and other electric appliances in buildings of the department.
    - Transportation, which included daily commuting and research travel by the faculty and staff members with the modes of ground transportation (roads) and airplanes.
    - Material use, which was focused only on consumable materials, i.e., paper and water use.
    - Waste, which was attributed to the consumption and generation of landfill waste, and the owned wastewater treatment operation of the department.
- Possible options for reducing energy consumption and greenhouse gas emissions were then proposed according to the resulting data of GHG evaluation.