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ScienceDirect

Energy Procedia 136 (2017) 438–443

Energy Procedia

www.elsevier.com/locate/procedia

4th International Conference on Energy and Environment Research, ICEER 2017, 17-20 July 2017, Porto, Portugal

CO_2 emission of tourist transportation in Suan Phueng Mountain, Thailand

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Abstract

Transportation represents the key contributor to greenhouse gas emissions, which are linked to global warming and climate change. The objective of this study was to estimate the amount of CO_2 emission from energy consumption by tourist transportation in Suan Phueng, Thailand. The methodology of a bottom up approach was observed by using questionnaire surveys. First, the questionnaire design can be validated by calculating the Item-Objective Congruence (IOC) index as 0.96, which was acceptable. Moreover, CO_2 emission from energy consumption by transportation was calculated following IPCC2006 guideline. Then, the 400 questionnaires were distributed to the tourists. The results estimated the average distances as 208.15 ± 139.38 km. Total energy consumption of gasoline and diesel in transportation were 4,810.85 and 8,640.91 liters. Car was the most popular vehicle for visiting this area about 78%, respectively. Total and mean CO_2 emissions in tourist transportation were 32,249.66 kg CO_2 eq and 21.20 kg CO_2 person^{-1}.

Peer-review under responsibility of the scientific committee of the 4th International Conference on Energy and Environment Research.

Keywords: CO_2 emission; tourist transportation; suan phueng mountain

1. Introduction

Global warming is often expressed as a significant change in average surface temperatures, resulting from

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1876-6102
Peer-review under responsibility of the scientific committee of the 4th International Conference on Energy and Environment Research.
10.1016/j.egypro.2017.10.300

changes in the planetary radiative balance, and determined by the concentration of greenhouse gases (GHG) in the atmosphere. Carbon dioxide (CO_2) is the most important greenhouse gas, accounting for 78% of the global anthropogenic emission (32.3 Gt) in 2011 [1]. In fact, recent data reveals that global CO_2 emissions were 150 times higher in 2011 (198 $MtCO_2$) than they were in 1850 (32,274 $MtCO_2$). Asia's gross domestic product became the largest in the world for 1994. Interestingly, though, Asia became the largest emitter of CO_2 due to rapid economic growth. In the past, the largest share of global emissions came from Europe and Northern America. But by the end of 2011, Asia dominated, contributing more than half of global CO_2 emissions, which are linked to global warming and climate change [1]. The GHG emission intensity per capita in Thailand for 2011 was the third GHG emission in Asia as highly emits about 103 tCO_2 eq/USD 100,000 [2]. The second Thailand's inventory in 2000 of anthropogenic GHG emission was about 229.08 $TgCO_{2eq}$. The energy sector is the largest contributor of greenhouse gas emissions equivalent to 159.39 $TgCO_{2eq}$, and share 69.6 percent of the total national emission. The energy consumption in transportation is the key major source of GHG emission in Thailand [3]. According to Energy Forecast and Information Technology Center, Energy Policy and Planning Office addressed the significant CO_2 emissions of 63.15 million tons generated by fuel consumption in which the transportation and traffic sector was responsible for the release of approximately 27% of GHG emissions from commercial energy consumption, such emissions area consequence of the driving force of transportation services in Thailand's economic and social development together with the continued growth of energy use in the sector [4]. Moreover to the a fore mentioned problems, Thailand continues to face the environmental impacts caused by the use of transportation fuels, especially GHG emissions and air pollutants, such as carbon monoxide (CO), hydrocarbon (HC), nitrogen oxide (NO_X), particulate matter (PM), sulfur dioxide (SO_2), etc. Such pollutants are proven to be directly harmful to human health and are considered as a major cause of the urban climate deterioration that is affecting people [5]. Beyond the health impact regarded as a direct effect, transportation related air pollution primarily causes greenhouse phenomena resulting from CO_2. The occurrence of such phenomena leads to changes in ecosystems, such as marine ecosystem transformation due to the increase in temperature that tremendously affect aquatic animal adaptations, thereby increasing the death rate. Hence, the scientist found the good practice for reducing impact of the environment from energy consumption in transportation sector.

The trends of tourism industries in Thailand were very fast increasing growth in the past decade. Estimates of tourism receipts directly contributing to the Thai GDP of 12 trillion baht range from 9 percent (1 trillion baht in 2013) to 17.7 percent (2.5 trillion baht) in 2015 [6]. The GHG emission of the tourism industry was produced from multiple perspectives, including transportation, sightseeing, accommodation and food, shopping, entertainment, post and telecommunication, etc. Meng et al. (2016) study the quantifying direct and indirect carbon dioxide emissions of the Chinese tourism industry. They found that carbon emissions were estimated to contribute 1.059% to the national CO_{2eq} in 2010. From a sector perspective, transportation accounted for two-thirds of the tourism carbon emissions, followed by accommodation and food services (12.45%) and shopping (12.10%). For urban area uses 84% of China's commercial energy. The 35 largest cities, containing 18% of the total population, contribute 40% of national energy uses and CO_2 emissions [7]. In 2009, the World Travel Tourism Council sets the goal of cutting the carbon emission of the tourism industry by 25-30% in 2020 and 50% in 2035 compared to the baseline of 2005 [8]. However, the energy consumption and CO_2 emission of the tourism industry in Thailand is very limited, because it is not separate energy consumption followed by the traditional part of the national economy account system. However, the CO_2 emission of the tourism activities in Thailand is sorely lacking available calculation, but it is very important for energy conservation and CO_2 emission reductions. Therefore, the purpose of this study is to propose a technique predicting the amount of CO_2 emissions by bottom up technique and GHG mitigation options of tourist transportation in Suan Phueng Mountain, Thailand.

2. Material and method

2.1. Questionnaire design

Questionnaire was used as the tools to collect data about CO_2 emission and reduction in tourist transportation in Suan Phueng, Thailand. To ensure the validity of the questionnaire by calculating the Item-Objective Congruence (IOC) index, the test was given to five experts to examine and rate each item so that the content met the objectives of