CHAPTER I
INTRODUCTION

Energy is an important factor in our daily lives, helping to improve the quality of life and playing a significant role in a country's economic development. In particular, energy demand in Thailand, being a developing country, has been increasing continuously. While the energy prices are constantly rising as well. Furthermore, Thailand has to face the environmental impacts caused by energy usage, particularly the impact on climate change resulting from global warming. Relevant international agreements have strict policies to reduce greenhouse gas emissions. There are driving factors for Thailand to push forward a low-carbon energy system. Thus, alternative and renewable energy need to be considered.

Biofuel is an alternative from other fossil fuels and it is obtained from living or biological material. Basically biofuel is produced by naturally grown plant matter which allows for a more sustainable and environmentally friendly. Biofuel can be derived into four generation, however, the significance generations are first and second generation biofuels. First generation or conventional biofuels are biofuels made from sugarcane, wheat, corn, beet, and vegetable oil. The important first generation biofuels are bioalcohol, biodiesel, biogas and vegetable oil. However, first generation biofuels production have made it clear that placing energy markets in competition with food markets results in higher food prices. Therefore, the second generation biofuels have been developed to solve this problem because they utilize lignocellulosic materials as the feedstocks which mostly come from agricultural waste such as forest residuals, straws and other agricultural by-products which are non-edible material.

Cassava rhizome is an attractive lignocellulosic material for bioethanol production. Production of cassava in Thailand is about 25.2 million tons per year which ranked 1st for cassava producer in South-East Asia and 3rd in the world. Furthermore, every kilogram of cassava is accompanied by production of 0.08-0.09 kg of the cassava rhizome, this gives an estimation of about 2.2-2.3 million tons of cassava rhizome produced per year and a large part of this is going as firewood and the rest as waste. Cassava rhizome has several characteristics that make it a potential

feedstock for fuel ethanol production. It has high cellulose and hemicelluloses content that can be readily hydrolyzed into fermentable sugars. In addition, cassava rhizome has high lignin content which is only flaw of ethanol production (Pattiya *et al*, 2007).

In order to evaluate the efficiency of biofuels in terms of energy and environmental aspect, life cycle assessment (LCA) has shown to be an effective tool to assess environmental impact of the bioethanol process. This assessment includes two main procedures. The first is a collection of the data which involves making detailed measurements during the manufacturing of the product, from farming of raw materials used in production and distribution, through its use, possible reuse or recycling and finally disposal. The second is characterization of the collected data into environmental impact categories and interpretation of the results which can help manufactures analyze their process and improve their products.

This work focuses on bioethanol production from potential lignocellulosic materials in Thailand. The purposes of this work consist of two main sections. Firstly, to design bioethanol conversion process derived from lignocellulosic materials in Thailand which cassava rhizome is selected as a raw material. Secondly, to improve the process to sustainable design based on life cycle assessment results by reducing cost of production, reducing waste, minimizing energy usage and reducing the environment impact from the process design.