CHAPTER I
INTRODUCTION

At present, the world is facing the increasing of carbon dioxide in the atmosphere which leads to the greenhouse effect and climate changes. This is a result of a significant increase in human population and unbalanced consumption of natural resources, especially fossil fuels. Concerns about natural resource depletion and environmental degradation have driven people and organization around the world to pay more attention to alternative energy research and development. As a consequence, biomass-based fuels have been proposed as an ecologically benign alternative to fossil fuels. The potential environmental benefits obtained from replacing fossil fuels with biomass-based fuels or biofuels derived from renewable sources are the main driving forces for promoting the usage of biomass to produce biofuels as well as biochemicals and biomaterials. Biomass refers to renewable carbon-based materials that are synthesized by plants through photosynthesis. This process can convert atmospheric carbon dioxide and water into sugar which is used by plants to synthesize complex materials with generic biomass. Currently, there are several technologies available for the conversion of various types of biomass into these valuable biomass-based products.

Biorefinery is the biomass conversion processes and equipment to convert biomass resources such as sugarcane, cassava, palm, and wood into the basic products such as flour, sugar, oil, and cellulose. These basic products can be converted into valuable products such as fuels, chemicals, materials and energy. This concept is similar to the current petroleum refinery which is a manufacturing plant of various fuels, chemicals, materials, and energy from petroleum (Cherubini, 2010; Cherubini *et al*., 2010). Biorefinery provides high cost products with low cost raw materials from potential use of resources and waste reduction (King *et al*., 2010). In addition, based on the carbon-neutral concept, biorefinery can help mitigate the global warming problem.

Thailand has great potential for biorefinery because of the abundance in biomass resources as feedstock for producing various bio-products. Currently, there are commercial production plants of both biofuels and biochemicals in Thailand and there have been discussions about the possibility of building the first biorefinery in the country. In the previous study, life cycle assessment (LCA) was used in the evaluation of energy consumption and environmental impacts associated with the production of biofuel and biopolymer from a possible biorefinery model in Thailand. Sugarcane and cassava were chosen as biomass feedstocks for producing bioethanol and polylactic acid (PLA) at different ratios. Furthermore, biomass residues such as cassava rhizome and cassava pulp which occur in large amounts have not been fully utilized yet in the study. Therefore, this research work further studied the biorefinery model with an attempt to produce biochemical feedstocks such as biosuccinic acid (BSA) and lactic acid (LA) for downstream polymer industry instead of biopolymer i.e. PLA and fully utilize biomass residues.

The study aims to use LCA to evaluate the biorefinery model that is designed to produce bioethanol, BSA and LA from sugarcane and cassava. Residues such as cassava rhizome and pulp are fully used to produce additional ethanol and biogas for energy or electricity generation. The scope of the research covers collecting inventory data (raw materials, chemicals, energy, utilities and emissions) for the production of bioethanol, BSA, and LA based on cradle-to-gate approach. The secondary data were collected from existing plants and literatures. Methodology used in the study follows ISO 14040 LCA framework. The inventory data were analyzed by using LCA software, SimaPro 7.1, with Eco-Indicator 95 and CML 2 baseline 2000 method to identify the environmental impacts in terms of global warming impact (GWP), acidification potential (AP), eutrophication potential (EP), and energy resources. The performance of the biorefinery model was evaluated in several aspects such as fuel and biochemical production, raw materials used, and total profit generated using scenario analysis. Finally, eco-efficiency parameters combining both economic and ecology aspects were used to find appropriate scenarios for potential application of biorefinery in Thailand.