PRELIMINARY STUDY OF PALM OIL BIODIESEL LIFE CYCLE COST ANALYSIS IN INDONESIA

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ABSTRACT

Recently, biodiesel have been gaining popularity and getting accepted as an alternative fuel for diesel engines. In the last few years, Indonesian government has a special interest in the development of this renewable energy, the use of which can help reduce oil imports. Biodiesel has a bright future in this country, as Indonesia is the world's largest producer of crude palm oil (CPO) — a desirable feedstock for biodiesel production. Biodiesel has the potential to become a significant industry sector in Indonesia. The use of biodiesel as a replacement for fossil-based diesel has a significant potential advantage to reduce dependency on conventional fuels. The limited current production of biodiesel is mostly due to the cost associated with the production. Hence, the cost performance of biodiesel needs to be improved to increase its competitiveness against fossil-based diesel. As a new renewable energy alternative, it is required to have an approach to compare biodiesel with the conventional one in economic terms. Life cycle cost analysis is the right tool, which also can help identify the key areas in biodiesel production cycle where changes are required to improve its cost performance. This study aims to assess the economics of biodiesel as an alternative transportation fuel for diesel vehicles in Indonesia based on life cycle approach. The scope of the study includes the palm cultivation/processing, the conversion to biodiesel, the distribution of the fuel, and all transportation activities taking place within the system boundary. This paper presents a preliminary model of Palm Oil Biodiesel Life Cycle Cost and the on-going activities to achieve the ultimate goals.

Keywords: Biodiesel, Palm Oil, Life cycle cost, Renewable energy, Energy alternative.

1. INTRODUCTION

The price of petroleum increases steeply in the last few years. This situation encourages Indonesian Government to take serious actions in preparing alternative energy for the future. That results in an initiative to gradually increase biofuels and biodiesel production. Replace fossil-based diesel (solar) with biodiesel is one of the final goals. Unquestionably, biodiesel is a promising choice to replace solar usage in Indonesia from both economic and environmental point of views. As has been known, the final price of solar is subsidized by Indonesian government. High solar consumption in Indonesia - about 35 billion liters every year – makes the economic stability of Indonesia worsen. Replacing subsidized solar with biodiesel will greatly reduce the dependency on unstable foreign sources of fuel based diesel. From environmental point of view, biodiesel emits less particulate pollution than traditional petroleum-based diesel fuels.

Since the initiative declared in 2006, Indonesian Government has set up National Standard for Biodiesel Quality and improved the national biodiesel blend from 5% to 10%. It is also expected that by year 2025, biofuels will have 5% share of national energy, along with the same share of other forms of new renewable energy (biomass, nuclear, water, sun and wind). Unfortunately, the plan to continuously increase biodiesel national production capacity doesn't seem to work that well. Biodiesel high production cost is suspected to be the main reason behind the abandoning of some biodiesel conversion plants. Clearly, economic viability of palm oil biodiesel needs to be revisited. To make biodiesel cost-competitive with diesel, areas where production cost can be reduced needs to be determined. This can be achieved by performing life cycle cost analysis.

Life Cycle Cost (LCC) analysis can help policy makers to assess whether palm-oil biodiesel is economically viable or not. Furthermore, it can help identify the key areas in biodiesel production cycle where changes are required to improve its overall cost performance and to increase the competitiveness of the final product.

2. BIODIESEL – ENERGY FOR THE FUTURE

Biodiesel is a common name of fuel produced from various feed-stocks (fats and oils), which consists of simple alkyl esters of fatty acids. Biodiesel – an inherently renewable energy source - possesses favorable characteristics which make it a good candidate as the energy for the future. First of all, it can be used by itself (B100) to replace diesel, so that there is no need to modify the diesel engine. It produces less hydrocarbons, carbon monoxide and particulate matter in the exhaust. Besides, it reduces emission of carbon dioxide up to 73%, reduce that of methane up to 51%, and reduce carbon monoxide emission by 48%. Its better lubrication property results in easier fuel injection component maintenance. Biodiesel does have a shortcoming: it has lower energy content than petroleum diesel.

Among all possible feedstock for biodiesel, palm oil is well-known as the highest oil yielding plant. The average yield is 3000-5000 kg palm oil per ha, compared to 400 kg/ha for soybean – the common biodiesel feed-stock in Europe. Additionally, palm oil can be harvested throughout the year.

The world biodiesel production is dominated by Europe with production level of 75 thousand barrels each day in 2006 (consist of 88% of total world production) (datacon, 2008). Germany by itself produced almost 50% of total world biodiesel production. Biodiesel production around the world is expected to increase at a compound growth rate of approximately 15.5 % between 2010 and 2013, according to a research report by market research and information analysis company RNCOS. It states that government incentives and a boom in the number of biodiesel plants in Asia (which include Thailand, Japan, India, China, Indonesia and Malaysia) will significantly contribute to the growth (Biofuels International news, March 17, 2011).

Commercially, biodiesel has been produced by several companies in Indonesia. PT Energy Alternative Indonesia is one the oldest biodiesel manufacturer in Indonesia and a partner in supporting Government program with renewable energy especially the Energy Self Sufficient Village projects. Big players of palm oil biodiesel in Indonesia include PT Wilmar Bioenergi Indonesia – a subsidiary of Wilmar International- the largest palm biodiesel manufacturer in the world with capacity of 350 thousand tons annually, PT Bakrie Sumatra Plantations Tbk. and the Indonesian Government three new plants co owned by PTPN III, IV and V with total capacity of 300 thousand tons bio fuel annually.

3. THE ECONOMIC ANALYSIS OF BIODIESEL

Regardless of the growing interest in biodiesel, rarely do we find research concerning its cost analysis. More researchers can be found concerning biofuels than those of biodiesel. Even though in general biodiesel is well accepted as a renewable energy, the high production cost remains a major barrier to its commercialization (Fan et al., 2010). Haas et al (2006) have developed a computer model to estimate the capital and operating costs of a moderately-sized industrial biodiesel production facility with annual production capacity of 10 million gallons. The major process operations in the plant were continuous-process crude degummed soybean oil trans esterification, and ester and glycerol recovery. The model was designed using contemporary process simulation software, and current reagent, equipment and supply costs, following current production practices. The result predicted a biodiesel production cost of US$0.53/l ($2.00/gal) with oil feedstock as the greatest contributor to this value (accounted for 88% of total estimated production costs). High cost of feedstock is also reported by Ho (2006). He suggested that rapeseed is indeed a relatively expensive crop to grow, requiring frequent rotation and extensive use of expensive fossil-fuel fertilizers, with major environmental concerns. The same thing for palm oil is suggested by USDA. They stated that palm oil is an extremely labor intensive and costly plantation crop to establish and manage.

Life cycle cost analysis for biofuels has been implemented by Nguyen et al. (2006). They concluded that LCC can provide important information to biofuels business players by enabling them comparing ethanol life cycle cost with one for conventional fuel. It also provides guidance in improving the production process by identifying key areas to increase biofuel productivity. A similar approach is performed by Sampattagul et al. (2007) for jatropha biodiesel.

4. PALM OIL BIODIESEL LIFE CYCLE COST – A WORK PLAN

Life cycle of palm oil biodiesel includes three main phases: palm tree cultivation, crude palm oil production and palm oil conversion to biodiesel as depicted in Figure 1. Accordingly, the LCC model is first broken down into three main phases: palm oil trees plantation, palm-oil milling, biodiesel conversion, and transportation activities. For each phase, the cost is further broken down into 5 main cost categories: Capital Cost, Operation Cost, Maintenance Cost, Externalities cost and Salvage Value, which are all converted to reflect their present value. As an example, the cost breakdown for the third phase is given in Figure 2. The maintenance cost which cover costs of material, equipment/tool and energy consumed, and labor costs, consists of preventive maintenance, scheduled maintenance, and breakdown maintenance for both machineries and the building. Externality cost, commonly referred as user cost, included in the cost framework to represent the environmental costs due to the production activities.

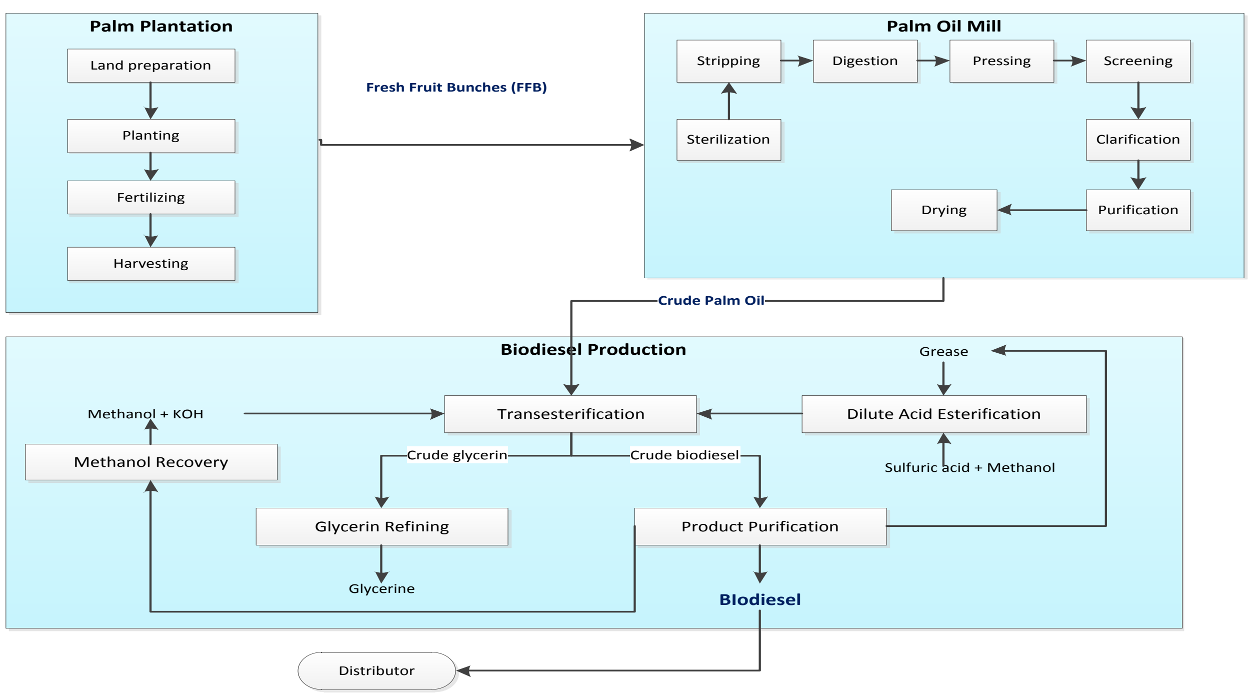

Figure 1. Palm Oil Biodiesel Life Cycle Boundary

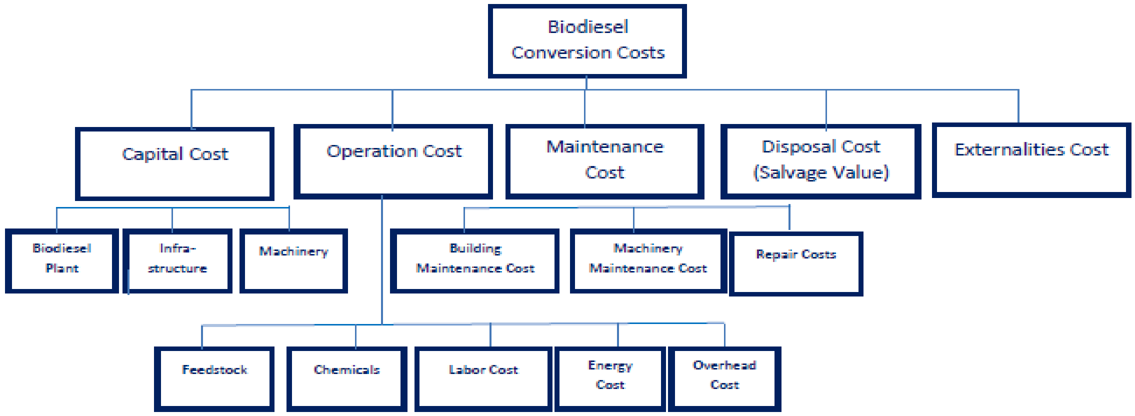

Figure 2. Cost Breakdown of the Final Phase

The LCC model will be developed using Excel with Visual basic features. Primary data to develop and verify the initial version are being sought from palm oil and biodiesel oil production facilities in Banten and Riau, Indonesia. The model is configured to be user friendly, which allow user to move between pages, to go back and forth to learn the overall process, to modify the default inputs as necessary or simply to learn the overall life cycle cost and its breakdown based on a set of inputs. Each sheet will be enriched with the information on assumptions used for each step of calculations, the formulas used, as well as a brief explanation of what the model is doing in that step.

The following parameters have to be determined prior to setting the default inputs:

(1). Palm oil yield over years during its life cycle.

(2). Capacity and economic life of palm oil milling facility.

(3). Capacity and economic life of biodiesel conversion facility.

(4). Distances and mode of transportation between palm oil plantations and milling facility.

(5). Distance and mode of transportation between milling and biodiesel conversion facilities.

(6). Transportation activities inside the milling and biodiesel conversion facilities.

It is important to note that there are two major transportation activities within the system boundary, i.e. transportation between palm plantation and palm oil milling, and between the milling facility and biodiesel conversion facility. The initial model will use the modes of transportation, the frequency of shipments between facilities and the distance between facilities provided by the case studies as the default values of the model.

Once the initial model is completed, it will be verified using the data collected from the production sites. The main concern in the verification step is to make sure that given the same input values as the current practice; the costs calculated by the software being developed are similar to the ones in real-life production activities. If the differences are significant, then explanations should be given or else the model has to be adjusted further. Verifications should be repeated until the accuracy of the model is acceptable. Team brainstorming will be conducted to decide the final model. As an example, the transportation cost from palm oil plantation to the milling facility for each ton FFB obtained from the model should be close to the real transportation cost as given in the survey report if one provides the same inputs to the model, i.e. total tonnage of FFB transport in a day, number of trucks used, capacity of each truck, diesel consumption of each truck, distance between the two points, etc.

4. CONCLUSION

Biodiesel is a promising renewable fuel for Indonesia. Palm oil is the most common feedstock and richly available in the country, but its economic viability for biodiesel production is in question. Life cycle cost can serve as an important tool for policy makers to assess whether an energy alternative like palm oil biodiesel is viable and practical in terms of cost.

A work plan for constructing palm oil biodiesel LCC model is presented in this paper. A computer model is currently under development and will be presented in the near future.

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