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The net cost of biofuels in Thailand—An economic analysis

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ABSTRACT

Biofuels are expected to represent a growing portion of liquid fuel consumption in Thailand due to environmental and social considerations in conjunction with policy goals supporting their domestic production and consumption. This paper reviews the economic costs associated with biofuel policy implementation in Thailand in the short term target year of 2011. Internal (production) and external (environmental, social, etc.) costs and benefits are evaluated, and, where possible, monetized. Domestic production of biofuel is calculated to be 9.5 billion THB (317 million USD) more expensive than importing the equivalent amount of petroleum. The environmental benefits from GHG savings as well as losses due to increased ground level ozone formation and government expenditure to support the biofuel industry yield a total "net cost" of 8.6 billion THB or 121 THB (4.04 USD) per capita for the year 2011. This result is contextualized with the (non-monetized) consideration that although biofuels are somewhat more expensive in the short term, their domestic production allows virtually all of the money to stay within the Thai economy as opposed to being sent abroad. This fact, coupled with significant uncertainty in future petroleum prices, could strongly influence the direction of Thai policy with respect to biofuels.

1. Introduction

Despite the global economic crisis of 2008, which has strongly depressed the gross domestic product (GDP) growth in Thailand and worldwide (FPO, 2008), Thailand's real annual GDP growth has, in past years, hovered around the 5% mark and is anticipated to rebound quickly with long term annual growth rates expected to be in the range of 4.5–6.0% (Gonsalves, 2006). This rapid GDP growth is reflected by drastic increases in energy use with growth in final energy consumption in Thailand during 2000–2008 at 4.1% (EPPO, 2009a). Oil consumption, a primary indicator of strong economic growth, has been increasing at a particularly high rate. From 2000 to 2008, for example, crude oil consumption has increased over 23% from 749,629 barrels per day to 925,432 barrels per day (EPPO, 2009b). At average oil prices of approximately 94 USD per barrel in the year 2008 (EPPO, 2009b), Thailand's 2008 net oil imports of 813,457 barrels per day would cost about 27.9 billion USD per year. At current prices, this equates to nearly 10% of the 2008 Thai GDP of 9.1 trillion THB or 300 billion USD and poses a major barrier to sustainable economic growth. Realizing their over-reliance on imported fuels, the Thai government has instituted a renewable energy policy centering on biofuel use and prioritized biofuel development as a matter of national interest. Thailand's current 15-year (2008–2022) alternative energy goals set production targets of bioethanol at 3.0, 6.2 and 9.0 ML/day and production targets of biodiesel at 3.0, 3.6 and 4.5 ML/day for short term (by 2011), medium term (by 2016) and long term (by 2022), respectively (DEDE, 2008a). However, a concern over the promotion of biofuels is that their production costs are generally higher than gasoline and diesel in either pure or blended form. Government incentive structures that have been put in place in order to meet short-term policy targets, such as mandatory blending for biodesiel and tax exemptions and subsidies for bioethanol, put the overall cost of the fuel substitution in question.

Nevertheless, the increased use of biofuel not only facilitates a reduction in fuel imports, but could also have an ameliorating affect on the environmental and societal costs of petroleum consumption—termed "externalities" in the economic literature (Sundqvist, 2004). The external effects of biofuels can be both environmental and non-environmental, and their externalities can be either positive (external benefits) or negative (external costs) (Soliño et al., 2009, Peters and Thielmann, 2008). For example, the potential external benefits of the increased demand for biofuels are job creation, income generation and stabilization of crop prices to farmers and the abatement of greenhouse gases (GHGs). Examples of the potential negative external effects of biofuel use are the emissions of volatile organic compounds (VOCs) that might pollute the atmosphere and adversely affect human health in the area of use (Milt et al., 2009), the impacts of land-use change in pursuit of higher feedstock yields and the loss of biodiversity. These externalities, while generally not accounted for within the market price, are vital to informed policymaking in order to reduce

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the negative impacts of Thai energy consumption and facilitate more sustainable biofuel production and use.

In this study, economic analysis is utilized to contextualize and monetize the various effects of achieving the short-term biofuels program targets in Thailand (by year 2011) with the primary objective of determining the overall "net cost" of the program. The economy-wide impacts of both the parties involved and not involved in the biofuel production processes are analyzed, and the overall cost-benefit of the biofuels program is calculated. The external effects of biofuels are evaluated and included in the calculation by comparing biofuel blends to the corresponding conventional fuels, i.e. gasoline and diesel. The short-term targets of the biofuels program in Thailand are used as the baseline case, and only the existing, licensed biodiesel and bioethanol plants where operation can start by 2011 are considered. Therefore, only biodiesel produced from palm oil and bioethanol derived from cassava and cane molasses are considered in the analyses, even though there are a variety of feedstocks (including jatropha or even agricultural residues such as bagasse and rice straw) that could possibly be used for commercial biofuel production in Thailand in the long term.

2. Methodology

2.1. Net cost analysis

In the study, a cost-benefit analysis of the Thai biofuel industry is performed. Factors such as production costs, environmental impacts and social benefits are simultaneously considered based on the overall process as illustrated in Fig. 1. The economic assessment is described in two parts: (1) the direct economic impacts on the parties involved in the biofuel production processes, e.g. farmers, mills/refineries and biofuel industries; and (2) the assessment of the benefits and costs of the impacts of achieving the biofuels program targets by the year 2011. The net cost (NC) that incorporates both internal and external factors as shown in Eq. (1) is used to determine the true cost of domestic biofuel production for the end consumer in Thailand:

$$\begin{aligned} \textit{Net Cost} = {} & (\textit{Cost of Consumed Biofuel}) \\ & -(\textit{Cost of Petroleum Consumption Avoided}) \\ & +(\textit{Government Expenditures}) \\ & +(\textit{Fleet Replacement Cost})-(\textit{Environmental Benefit}) \end{aligned} \quad (1)$$

where *Cost of Consumed Biofuel* is the total cost of consumed biodiesel and bioethanol in the year 2011; *Cost of Petroleum Consumption Avoided* is the total cost of diesel and gasoline that can be avoided due to the use of biofuel in the year 2011; *Government Expenditures* is the government expenditures used to promote the biofuel program; *Fleet Replacement Cost* is the potentially increased cost of replacing the motor fleet with vehicles that are capable of running on higher blends of biofuel that may be implemented in the future; *Environmental Benefit* is the potentially reduced emissions when considering the transition from petroleum to biofuels (in this study, the two major factors to consider with regards to emissions are the effects on microclimate and

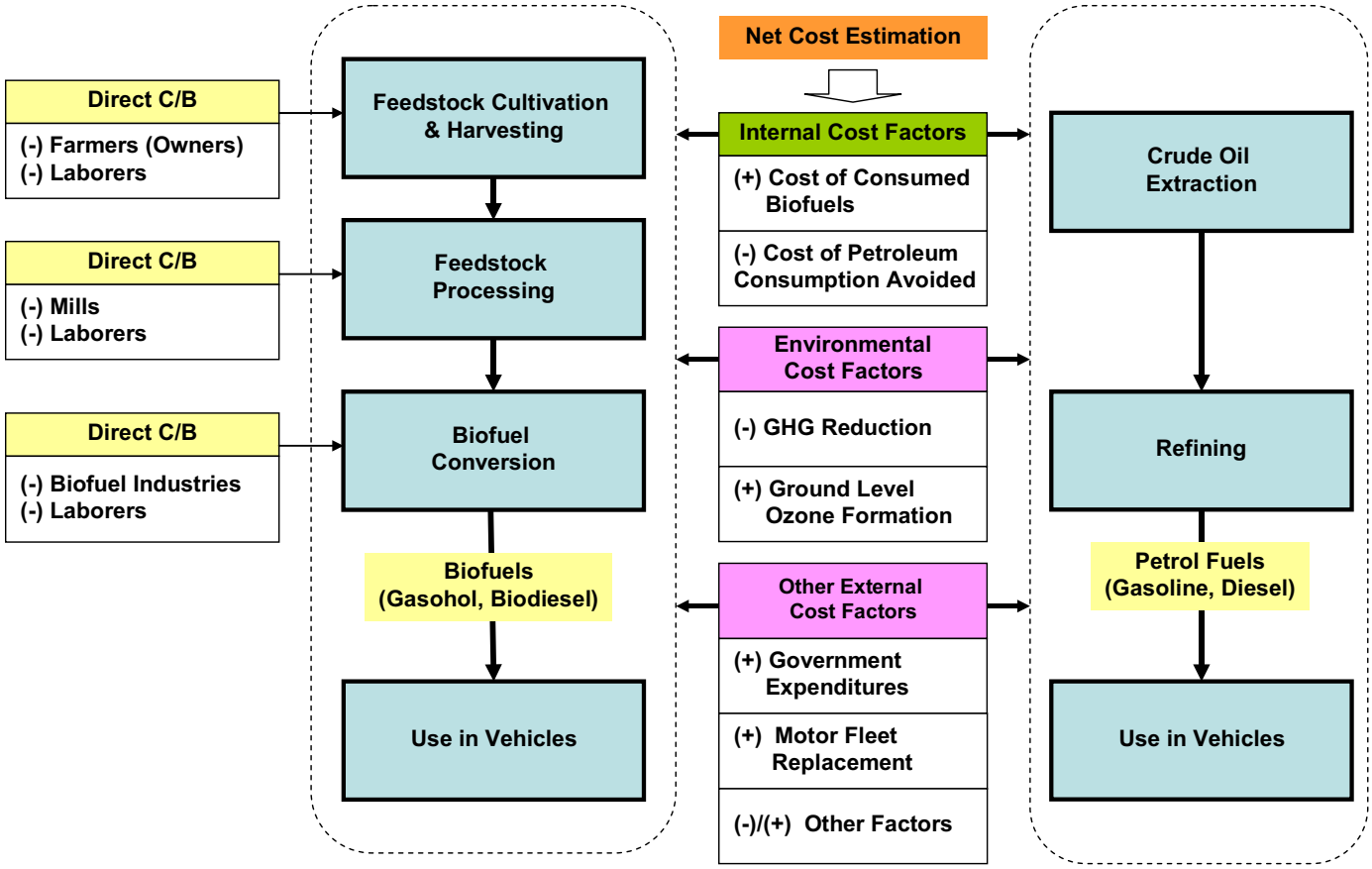

Fig. 1. Systems diagram for economic analysis of biofuel in Thailand.