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# Imported palm oil for biofuels in the EU: Profitability, greenhouse gas emissions and social welfare effects

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ABSTRACT

We examine the social desirability of renewable diesel production from imported palm oil in the EU when greenhouse gas emissions are taken into account. Using a partial market equilibrium model, we also study the sectoral social welfare effects of a biofuel policy consisting of a blend mandate in a small EU country (Finland), when palm oil based diesel is used to meet the mandated quota for biofuels. We develop a market equilibrium model for three cases: i) no biofuel policy, ii) biofuel policy consisting of socially optimal emission-based biofuel tax credit and iii) actual EU biofuel policy. Our results for the EU biofuel market, Southeast Asia and Finland show very little evidence that a large scale use of imported palm oil in diesel production in the EU can be justified by lower greenhouse gas emission costs. Cuts in emission costs may justify extensive production only if low or negative land-use change emissions result from oil palm cultivation and if the estimated per unit social costs of emissions are high. In contrast, the actual biofuel policies in the EU encourage the production of palm oil based diesel. Our results indicate that the sectoral social welfare effects of the actual biofuel policy in Finland may be negative and that if emissions decrease under actual biofuel policy, the emission abatement costs can be high regardless of the land use change emissions.



## 1. Introduction

Worldwide, many countries have adopted energy and biofuel policies in order to reduce greenhouse gas (GHG) emissions and to be less dependent on fossil and imported energy. These policies typically involve support measures for the production and consumption of renewable energies. According to the Renewable Energy Directive (RED), adopted in the European Union (EU) in 2009, the share of renewable transport fuels of all transport fuels is destined to increase to 10% by 2020, replacing the older 5.75% goal for 2010 [1]. Since 2011, the RED has also required that the life-cycle GHG emissions of renewable transport fuels, used to meet the 10% target, should be at least 35% lower than the life-cycle GHG emissions of fossil transport fuels. In October 2012

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the European Commission (EC) proposed to limit the share of biofuels made from edible crops to 5% of all transport fuels, just above the current output of 4.5%, which means that the use of food crops in biofuel production would increase only at the rate proportional to overall transport fuel consumption [2]. The proposition made by the EC stems from the global concern over increasing food prices and the possible indirect land use change (ILUC) impacts of biofuels made from food crops. However, EC only recommended the voluntary inclusion of the ILUC impacts in the reports of the fuel suppliers, without any true mandatory requirements.

National biofuel policies founded on the RED have increased the demand for renewable transport fuels, as well as the demand for alternative renewable feedstocks to produce fuels in the European Union. One of the main feedstocks used in the renewable transport fuel production in the EU is domestically produced rapeseed. The countries in the EU also import renewable fuels and raw materials from abroad to meet the growing demand. The use of Southeast Asian palm oil in the production of renewable fuels has increased significantly since 2003 when EU set the goal to increase the share of renewable transport fuels of all transport fuels. According to USDA [3], in 2010, EU countries consumed approximately 625,000 metric tons of imported palm oil in the production of renewable transport fuels and the amount was expected to have increased annually by 50,000 metric tons until the year 2012. The amount of palm oil used in transport fuel production is still supposed to grow after 2012, even if the ECs' bill to cap the use of food crops in biofuel production becomes a law. This is because the market price of palm oil in the EU is still about 15-25% lower than the price for other vegetable oils, which makes palm oil a more attractive feedstock for biofuel producers [3]. In 2010, EU countries imported also approximately 574,000 metric tons of biodiesel from Indonesia and Malaysia, which are the largest producers of palm oil with a share of more than 80% of total world supply [4].

Palm oil as sustainable feedstock of renewable transport fuels is subject to endless debate. The opponents stress that if new oil palm plantations are established by clearing natural rainforest in Southeast Asia to meet the increasing demand for palm oil, the life-cycle GHG emissions of palm oil based renewable fuels can be higher than those of fossil fuels [5,6]. Importing firms respond to criticism by stressing that they take all required measures to guarantee that the production of palm oil is sustainable. From this angle, the use of palm oil to produce renewable transport fuels can be warranted by lower life-cycle GHG emissions compared with rapeseed oil and fossil fuels, but only if the cultivation of oil palms does not result in the clearing of rainforests or other high biomass ecosystems. However, the sustainability requirements set by the Roundtable on Sustainable Palm Oil (RSPO), followed by many renewable transport fuel producers, are criticized for neglecting the true ILUC impacts of oil palm cultivation [7]. These impacts emerge when, for example, food crop cultivation has to expand elsewhere, to make room for palm oil production, and can thus lead in the clearing of rainforests. Despite this criticism and the intention to limit the use of food crops as biofuel feedstocks, EC officially recognized in November 2012 that palm oil which is produced following the sustainability requirements of RSPO meets the sustainability and emission reduction criteria of the RED [8].

There is a need to examine the social desirability of the use of palm oil in renewable transport fuel production in the EU when the GHG emissions are accounted for. While the welfare effects of biofuel policies have been quite extensively studied in the US,[1] especially for ethanol, less research has been conducted in the EU. There are several papers on the impacts of EU biofuel policies on agricultural production and markets as well as on the GHG emissions resulting from EU biofuel policy (e.g. [9,10] and for a review of biofuel market equilibrium models, see Ref. [11]). However, there are fewer studies on the social welfare impacts of EU biofuel policies which try to combine the welfare effects on the consumer, producer and the society (for an example on forest bioenergy, see Ref. [12]). The existing market equilibrium models that study the LUC impacts of biofuel policies are usually based on assumptions on how and where land use will change in response to economic factors. In this paper we approach LUC impacts from a different and more transparent angle. We define a range of possible LUC impacts, in terms of GHG emissions, according to various previous land use types. We choose this approach mainly because the modeled GHG emissions resulting from LUC can be extremely sensitive to underlying assumptions, especially for price-induced LUC [13]. By also applying different values for the price elasticities of palm oil supply, we are able to study how the social desirability of renewable diesel production is affected by feedstock supply assumptions, under different estimates for LUC GHG emissions.

Loosely following the more general equilibrium models by for example Cui et al. [14], and De Gorter and Just [15], we develop a partial market equilibrium model to examine the socially optimal use of palm oil in renewable diesel[2] production in the EU. We solve the market equilibrium model for three cases: (i) no biofuel policy, where the excise tax and thus also the producer price is the same for the fossil and renewable diesels, (ii) biofuel policy consisting of a uniform excise

[1] When it comes to national welfare, many US studies find blend mandates, in combination with fuel taxes, superior to tax credits and biofuel subsidies (see for example De Gorter and Just [15,24] and Lapan and Moschini [25]). However, Ando et al. [26] severely criticize the use of blend mandates. They find that mandates overemphasize the role of substitution of biofuels for fossil fuels by omitting the loss in the consumer welfare. In global perspective, regional blend mandates have ambiguous effects on the GHG emissions, land use and welfare [27,28]. According to US studies by Lapan and Moschini [25] and Cui et al. [14], largest national welfare gains of second-best biofuel policies, which do not consist of import tariffs, but of taxes, subsidies and mandates, result from their impact on oil market and trade.

[2] In this paper, we focus on the use of imported palm oil as feedstock in renewable diesel production in the EU. To distinguish between the production methods, we use the term renewable diesel to denote a diesel which is refined from vegetable or waste oil by hydro treatment, and biodiesel to refer to diesel produced by transesterification of vegetable oil. We focus on renewable diesel, because it is a more perfect substitute for fossil diesel than traditional biodiesel, and because less vegetable oil is needed to produce one fossil diesel energy equivalent metric ton of renewable diesel than one fossil diesel energy equivalent metric ton of biodiesel [10].