Transportation Research Part D 63 (2018) 291–308

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

How the cap limit for food-crop-based biofuels may affect France's stakeholders by 2030? A range-based multi-actor multi-criteria analysis

Gino Baudry*

Imperial College London, CEP – Centre for Environmental Policy, Faculty of Natural Sciences, South Kensington Campus, London SW71NA, United Kingdom
University of Nantes, LEMNA – Laboratoire d'Économie et de Management de Nantes Atlantique, Chemin de la Censive du Tertre, 44322 Nantes, France

ARTICLE INFO

Keywords:
Multi-criteria analysis
Multi-actor analysis
Biofuel policy
Sustainability assessment

ABSTRACT

From 2012 to 2016, the long-term signal in the biofuel market changed almost once per year, leading to a drastic decrease in investments and contributing to multiple production unit closures in France and around Europe. The European Commission proposed a new renewable energy directive that includes a 3.8% cap limit on the contribution of food-crop biofuels by 2030. Given the role of biofuels in green growth, the bioeconomy, and renewable energy incorporation targets, how will this measure affect the stakeholders by 2030? Will it lead to, contribute to, or hamper their sustainability criteria? This paper aims to contribute to this debate by studying the case of France. To this end, our methodology—the range-based multi-actor multi-criteria analysis—aims to (1) explicitly consider the stakeholder groups and their sustainability criteria; (2) evaluate and compare how the cap limit will affect these sustainability criteria whether or not advanced biofuels are deployed by 2030; (3) capture the uncertainty of the context evolution and biofuel capacity to fulfil the stakeholders' sustainability criteria by means of a Monte Carlo. The results suggest that the cap limit is a double-edged sword for the stakeholders and their sustainability criteria. Shifting towards advanced biofuels while limiting the food-crop biofuels is the better alternative for most of the stakeholders. Nevertheless, given biofuel policy instability and the lost confidence of investors, such a shift may not occur by 2030. In such a case, this paper demonstrates that the cap limit may highly and negatively affect the stakeholders and their sustainability targets, whereas fostering French food-crop biofuel production at its full capacity level constitutes a better alternative. As no alternative is suited to all actors simultaneously, this paper also studies the strengths and weaknesses of these alternatives from each stakeholder groups' perspective.

1. Introduction

France has been promoting biofuels since 1987. The initial objectives were to reduce crude-oil consumption while reducing the environmental impacts by including organic oxygenated components in fossil fuels. Five years later, in response to the Mac Sharry reform that introduced the 'set-aside land' concept, biofuels were promoted to support the agricultural sector, that is, to maintain and

* Address: Imperial College London, CEP – Centre for Environmental Policy, Faculty of Natural Sciences, South Kensington Campus, London SW71NA, United Kingdom.
E-mail addresses: g.baudry@imperial.ac.uk, gino.baudry@univ-nantes.fr.

https://doi.org/10.1016/j.trd.2018.05.012

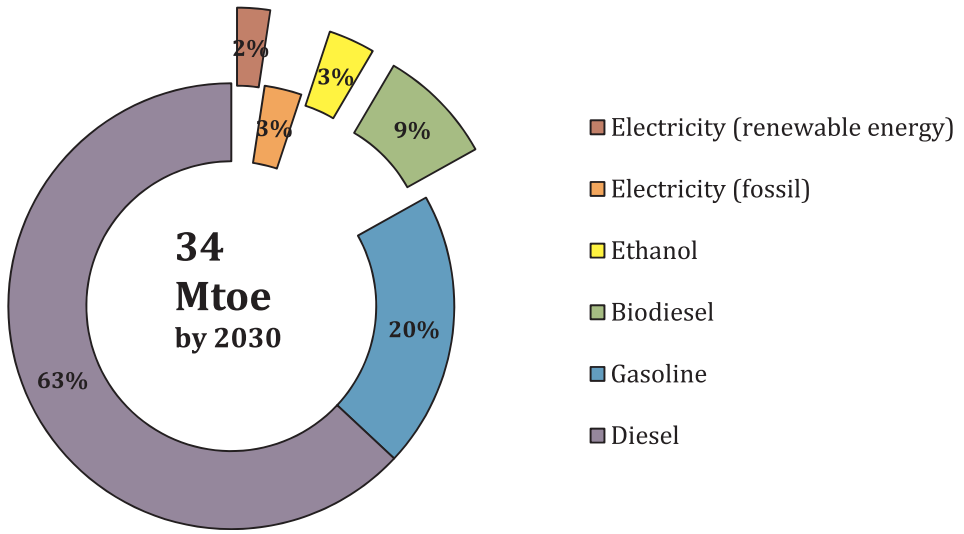

Fig. 1. Expected energy mix in the French transport sector by 2030 (based on (ADEME, 2014)).

create rural jobs while developing and diversifying market opportunities and farmer incomes (Cours des Comptes, 2012). During the following 2 decades, the Kyoto protocol, the European Renewable Energy Directive, and the French law on energy transition and green growth successively led to set 5.75%, 10%, and 15% caps for renewable energy in the transport sector by 2010, 2020, and 2030, respectively. France's law, in particular, emphasises the social actors' involvement, their empowerment, and the multiple sustainability issues regarding the shift towards a low-carbon economy. That is, biofuels are at the crossroads of the French strategy for their bioeconomy, green growth, and the agriculture and transport sectors.

Based on the French Environment and Energy Management Agency (ADEME) roadmap, Fig. 1 shows that biofuels are expected to fulfil more than 80% of the 15% renewable energy cap in the transport sector (ADEME, 2014), that is, 4.25 Mtoe.[1]

The sustainability targets thus rely on the achievement of the biofuel incorporation objective, which leads to questioning the overall sustainability of biofuel consumption regarding (1) multiple issues such as climate change, green growth, and bioeconomy; (2) multiple perspectives such as feedstock producers, public authorities, and nongovernmental organisations (NGOs). The negative and positive contributions of biofuel can, for example, be measured through their support of the agriculture sector or energy independence (Bergtold et al., 2017); greenhouse gas (GHG) mitigation potential (Hoefnagels et al., 2010; Menten et al., 2013); indirect land use change (ILUC) (Ahlgren and Di Lucia, 2014; Gawel and Ludwig, 2011); the land grabbing phenomenon (Bracco, 2015; Hamelinck, 2013); competition with food-use (Ajanovic, 2011; Ghoddusi, 2017; Mueller et al., 2011; Serra and Zilberman, 2013; Whistance et al., 2016), and so on. The literature also provides papers that propose assessing biofuel contribution based on multiple sustainability criteria. Buchholz et al., (2009) analyzed how key experts perceive 35 sustainability criteria for bioenergy regarding the levels of agreement and uncertainty. Similarly, Gallego Carrera and Mack (2010) proposed a survey among European experts but focused on social indicators. In their paper, Baudry et al. (2017) assessed 18 biofuel options based on French stakeholders' sustainability criteria. In addition, other papers such as Turcksin et al. (2011) who assessed 4 biofuel options regarding 33 sustainability criteria defined by Belgian stakeholders, operationalized these sustainability criteria using multi-criteria analysis frameworks.

The above-mentioned literature reveals a low consensus level regarding sustainability criteria among the stakeholders, but a common result is that a shift from conventional towards advanced biofuels is better to address sustainability issues. Nevertheless, what if this expected shift does not occur? What if the biofuel scheme fails in pulling the shift from the conventional to the advanced biofuels? Would it be better to foster or limit food crop biofuels' contribution? Given the wide range of actors involved and their multiple and conflicting sustainable criteria, the answer is not straightforward. This paper aims to fill this gap in the literature and results from a previous work in which many actors from various backgrounds mentioned serious doubt concerning the actual large-scale deployment of advanced biofuels by 2030 (Baudry et al., 2017).

Why would the shift towards advanced biofuels not occur by 2030? Over the years, the European Commission has revised the biofuel support scheme multiple times to broaden the range of considered sustainability criteria. The drawback, nevertheless, is in the confusing and misleading signals conveyed to the industry (Table 1). This confusion highly hampered the investors' confidence and delayed advanced biofuels investment and thus deployment, which was first expected by 2020, then 2030, and is still highly uncertain.

Although French energy demand in the transport sector slightly increased in the last decade, biofuel consumption remains under its 2012 level. French biofuel production has mostly been replaced by fossil fuels and palm oil-based biofuels (EurObserv'ER, 2015), for which sustainability issues are also highly debated (e.g. Gawel and Ludwig, 2011; Mukherjee and Sovacool, 2014). Setting a cap

[1] Mega ton oil equivalent.