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Investments of oil majors in liquid biofuels: The role of diversification, integration and technological lock-ins

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ARTICLE INFO

Article history:
Received 24 August 2011
Received in revised form
19 August 2012
Accepted 23 August 2012
Available online 27 September 2012

Keywords:
Biofuels
Sugarcane ethanol
Oil companies
Technology lock-ins
Brazil

ABSTRACT

The increasing use of liquid biofuels has been justified by highly volatile and rising oil prices, geopolitical instability of countries that control most of proven oil reserves, growing demand for passenger transportation and environmental concerns, especially climate change. Investments in the sector are increasing steadily, with oil majors being responsible for rising investments into liquid biofuel joint ventures, research and development projects and logistics. This paper analyses the underlying motivations of these investments by evaluating corporate diversification and integration strategies. Findings indicate that vertical integration and diversification are an integral part of oil major's strategic behavior toward biofuels, although strategies differ substantially among companies. In the short term current major oil companies' investments in liquid biofuels are driven by the requirement to comply with binding mandates for biofuels, whereas in the long-term liquid biofuels, if produced on a significant scale, could be classified as non-conventional liquid hydrocarbon reserves for oil majors where access to other (non-)conventional resources is not secured. Finally, given existing technology lock-ins it seems unlikely whether different paths for producing liquid biofuels will be able to co-exist in the long term, or there will be only one dominant path possibly controlled by large oil companies.

1. Introduction

The increasing use of liquid biofuels has been justified by highly volatile and rising oil prices [1,2], geopolitical instability of countries that control most of the known oil reserves [3,4], increased demand for passenger transportation [5] and environmental concerns, especially climate change [6,7].

Energy security, in fact, remains one of the most important driving factors behind the increasing use of alternative fuels in the transportation sector [8]. Maintaining access to reserves continues to be an essential strategy for oil majors as demand for conventional oil is estimated to supply the gross of transportation road fuels, [9]. As such, non-conventional oil resources, including tar sands and shale oil, and even ultra-deep water petroleum resources, have become important as access to more conventional oil is becoming difficult [3,10–12]. For example, as of today Exxon's and Shell's non-conventional oil represents as much as 12% and 11% of the companies' proven oil reserves, respectively. Therefore, it seems acceptable to deduce that liquid biofuels, if produced on a significant scale, could be classified as non-conventional liquid hydrocarbon reserves for oil majors where access to other (non-) conventional resources is not secured.

In terms of environmental concerns, liquid biofuels are considered as one of the major options to curb greenhouse gas emissions in the transportation sector [13–17], although

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0961-9534/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biombioe.2012.08.017

in some regions concerns still remain related to food-fuel competition [18–22], biodiversity [23] and life cycle emissions [24–27]. However, the main reasons for promoting liquid biofuels continue to differ considerably among countries. The U.S. government has strongly encouraged the expansion of corn-derived ethanol in order to promote energy independence and as a way to reduce air pollution and health problems, particularly through a progressive ban of MTBE [28]. The enactment of the Energy Policy Act of 2005 [29] and the specifications of the Renewable Fuel Standard – RFS [30] brought security and stimulated the growth of U.S. production. From 2000 to 2010 the production grew from 6.4 hm^3 to 49 hm^3 [31]. For 2022, the government aims to reach a value of 492 hm^3. While a specific ethanol target is not mentioned in the RFS – except that 946 dam^3 should be derived from cellulosic biomass by 2013 [32] – reaching this target is believed to imply a large-scale use of ethanol in fuel blends [33].

Europe is another major consumer market for liquid biofuels. The European Union (E.U.) legislation has been mainly motivated by concerns to secure European energy supply, environmental protection, and achievement of the Kyoto Protocol targets [31,34]. Due to the flexibility of E.U. legislation, a variety of biofuel support policies are now in place in the E.U. member countries to reach this target, including standards, quotas, economic and fiscal measures [35].

In the case of Brazil, the Proálcool program launched in the 1970s is a success story, although social and environmental concerns remain [17,36–40]. Current policies on ethanol in Brazil focus on ethanol-gasoline blending mandates, minor tax reductions for blended fuels, and tax incentives to encourage the use of ethanol-powered vehicles [41].

From the end of 2004–2009, annual average growth rates for biofuels reached 20% for ethanol and 51% for biodiesel, despite the global economic crisis of 2008 [42]. According to IEA, biofuels may account for 7% of road transport energy demand in 2020 and 11% in 2030 under its "450 ppm" scenario – on energy equivalent basis. Increases will be initially due to a wider adoption of first generation biofuels, especially sugarcane and corn ethanol. By 2030 first generation ethanol, and to some degree second generation biodiesel, will have begun to substitute first generation technologies [10].

However, while first generation biofuels are less technological risky, second generation biofuels are an R&D priority, particularly in countries or regions where first generation biofuel supply can exacerbate food versus fuel conflicts or environmental degradation. These fuels derive from the conversion of lignocellulosic material through biochemical or thermochemical routes.

Hence, given the strong policy support, investments in the sector are now increasing steadily. Contributions come from government (through support policies such as blending mandates or R&D) or venture capital, but increasingly also from major oil companies such as ExxonMobil, Royal Dutch Shell, BP, and Petrobras [42]. Oil majors are of particular interest given their market position role in the global road transportation sector and the frequent claim that they impede the development and dissemination of renewable transportation alternatives such as biofuels.

This leads to the following two questions:

1. To what degree can oil major investments in first and second generation liquid biofuels be explained with regard to integration and diversification strategies in the light of more difficult access to conventional oil reserves as well as the rising importance of biofuel blending mandates, which affect the oil companies' downstream markets? In addition, does the possible "greenwashing" or corporate image play a more significant role? – While different studies have analyzed the valuation of corporate sustainability of oil companies [43–47], there is still no agreement on the drivers behind oil companies investments in this sector.

Chandler [48] defines diversification as product diversification and integration as vertical integration. By diversification in this paper we thus mean the inclusion of non-conventional resources into the oil major's energy portfolio. This can include biofuels, but also, for example, Canadian tar sands. Vertical integration is analyzed from the standpoint of strategic access to resources. For example, oil majors have to comply with government blending mandates and may have considerable difficulties in securing supply of cheap biofuel feedstock.

2. Can the quality and amount of current major oil companies' investments in liquid biofuels be explained by existing technological lock-ins [49–51] in the hydrocarbon industry especially for global road transport?

Technological lock-in describes a situation in which an economy remains faithful to a certain type technology or technological system. For further detail, see [49–53].

By understanding the underlying motivations of oil major investments in the liquid biofuels sector this paper does not only aim to give information on their potential role in the future renewable liquid transportation fuels matrix, but also on the development of the biofuel sector as a whole.

The analysis is based on information on investment volumes and quality from four oil majors (BP, Royal Dutch Shell, ExxonMobil and Petrobras), which has been compiled from their respective 20F – BP, Shell, Petrobras (20F is a form issued by the U.S. Securities and Exchange Commission that must be submitted by all private companies out of United States in order to inform company's business and financial conditions) – and 10K – ExxonMobil – reports (10K is an annual report for U.S. firms that offers a comprehensive overview of the company's business and financial conditions), the corporate sustainability reports as well as publicized industry news in technical journals, newspapers or industry blogs.

Following this brief introduction, the remainder of this paper is organized as follows: Section 2 presents the main investment data of the assessed oil companies. Section 3 analyses the investments of the selected oil companies in first and second generation liquid biofuels. Section 4 aims at identifying the mains motivations behind the different strategies of oil companies in the liquid biofuels industry. Finally, Section 5 concludes this paper with a few final remarks on integration, diversification and technological lock-ins.