



Government initiatives

The Japanese biofuel program – developments and perspectives[☆]Tatsuji Koizumi^{*}

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ABSTRACT

The Japanese government is promoting a biofuel program to deal with environmental and energy security problems and to promote rural development. This study is an economic analysis of domestic biofuel markets and programs and reviewing the Japanese biofuel program. At present, verification tests and large-scale projects for biofuel production have been launched, but current agricultural products based on biofuel production have experienced some problems in the way of high production costs, securing feedstock, and food availability. Japan is promoting the production of biofuel from cellulose and unused resources, and the R&D for second-generation biofuel is very active. The Japanese government needs to continue to assist on these research projects in the mid- to long term so Japan can increase its domestic biofuel production and imports in the future. The most crucial task for the Japanese biofuel program is establishing *sustainable criteria for biofuel*, which determine the limitations of GHG emissions, and pay close attention to bio-diversity, food availability, and social consequences. To realize these goals, further research and dialog with related countries and regions will be required.

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1. Introduction

The Japanese Government is promoting biofuel programs to deal with energy security and environmental problems, to increase farm income and revitalize rural areas, and to enhance employment. The government is promoting biofuel production and utilization among all renewable energies. It is also promoting the further reduction of GHG emissions, R&D for second-generation biofuel, and the establishment of sustainable criteria. These promotions can contribute to the development of biofuel production, which will harmonize the environment and food availability. These Japanese programs are advance in Asia. Japan will depend on imported biofuel to meet its biofuel utilization target in the future. These initiatives by Japan can impact biofuel programs not only in neighboring Asian countries, but also those of biofuel trade partner countries, such as Brazil, Indonesia, and Malaysia.

Several studies have addressed Japanese biofuel production and programs. Ushiyama (1999) examined the future potential of Japanese renewable energy including biomass. Koizumi (2007) used econometric models to examine how Japanese bioethanol imports would impact the Brazilian and world sugar markets. Koizumi and Ohga (2007) and Koizumi (2008) performed an economic analysis of the available supplies of domestically produced biofuel.

Matsumoto et al. (2009) reviewed biofuel initiatives, strategies, policies, and the potential of biofuel in Japan. However, these studies were based on production and programs before 2009. The Japanese Government has since released many programs. The present study is an economic analysis of these domestic biofuel markets and programs and an examination of the Japanese biofuel program. The next section covers Japanese biofuel production and programs and renewable energy development. The third section covers the development and perspectives of the Japanese biofuel program. The last section provides a summary and conclusion.

2. Japanese biofuel production and programs

2.1. The history of Japanese biofuel production and biomass storage

The history of bioethanol production in Japan dates back to 1889, when a factory was built in Hokkaido to produce bioethanol using potatoes as raw material through *malt saccharification* (Table 1). In 1937, to meet military demand, an alcohol monopoly system was launched to produce bioethanol from potatoes, and by 1944 Japan was producing 170 thousand kl of bioethanol per year. During World War II, bioethanol-blended fuel was used as an alternative to gasoline for fighter attack and training airplanes. It is estimated that by 1945 bioethanol constituted 26.7% of total liquid fuels¹ because petroleum import lines from the Pacific area were

[☆] The opinions expressed in this report belong to the author and doesn't necessarily reflect of Japanese government.

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¹ This figure is estimated from Miwa (2004).

Table 1
Developments in Japanese biofuel.

Year	Topics and main programs
1899	First bioethanol facility was build in Hokkaido
1944	170 thousand kℓ of bioethanol was produced
1997	Kyoto Protocol was adopted
2001	Promoting the recycling of various types of resources, including biomass (Basic Law on Promoting the Formation of a Recycling-Oriented Society)
2002	Biomass Nippon Strategy, which was a plan to promote the production and utilization of biomass energy, was adopted by Cabinet meeting
2003	3% of bioethanol blend to gasoline was approved by revised the Law on Quality Securement for Benzin,etc (Quality Securement Law).
2005	Kyoto Protocol was entered into force Kyoto Protocol Target Achievement Plan was adopted by Cabinet meeting
2006	New Biomass Nippon Strategy was adopted by Cabinet meeting
2007	Boosting the production of biofuel in Japan, which was long term plan to utilize and produce biofuel, was decided by Executive Committee on Biomass Nippon Strategy.
2008	Biofuel Act, which decided tax privilege for bioethanol production and utilization, was enacted
2009	Sophisticated Methods of Energy Supply Structures Law, which required petroleum and gas enterprises to use biofuel and biogas, was enacted

Source: Author.

broken at the end of the war. Biodiesel from soybean oil was also produced and used for fleets – mainly destroyers – and *Jatropha curcas*-based biodiesel was developed by former army-related petroleum refiners and used for tank fuel and lamps.

After World War II, Japan continued to produce bioethanol from imported molasses. However, the two oil crises in the 1970s shifted the focus of Japan's energy policy to energy savings and to reducing Japan's reliance on oil,² with the result that the adoption of biofuel was not considered until recently. However, under the Kyoto Protocol, Japan is committed to cutting its 1990 greenhouse gas emissions by 6% before the end of the first commitment period (2008–2012). The decision to promote the recycling of various types of resources, including biomass, was enacted as the Basic Law on Promoting the Formation of a Recycling-Oriented Society in 2001. The first time the government announced a plan to promote biofuel production and the utilization of biofuel was in the Biomass Nippon Strategy, which the Cabinet adopted in December 2002.

The Kyoto Protocol Target Achievement Plan, which the Cabinet adopted in April 2005, calculated that the new energy input in 2010FY³ resulting from the implementation of the new energy countermeasures would be equivalent to 19.1 million kℓ of crude oil, which is projected to result in a reduction of 46.9 million tons of CO₂ emissions. The goal was to achieve a reduction in CO₂ equivalent to 500 thousand kℓ of crude oil.⁴

When the Kyoto Protocol came into force in April 2005, Japan determined that, to meet its targets, it would be necessary to convert biomass energy into useful forms of energy, such as transportation fuels, and to draw a roadmap for the adoption of domestically produced biomass as transportation fuel. In March 2006 the Cabinet adopted the revised Biomass Nippon Strategy, the most striking features of which were that biofuel became the main force among various biomass products.

The Biomass Nippon Strategy categorizes biomass into three types: waste biomass, unused biomass, and energy crops. Based on data as of 2008, Japan stored 298 million tons of waste biomass

and 17.4 million tons of unused biomass. The provisional estimate for the energy potential of unused biomass is approximately 14 million kℓ in crude oil, and the provisional estimate for the energy potential of energy crops is approximately 6.2 million kℓ in crude oil (Ministry of Agriculture, Forestry and Fisheries, 2010). Thus, there is potential to expand the production of biofuel in Japan.

2.2. Biofuel program

The Japanese Government has been promoting bioethanol production and its use for automobiles since 2003. In March 2009 the Japanese bioethanol production level was estimated at 200 kℓ (Ministry of Agriculture, Forestry and Fisheries, 2010). At present, verification tests and large-scale projects for bioethanol production have been launched at ten locations in Japan. Large-scale demonstration projects were initiated in 2007 to collect data for domestic transportation biofuel and to support a model project for the local utilization of biomass. The Ministry of Economy, Trade and Industry is promoting biofuel programs from an energy security incentive, while the Ministry of Agriculture, Forestry and Fisheries is promoting it mainly from the perspective of rural development. The Ministry of Environment is promoting it for environmental reasons.

Hokkaido Bioethanol Co. Ltd in Shimizu Town, Hokkaido, produces bioethanol from surplus sugar beets and substandard wheat. Its facility's capacity is 15 thousand kℓ/year. Oeon Holdings, in Tomakomai City, Hokkaido, produces bioethanol from non-food rice, and its facility's capacity is 15 thousand kℓ/year. JA Agricultural Cooperatives in Niigata City, in Niigatas Prefecture, produces bioethanol from non-food rice, and has a capacity of one thousand ℓ/year (Ministry of Agriculture, Forestry and Fisheries, 2010). In addition to these projects, the soft cellulose-based bioethanol project has been promoted since 2008 to use rice straw and wheat straw to produce bioethanol. Rice and wheat straw-based bioethanol is produced at 3.7 ℓ/day in Hokkaido, and rice straw and rice husk-based bioethanol is produced at 200 ℓ/day in Akita Prefecture. Rice straw and other cellulose material-based bioethanol is produced at 100 ℓ/day in Chiba Prefecture, and rice straw and wheat straw-based bioethanol is produced at 16 ℓ/day in Hyogo Prefecture (Ministry of Agriculture, Forestry and Fisheries, 2010).

The municipal government and non-governmental organizations are promoting the production of biodiesel from used vegetable oil blended with diesel for use by public buses, official cars, and municipal garbage trucks. As of March 2008 the total amount of biodiesel production was estimated at 10,000 kℓ (Ministry of Agriculture, Forestry and Fisheries, 2010). Most of the municipal government and non-governmental organizations' production levels are smaller than those of the bioethanol facilities since NGOs and local governments produce biodiesel in small plants using recycled rapeseed oil as the main feedstock. Twenty biodiesel fuel projects have started since 2007.

3. Developments and perspectives of Japanese biofuel programs

3.1. Future direction of domestically produced biofuel

In February 2007, seven ministries and the Cabinet Office released a "roadmap" to expand biofuel. The goal was to produce 50 thousand kℓ of biofuel domestically per annum by 2011 FY. If appropriate technical development is achieved, such as reducing the costs of collection and transportation, developing resource crops, and improving bioethanol conversion efficiency, a significant

² Japan relied on oil for 77.4% of energy consumption in 1973, and 71.5% in 1979, but it dropped down to 49.4% in 2001 (Ministry of Economy, Trade and Industry, 2009).

³ 2010 FY means fiscal year from April, 2010 to March,2011

⁴ 500 thousand kℓ of crude oil is equivalent to 800 thousand kℓ of bioethanol.

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