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Biofuels Annual

Market for Liquid Transport Biofuels Remains Steady as Japan Remains Focused on Advanced Fuels

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Report Highlights:
Japan's current renewable energy policy focuses on generating power from solar, wind, and geothermal sources. Imports of wood pellets have been increasing for thermal power generation. For biofuels, FAS projects that the Government of Japan (GOJ) will achieve its 2010 plan to introduce 500 million liters (crude oil equivalent) of biofuels by 2017. There is a broad consensus within Japan biofuels should not be produced using food crops. Consistent with this view, Japan is focusing research efforts on technology to produce biofuels from sources that do not compete with food.
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I. Executive Summary

Japan's current renewable energy policy focuses on generating power from solar, wind, biomass, and geothermal sources. For biofuels, the Government of Japan (GOJ) maintains its 2010 plan to introduce 500 million liters (crude oil equivalent) of biofuels[1] by 2017, and has required the oil industry to meet the goal. The oil industry decided to introduce 1,940 million liters of bio-Ethyl Tert-Butyl Ether (ETBE), which is equal to 500 million liters (crude oil equivalent) of biofuels, nearly all of which will be imported to the Japanese market. Biodiesel plays virtually no role in meeting the 2017 goal.

Bio-ETBE blended gasoline is far more prevalent than E3 gasoline and is widely distributed. In 2012, the GOJ permitted sales of E10 and ETBE22 gasoline and vehicles designed to use these biofuels; however, this change has had a limited effect on the market as the supply of E3 and E10 remains small compared to that of bio-ETBE gasoline. The Japanese petroleum industry does not have any plans to supply ETBE22 gasoline.[2]

When considering biofuels, there are two significant issues that Japan takes into account: 1) food-vs-fuel and 2) carbon emissions.

Japan has a low food self-sufficiency rate; imports comprise the majority of the food it consumes. As a result, Japanese people are highly sensitive to issues of rising food prices, leading to a debate within Japan critical of using food crops to produce biofuels.

Japan has established its own sustainability standards for biofuels and only allows for bioethanol with a CO2 emission of less than 50 percent that of gasoline. The GOJ used a Life Cycle Assessment (LCA) to calculate the CO2 emissions of the entire chain, from the initial cultivation of the raw material to the transportation of the final product to the end consumer, and concluded that only Brazilian sugarcane ethanol meets Japan's sustainability standards. Based on available sources, Japan's imports of ethanol for fuel in 2015 were estimated to be approximately 606 million liters (including the ethanol in imported ETBE) equaling an average blend of 1.14 percent. The ethanol for fuel was all imported from Brazil. Discussions to update the sustainability standards for biofuels may start this year.

Japan has restarted only a few of its nuclear power reactors, forcing Japan's power companies to rely on other methods to generate power, such as hydro and coal. The power companies are also turning to wood pellets as a renewable energy source. Imports of wood pellets, which reached a record 232,425 metric tons (MT) in 2015, are expected to increase further because the trend of mixing wood pellets with

[1] The conversion factor for ethanol into crude oil is 0.607. Thus, 500 million liters (crude oil equivalent) of biofuels is equal to 824 million liters of ethanol. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act." (http://www.enecho.meti.go.jp/notice/topics/017/pdf/topics_017_002.pdf).
[2] There are two methods for blending bioethanol with gasoline: "direct blending" and "ETBE." The oil industry in Japan promotes the ETBE method because it is less costly for them than the other method.

coal for thermal power generation is expected to continue and the number of small and mid-scale biomass power facilities (below 10,000 kW), which use wood materials including wood pellets is increasing under the Feed-in Tariff (FIT) system.

II. Policy and Programs

Major Ministries Involved in Biofuel Policy

A number of ministries collaborate on Japan's biofuels policy, but three ministries - the Ministry of Economy, Trade and Industry (METI), the Ministry of Environment (MOE), and the Ministry of Agriculture, Forestry and Fisheries (MAFF) – play major roles in developing and implementing biofuels policies. MOE's main concerns are preventing global warming and meeting Japan's commitment to reduce its greenhouse gas (GHG) emissions. In May 2015, Japan announced its commitment to reduce its 2013 levels of GHG emissions by 26 percent by 2030. In terms of energy security, METI is interested in biofuels as a supplemental source of fuel and is interested in analyzing the cost-benefit of shifting to renewable fuels and their impact on automobiles and infrastructure. METI collaborates with the oil industry to introduce biofuels in the market. MAFF's goal is to revitalize rural communities by producing biofuels or renewable energies (e.g., heat and power) from domestically available sources (e.g., rice for non-food purpose for biofuels; and livestock and wood wastes for renewable energies).

Policy Goals

On April 11, 2014, Japan published its Basic Energy Plan for the next five years. This strategy considers renewable energy as an important source for three reasons: (1) to increase its domestic production of renewable energy to ensure a stable supply. This has become especially important since the 2011 Great East Japan Earthquake, when all of the nuclear reactors were shut down, as Japan's imports of energy for generating power have increased by approximately three trillion yen (approximately $30 billion); (2) to prevent global warming; and (3) to promote a distributed power system to revitalize regional economies.

Japan aims to increase the share of its power supply from renewable energy sources to 22-24 percent by 2030. For biofuels, the Basic Energy Plan states that "Concerning biofuels, which are mostly imported, Japan continues to introduce the fuels in light of international trends and technical development of the next generation of biofuels." According to sources, this statement indicates the GOJ's belief that biofuels from sources that do not compete with food, e.g., cellulosic ethanol, are to be considered as part of Japan's energy supply. Under the Sophisticated Methods of Energy Supply Structure Act, the GOJ requires oil refiners to supply 500 million liters of biofuels (crude oil equivalent) by 2017[3]. According to Japanese government sources, discussions to set a target for after 2017 will begin later this year.

Road Map to Introduce Bio-ETBE in Japanese Market by the Oil Industry (Million Liters)											
Calendar Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Introduction Bio-ETBE - Road Map	Test marketing period		200	840	→						1,940
Bio-ETBE: Penetration in Japaense Market											
Domestic Production of Bio-ETBE*	0	0	143	140	160	160	160	160	160	160	160
Imports of Bio-ETBE	8	7	57	700	693	679	787	1,081	1,271	1,600	1,780
Total	**8**	**7**	**200**	**840**	**853**	**839**	**947**	**1,241**	**1,431**	**1,760**	**1,940**
Calculated Volume of Bioethanol**	3	3	85	356	361	355	401	526	606	746	822
Crude Oil Equivalent***	2	2	51	216	219	216	244	319	368	453	500

Sources: The World Trade Atlas; Petroleum Association of Japan

* Post's Estimate based on available sources.

** The conversion factor for ETBE into ethanol is 0.4237. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (http://www.enecho.meti.go.jp/notice/topics/017/pdf/topics_017_002.pdf).

*** The conversion factor for ethanol into crude oil is 0.607. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply

Government Incentives for Biomass-based Fuels

In 2008, the GOJ introduced tax incentives to encourage the use of bioethanol by amending the Quality Control of Gasoline and Other Fuels Act. The gas tax is usually ¥53.8 per liter (approximately $0.53). Under the special measure, the gas tax is lowered by ¥1.6 per liter (about $0.02) if a fuel contains 3 percent bioethanol. The incentive is a fixed-term special measure, which is effective until March 31, 2018.

The GOJ removed its 3.1 percent tariff on ETBE to encourage the use of ETBE. Under the 2014 Temporary Measures concerning Customs Act, imports of ETBE derived from biomass is tariff free through March 31, 2018.

Also in 2008, the Law to Promote the Usage of Biomass Resources to Produce Biofuels entered into force. The legislation includes tax breaks and financial assistance for biofuel manufacturers and farmers producing feedstock, such as agricultural cooperatives and private businesses. The government encourages collaboration of those two groups, and their plans are monitored by MAFF in order to qualify for the benefits. Under the scheme, newly built biofuel facilities that are approved for the program by 2018 will have their fixed property tax reduced by half for three years. The redemption period for interest-free loans for farmers will be extended by two years, to a total of 12 years, for farmers producing feedstock.

Environmental Sustainability Standards for Liquid Biofuels Used in Transport

In 2010, MOE released the first version of the "Life Cycle Assessment (LCA) Guideline for Biofuels" to allow manufacturers and importers of biofuels in Japan to assess their biofuels businesses.[4]

In 2010, the GOJ established its own sustainability standards for biofuels. METI notified oil distributors that, in light of the LCA, GHG emissions from the bioethanol they procure must be less than 50 percent that of gasoline, and the bioethanol must not compete with the food supply[5]. According to MOE's LCA analysis, the only source of bioethanol which can fulfill the METI's GHG emissions requirements is bioethanol from sugar cane grown on existing farmland in Brazil.

[4] For more details about LCA, refer to GAIN JA4018.
[5] The same sorts of requirements are applied to biodiesel. GHG emissions from biodiesel must be less than 50 percent of light or diesel oil.

METI's Expert Committee to Discuss the Future of Biofuels Usage in Japan is considering advising MOE to revise the LCA Guideline for Biofuels to include the latest available assessments on GHG emissions of biofuels feedstocks.

Feed-in Tariff System to Promote Renewable Energy in Heat and Power Plants

In 2012, the GOJ introduced a feed-in tariff (FIT) system for electricity from renewable energy sources such as solar and wind power. Under the system, power companies are obliged to buy electricity at set rates for set periods (for 10 to 20 years). The rates are reviewed annually and are expected to decrease as the costs incurred by power companies to buy electricity from renewable energy sources are passed on to consumers through increased electricity rates. Since the system was introduced, the number of power generating facilities using renewable energies has steadily increased.

FIT Purchase Rates for FY2016	
Solar power	Y24-33 (approximately $0.24-0.33) per kWh
Wind power	Y22-55 (approximately $0.22-0.55) per kWh
Hydro power	Y14-34 (approximately $0.14-0.34) per kWh
Geothermal power	Y26-40 (approximately $0.26-0.4) per kWh
Biomass derived power	
-Wood materials	Y13-40 (approximately$0.13-0.4) per kWh
-Waste materials	Y17 (approximately$0.17) per kWh
-Biogas from methane fermentation	Y39 (approximately$0.39) per kWh

In 2014, renewable energy accounted for 12.2 percent of Japan's total power supply. Hydropower accounts for nine percent. The GOJ aims to increase the proportion of renewable energies to 22-24 percent by 2030. This goal is challenged by the high cost of generating power from renewable sources. For example, the cost to be borne by consumers in 2016 for the FIT system will be ¥2.25 per kilowatt-hour, for a total of ¥1.8 trillion (approximately $18 billion). This issue of high costs is under discussion by the GOJ.

III. Gasoline and Diesel Markets

Trends in Fuel Use

The GOJ estimates that gasoline demand will continue to decrease, largely due to three factors: (1) the decrease in the number of automobiles as a result of the decline in Japan's population, (2) improved vehicle fuel efficiency, and (3) the increase in energy-saving automobiles, such as hybrid cars. In 2015, demand for gasoline was 53 billion liters, and by 2020 it is forecast to decrease to 47 billion litters.

The GOJ estimates that the demand for diesel will continue to decrease due to the decline in the number of trucks as a result of streamlining logistics systems. However, the decrease will be offset over the next

several years as the number of diesel-fueled passenger cars is expected to increase. In 2015, demand for diesel was 33 billion liters and it is forecast to stay about the same level for the foreseeable future.

Demand for jet fuel is expected to decline slightly due in large part to improved airplane fuel efficiency. In 2015, demand for jet fuel was 5.4 billion liters, and by 2020 it is forecast to decrease slightly to 5.2 billion litters.

Japan's transportation sector (excluding railways) depends on fossil fuel for 98 percent of its energy, followed by electricity (two percent) and natural gas (0.1 percent). In its 2014 Basic Energy Plan, the GOJ stated that it will promote diversification of energy sources in the transportation sector. Biofuels are considered to be an important energy source along with electricity, natural and LP gases, and hydrogen. The GOJ is encouraging the increased use of biofuels in jet fuel.

Fuel Use History (Million Liters)

Calendar Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gasoline Total	61,422	60,552	59,076	57,473	57,347	55,643	54,116	56,207	55,419	52,975	53,104
Diesel Total	37,136	36,606	35,557	33,722	32,308	31,324	30,525	33,391	34,079	33,583	33,476
Jet Fuel Total	5,144	5,453	5,916	5,676	5,087	5,025	5,060	5,053	5,171	5,340	5,388
Total Fuel Markets	103,702	102,611	100,549	96,871	94,742	91,992	89,701	94,651	94,669	91,898	91,968

Fuel Use Projections (Million Liters)

Calendar Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Gasoline Total	52,067	50,179	49,290	48,203	46,854	45,683	44,541	43,427	42,341	41,283	40,251
Diesel Total	33,553	33,229	33,325	33,332	33,259	33,226	33,193	33,159	33,126	33,093	33,060
Jet Fuel Total	5,300	5,248	5,244	5,252	5,237	5,206	5,174	5,143	5,112	5,082	5,051
Total Fuel Markets	90,920	88,656	87,859	86,787	85,350	84,114	82,907	81,730	80,580	79,458	78,362

Source: Ministry of Economy, Trade and Industry (METI)
Notes:
- Numbers for 2010 and 2011 are forecast by METI in 2010. Actual numbers are not available due to the Great East Japan Earthquake occurred in 2011.
- Numbers for 2021 onwards are forecast by Post.
- Years are Japanese fiscal year, April - March.

Trends in Engine Technology

In order to help reduce Japan's GHG emissions, the Japanese auto industry is promoting the so called "clean energy vehicles," which include electric, hybrid, and natural gas fueled cars. Japanese auto companies began selling hydrogen fuel cell vehicles in 2014. Since the GOJ introduced subsidies and tax incentives for "clean energy vehicles" in 2009, the number of these vehicles has been increasing, with the total number of "clean energy vehicles" in Japan exceeding five million in 2014, the last year for which data is available. Although clean energy vehicles still only account for 6.7 percent of the total number of automobiles in Japan, their numbers are expected to increase further.

Number of Clean Energy Vehicles in Japan

	2010	2011	2012	2013	2014
Hybrid cars				3,870,000	4,760,000
Plug-in hybrid cars				30,000	45,000
Electric vehicles				54,000	70,000
Fuel cell vehicles				0	102
Natural gas fueled cars				41,000	42,000
Clean diesel cars				145,000	233,000
Total	1,480,000	2,110,000	3,020,000	4,140,000	5,150,102

Source: Japan Automobile Manufacturers Association

Development in Vehicle Fleet Efficiency

In 2012, a new standard for vehicle fleet efficiency was established for gasoline fueled passenger vehicles. The goal of the new standard is to attain vehicle fleet efficiency of 20.3 km per liter by 2020, compared to the 2009 level of 16.3 km per liter. As a result of the efforts by the auto industry in developing technologies to improve efficiency, by 2014 the average fleet efficiency of gasoline fueled passenger cars was 21.8 km per liter. Ministry of Land, Infrastructure and Transport will start to consider setting a new standard.

IV. Ethanol

Production

Virtually all (99 percent) ethanol in Japan is imported. Japan imports un-refined ethanol, which is then distilled to produce refined ethanol for industrial purposes. There are about 30 such refineries throughout the nation. Currently, two companies produce approximately one million liters of synthetic ethanol annually from ethylene for use in industrial chemicals, and three refineries produce approximately a total of two million liters of bioethanol from molasses and rice for fuel in Japan.

Refineries of Ethanol for Fuel

Location	Feedstock	Estimated production of ethanol in 2015
Niigata Prefecture	Rice for non-food purpose	0.2 million liters
Okinawa Main Island	Molasses	1.8 million liters
Okinawa Miyakojima Island	Molasses	17 thousand liters

Of those three facilities, one is located in Niigata Prefecture and is operated by JA Zen-noh, a federation of agricultural cooperatives. It uses high yield rice grown specifically for biofuel production. The facility produced approximately 0.2 million liters of bioethanol from rice in 2015. The ethanol is used as part of an E3 blend, and the E3 gasoline is sold at six affiliated gas stations around Niigata Prefecture.

The two other facilities are located in Okinawa Prefecture; one is on the main island of Okinawa, and the other is on Miyakojima Island, about 300 kilometers southwest of the main island. The ethanol for fuel project on the main island of Okinawa is supervised by MOE, and in 2015 the facility produced approximately 1.8 million liters of ethanol from molasses, which is obtained from the process of making sugar from sugarcane. The facility on Miyakojima Island is run by the Miyakojima City Government in cooperation with a local oil supplier. It also uses molasses to produce ethanol. In 2015, it produced 17 thousand liters of ethanol. The ethanol produced on those islands is used as part of an E3 and E10 blend and is sold at gas stations on the two islands.

Two Ethanol Facilities in Hokkaido Shut Down Operations

In 2014, MAFF discontinued providing assistance to three refineries producing bioethanol for fuel, because it determined that, without government support, high production costs - including an increase in feedstock prices - make continuation of their business extremely difficult. Two of those refineries produced approximately 24 million liters of bioethanol annually in Hokkaido. They sold the bioethanol

to Japan Biofuels Supply LLP, a company established jointly by the Petroleum Association of Japan (PAJ) member companies, to produce ETBE. Since MAFF discontinued its support, they have shut down their operations. The third is the refinery in Niigata Prefecture noted above. It continues to operate but has reduced production to less than half of what it used to produce.

Domestic Production of ETBE

In 2010, Japan Biofuels Supply LLP started to produce ETBE domestically. Each year, the company produces 140 million liters of ETBE, utilizing 59 million liters of ethanol. Previously, both domestically produced and imported ethanol was used to make ETBE, but since the two ethanol refineries in Hokkaido were shut down in 2014, the company relies on imported ethanol.

PS&D – Ethanol

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Beginning Stocks	10	15	13	12	3	3	4	4	5	5
Fuel Begin Stocks	0	0	0	0	0	0	0	0	0	0
Production	0	20	25	24	23	22	2	2	1	1
Fuel Production*	0	20	25	24	23	22	2	2	1	1
Imports	325	439	739	732	738	799	943	1,041	1,181	1,257
Fuel Imports	3	66	336	338	334	382	517	606	746	822
*>of which is ETBE (a)***	3	24	296	294	288	334	458	539	678	754
Exports	0	11	5	5	1	0	0	0	0	0
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption*	320	450	760	760	760	820	945	1,042	1,182	1,256
Fuel Consumption	3	86	361	362	357	404	519	608	747	823
Ending Stocks	15	13	12	3	3	4	4	5	5	7
Fuel Ending Stocks	0	0	0	0	0	0	0	0	0	0
Total BalanceCheck	0	0	0	0	0	0	0	0	0	0
Fuel BalanceCheck	0	0	0	0	0	0	0	0	0	0
Production Capacity										
Number of Refineries	32	35	35	35	35	37	37	37	37	37
Nameplate Capacity	575	607	625	625	625	625	626	626	626	626
Capacity Use (%)	0%	3%	4%	4%	4%	4%	0%	0%	0%	0%
Co-product Production (1,000 MT)										
DDG										
Corn Oil										
Feedstock Use for Fuel (1,000 MT)										
Molasses	1	1	1	2	5	8	8	8	8	8
Rice	0	2	2	2	2	2	2	1	1	1
Wheat Kernals	0	25	31	31	28	25	0	0	0	0
Sugar Beets	0	95	124	116	105	95	0	0	0	0
Market Penetration (Million Liters)										
Fuel Ethanol	3	86	361	362	357	404	519	608	747	823
Gasoline	57,473	57,347	55,643	54,116	56,207	55,419	52,975	53,104	52,067	50,179
Blend Rate (%)	0.0%	0.1%	0.6%	0.7%	0.6%	0.7%	1.0%	1.1%	1.4%	1.6%

Sources: The World Trade Atlas; Ministry of Economy, Trade and Industry; Ministry of Agriculture, Forestry and Fisheries

Notes:

- *Post's estimates.
- ** The conversion factor for ETBE into ethanol is 0.4237. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (http://www.enecho.meti.go.jp/notice/topics/017/pdf/topics_017_002.pdf).

Consumption

Two Blending Methods in Japanese Market

There are two methods for blending bioethanol with gasoline: "direct blending" and "ETBE." In Japan, MOE promotes direct blending, while METI supports the ETBE method. The reason for the latter is that it is more costly for oil distributors to renovate the facilities for direct blending.

Biofuels Blend Rates

Japan's direct blend limit for ethanol is regulated in the Gasoline Quality Assurance Law at three percent (E3). The blend rate of ETBE into gasoline is seven percent. In April 2012, the law was revised to allow the sale of types of gasoline blended with 10 percent of ethanol (E10) or 22 percent of ETBE (ETBE22). The E10 or ETBE22 gasoline is only allowed to be used with vehicles designed to use E10/ETBE22 fuel. Japanese automakers have introduced some automobile models that can run on E10 or ETBE22, but the number of these cars is very small.

Consumption and Distribution Channel

In 2015, about 42 percent of ethanol was used for food processing, cosmetics and toiletry products, and medical and hygienic purposes, and 58 percent of ethanol was used for fuel. Most of the ethanol for fuel is used in ETBE.

The distribution channel for ethanol blended gasoline (E3/E10) is very limited compared to that for ETBE blended bio-gasoline. E3/E10 gasoline is available only in a few prefectures, e.g., Okinawa and Niigata. However, ETBE blended bio-gasoline is available throughout the nation. Consumption of ETBE blended bio-gasoline is expected to increase over the next few years as the PAJ is mandated to introduce 1,940 million liters of ETBE by 2017[6].

Since April 2016, sales of E3 blended gasoline have been suspended in Okinawa because Petrobras, the parent company of the oil refinery company in Okinawa which had supplied base gasoline (sub-octane gasoline) [4] to blend with ethanol to make E3/E10 gasoline decided to withdraw from the oil refining business. Who will take over the business has not been decided. Until the supply of base gasoline is resumed, fuel ethanol facilities in Okinawa are forced to keep ethanol in the tanks of the facilities.

Trade

In 2015, Japan imported 606 million liters of ethanol for transportation, which incudes that in ETBE.

[6] The mandate is for 500 million liters crude oil equivalent of biofuels, and the choice was then made by the PAJ to use ETBE to meet the goal.

According to available information, all imported ethanol for fuel comes from Brazil.

In 2009, Japan Biofuels Supply LLP began importing ethanol to produce ETBE domestically. It imported approximately 40 million liters of ethanol each year through 2014. The import quantity is expected to increase to approximately 65 million liters because the two major suppliers of ethanol for fuel in Hokkaido have closed their operations. In 2010, a joint venture established between Japanese and Brazilian companies started importing ethanol for fuel. The company supplies ethanol for fuel mainly in Okinawa Prefecture.

Imports of ETBE are far greater than those of ethanol for fuel. In 2015, Japan imported all 1.271 billion liters of bio-ETBE (equal to an ethanol equivalent of 539 million liters) from the United States. Use of bio-ETBE is expected to increase further, as the PAJ aims to supply 1,940 million liters of bio-ETBE by 2017. Of these, the PAJ expects to import 1.8 billion liters, all of which will come from the United States as the PAJ has a purchase contract with a U.S. company.

V. Biodiesel

Overall Supply and Demand Situation

Japan's production of biodiesel is extremely limited. Post estimates biodiesel production at 15 million liters in 2015 based on data from the Japan Organic Recycling Association. Post estimates that the production will remain at the same level. Due to lower diesel prices, demand for biodiesel, which is a substitute of diesel, is likely to decrease. However, robust exports of biodiesel will offset the decrease in domestic demand.

Production

The most common feedstock for bio-diesel production in Japan is used cooking oil. It is said that the total amount of used cooking oil discharged annually in the country is about 450 thousand MT, from which about 410 million liters of biodiesel could be produced.

Municipal governments and regional non-profit organizations are participating in small-scale bio-diesel projects called the "Rapeseed Project". Currently, there are about 118 projects. The projects involve growing rapeseed to produce cooking oil, collecting the used oil, and recycling it as biodiesel fuel. The biodiesel fuel is used mainly for garbage and cargo trucks.

There is another project by the City of Kyoto to collect used vegetable oil from restaurants and individual households. The oil is processed into biodiesel fuel at the city's refinery, which produces five thousand liters per day. Approximately 1.3 million liters of biodiesel fuel is produced annually in the refinery and used for the city's garbage trucks (B100) and municipal buses (B20).

In Kyoto, there is also a private company producing biodiesel fuel from used vegetable oil. The firm started from a citizen's group whose activities included collecting used cooking oil for the purpose of environmental protection. To date, the firm has established its own network to collect used cooking oil

from individual households, restaurants, and any public or private organizations nationwide. Its refinery in Kyoto can produce 11 million liters of biodiesel fuel annually. According to the company, it is the largest capacity biodiesel fuel refinery in Japan. In 2011, the company began exporting a steady stream of biodiesel fuel to the Netherlands.

PS& D – Biodiesel

Biodiesel (Million Liters)										
Calendar Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Beginning Stocks		0	0	0	0	0	0	0	0	0
Production*	8	9	10	12	14	14	15	15	16	16
Imports					0.1	0.5	0.6	1.1	1.3	1.3
Exports					2.3	3.1	3.2	3.6	4.6	4.6
Consumption	8	9	10	12	12	11	12	13	13	13
Ending Stocks										
BalanceCheck	0	0	0	0	0	0	0	0	0	0
Production Capacity										
Number of Biorefineries**	71	66	58	58	40	46	43	43	43	43
Nameplate Capacity										
Capacity Use (%)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Feedstock Use for Fuel (1,000 MT)										
Used Cooking Oil***	8	9	11	13	15	15	16	16	17	17
Feedstock B										
Feedstock C										
Feedstock D										
Market Penetration (Million Liters)										
Biodiesel, on-road use*	8	9	10	12	12	11	12	12	12	12
Diesel, on-road use	29,999	28,247	27,426	26,014	24,724	24,345	23,731	23,606	23,708	23,479
Blend Rate (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%
Diesel, total use										

Sources: Japan Organic Recycling Association; The World Trade Atlas; Ministry of Economy, Trade and Industry

Notes:

- Years are Japanese fiscal year, April - March.
- * Post's estimates based on available information.
- ** Numbers are based on the annual survey conducted by the National Biodiesel Fuel Utilization Council.
- *** Post's estimates with the average recycle rate of 91%.

Consumption

Japan currently uses 23.6 billion liters of diesel for on-road transportation, and over 80 percent of

biodiesel is consumed in this market. The calculated national average blend rate is a mere 0.1 percent. Given that on-road diesel use is expected to remain flat for some years, no change in the biodiesel market or blend rate is foreseen unless a new role for biodiesel is established in post-2017 biofuel goals.

Japan's blend rate for biodiesel is five percent (B5). By receiving special approval from METI, operators are able to use biodiesel with a blend rate higher than five percent for their trucks and buses, as is the case for the City of Kyoto.

According to a survey conducted in 2014 by the Japan Organic Recycling Association, approximately 87 percent of biodiesel in Japan is used for trucks and buses, followed by passenger cars (five percent), heavy machinery at construction sites (four percent), agricultural machinery (two percent), and generating power (one percent).

According to an industry source, consumption of biodiesel in the transportation sector is not expected to increase beyond small changes because distribution channels are not established and fuel standards limit blending due to concern that fuel blended rate at higher rates may cause engine trouble. But such concerns have proven to be unfounded and are commonly seen as an argument against change. U.S. and European programs have successfully introduced blends above B5 at large scale with organized programs aimed at producers, distributors and consumers to insure fuel quality, safety in handling, and problem-free vehicle fleet management. A number of countries, most notably Brazil, Argentina, Malaysia, and Indonesia, have reached the B7-10 level and are pushing higher. In the United States, long-haul, heavy duty truck fleets routinely fill up with B10, and over 95 percent of diesel engines in use today are approved for blends up to B20 by original engine manufacturers, included Japanese manufacturers. European fuel standards approve B7 use and a number of municipal bus systems and managed fleets use B10. Engines are proven to run longer on biodiesel blends as compared to fossil diesel alone.

In Japan, national government and several local governments have tightened controls on exhaust emissions from diesel-powered vehicles, one of which urges to replace old diesel vehicles with the new models, which meet the new emission standards. The use of biodiesel in combination with appropriately designed engines can lower most unwanted emissions beyond that which can be accomplished by using fossil diesel alone. Indeed, the main driver for New York City's biodiesel mandate for heating oil is to lower health damaging pollutants.

Trade

Since 2011, a private company in Kyoto has been exporting biodiesel to the Netherlands. (See Production section above.)

Japan's imports of biodiesel have been increasing. According to an industry source, biodiesel is most likely imported for the use of generating power.

In 2015, Japan imported 1.1 million liters of biodiesel. Of this, 96 percent was from Malaysia. The import tariff for biodiesel from Malaysia is zero due to a bilateral economic partnership agreement. Japan's import tariff is 3.9 percent.

Key Suppliers of Biodiesel to Japan					
Partner Country	Unit	2012	2013	2014	2015
World	KL	82	492	614	1,064
Malaysia	KL	0	416	442	1019
Germany	KL	34	32	38	41
Indonesia	KL	0	0	124	3
United States	KL	0	1	1	1
Source: The World Trade Atlas					
Note: HS Code 3826-00					

VI. Advanced Biofuels

Research and Development

Japanese private companies and Japan's scientific community, including universities and public and private research institutions, are expending significant effort toward basic and applied research related to biofuels. The focus of their research projects is cellulosic and algal sources and technologies to mass produce biofuels in a sustainable way. Several joint research projects aim to mass produce bio jet fuel from algae. The goal is to commercialize these fuels by 2030.

Development in Fuels from Algae - Two Examples

In 2015, the Algal Biomass and Energy System R&D Center at University of Tsukuba held an international symposium on algal biomass. In the symposium attended by officials of both Japanese and U.S. governments as well as researchers and company representatives, the participants discussed collaboration between Japan and the United States to develop an algal biomass industry.

A venture firm in Tokyo plans to produce bio jet fuel from euglena, a kind of algae, and aims to commercialize it by 2020. The firm has a farm to grow euglena on Ishigaki Island in Okinawa Prefecture, and is building a facility to produce bio jet fuel from the euglena in Yokohama City. The facility will have an annual production capacity of 125 million liters of bio jet fuel.

The GOJ aims to Introduce Bio Jet Fuel from Algae in 2020

The Government of Japan (GOJ) wants to introduce bio jet fuel for commercial flights in 2020, the year that the Summer Olympic Games and Paralympic Games will be held in Tokyo. In 2015, the Ministry

of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Economy, Trade and Industry (METI) established a joint expert committee to discuss the plan. The committee has two working groups; one studies the supply chain of bio jet fuel, and the other examines fuel production. The committee may consider importing bio jet fuel when the quantity of domestic production is not sufficient.

Production and Consumption of Cellulosic Ethanol

The Bioethanol Division of a private company in Sakai City, Osaka that operates recycling facilities to process waste products and materials began production of ethanol from wood and lumber waste in 2007. Its annual production capacity is 1.4 million liters. For the first several years, the company supplied the ethanol to a couple of oil distributors who make E3 gasoline to sell at the distributors' affiliated gas stations. However, because E3 gasoline did not come into wide use, there is little demand for the company's ethanol. The company is currently using most of the ethanol it produces to generate power for its facility, and it sells the rest of the ethanol to an industrial alcohol distributor.

VII. Biomass for Heat and Power

Japan's production and import of wood pellets is increasing. Imports of palm kernel shells (PKS) used for heat and power is also increasing. Although Japan has abundant biomass resources, it is unable to extract those resources economically. Imports of wood pellets and PKS are therefore likely to increase in the coming years because the trend of mixing wood pellets with coal for thermal power generation is expected to continue and the number of biomass power facilities, which use wood materials including wood pellets and PKS, is increasing under the Feed-in Tariff (FIT) system.

Since the GOJ's Biomass Nippon Strategy was unveiled in 2002, the introduction of pellet boilers and stoves for heating in public facilities and ordinary households has expanded. Accordingly, the number of plants and the production of pellets have increased significantly. In 2014, Japan's production of wood pellets was 126 thousand MT, and there were 142 plants. The production scale of wood pellet plants in Japan is very small compared to modern commercial plants in the United States and Europe. About 60 percent of the plants in Japan produce a mere 100 – 1,000 MT each year. In the FY2015 Annual Report on Forest and Forestry in Japan, the Ministry of Agriculture, Forestry and Fisheries (MAFF) points out that in order to increase competitiveness of domestically produced wood pellets, the production scale of the wood pellets plants must increase.

In Japan, most of the nuclear power reactors are currently shut down due to the national debate on the safety of nuclear power generation that began in the wake of the nuclear power plant accident in Fukushima occurred in 2011. Japan is now forced to rely on other energy sources to generate power.

After the accident in Fukushima, power companies began using wood pellets as a stable source for thermal power generation, though coal is still the main source. The companies use imported wood pellets, as prices are lower compared to those produced domestically. Japan has a zero import tariff for wood pellets (HS4401.31).

In 2015, Japan's imports of wood pellets increased 140 percent from the previous year to 232 thousand MT. Of these, 146 thousand MT, or 63 percent, were imported from Canada, followed by China (25 percent) and Vietnam (12 percent). According to industry sources, Canada is the leading supplier due to competitive prices and quality. Imports of wood pellets are likely to increase in the coming years because the trend of mixing wood pellets with coal for thermal power generation is expected to continue and the number of small and mid-scale biomass power facilities (below 10,000 kW), which use wood materials including wood pellets and palm kernel shells (PKS) is increasing under the Feed-in Tariff (FIT) system (see the section II. Policy and Programs).

Key Suppliers of Wood Pellets to Japan

	Quantity (Metric Tons)			
Partner Country	2012	2013	2014	2015
World	71,981	83,769	96,745	232,425
Canada	66,470	72,151	90,676	146,150
China	653	5,242	-	57,870
Vietnam	3,533	2,897	1,979	27,440
Indonesia	15	629	410	304
United States	233	326	563	237

Source: The World Trade Atlas
Note: HS Code: 4401.31

Japan - Import Price of Wood Pellets					
Partner Country	Unit	Unit Value (United States Dollars)			
		2012	2013	2014	2015
World	T	268.64	241.94	251.25	196.34
United States	T	418.1	452.82	477.47	441.02
China	T	450.79	215.17	0	208.51
Canada	T	272.03	247.94	254.77	197.89
Vietnam	T	160.08	175.69	196.7	161.2
Indonesia	T	176.51	173.83	145.54	141.72

Source: The World Trade Atlas
Note: HS Code: 4401.31

PS& D – Wood Pellets

Wood Pellets (1,000 MT)										
Calendar Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Beginning Stocks		0	0	0	0	0	0	0	0	0
Production*	36	51	58	79	98	110	126	145	167	192
Imports**	42	59	73	74	72	84	97	232	302	362
Exports**	4	3	3	4	4	5	4	0.5	1	1
Consumption	74	107	128	149	166	189	219	376	468	553
Ending Stocks										
BalanceCheck	0	0	0	0	0	0	0	0	0	0
Production Capacity										
Number of Plants*	63	75	85	108	109	115	142	150	155	160
Nameplate Capacity										
Capacity Use (%)	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Sources: Ministry of Agriculture, Forestry and Fisheries; The World Trade Atlas

Notes:

- *Numbers for 2015 onwards are forecast by Post.
- **Numbers for 2016 onwards are forecast by Post.

Japan's imports of palm kernel shells (PKS) are also increasing to use for biomass power generation. In 2015, its imports of PKS doubled from the previous year to 456 thousand metrics tons, most of which came from Malaysia and Indonesia. Japan has a zero import tariff for PKS. Imports of PKS as well as wood pellets are expected to increase for years to come. Industry sources expect PKS imports to reach 1 million MT in 2016.

Japan Import Statistics				
Commodity: 2306.60.000, Palm Kernel Shells and Others				
Partner Country	Quantity (Metric Tons)			
	2012	2013	2014	2015
World	25,838	131,224	244,178	456,084
Malaysia	17,143	68,560	112,500	200,913
Indonesia	8,673	62,645	131,678	255,104
China	0	0	0	41
Thailand	22	0	0	0
United States	0	19	0	0
Ecuador	0	0	0	26

Source: The World Trade Atlas

Japan is considering establishing its own standards to address concerns about environmental sustainability criteria for biomass products.

VIII. Notes on Statistical Data

Table – Road Map to Introduce Bio-ETBE in Japanese Market (Unit: Million Liters)
Sources: The World Trade Atlas; Petroleum Association of Japan
* Post's Estimate based on available sources.
** The conversion factor for ETBE into ethanol is 0.4237. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (http://www.enecho.meti.go.jp/notice/topics/017/pdf/topics_017_002.pdf).

Table – FIT Purchase Rates for FY2015

Table – Fuel Use History (Unit: Million Liters)
Source: Ministry of Economy, Trade and Industry (METI)
Notes:
- Numbers for 2010 and 2011 are forecast by METI in 2010. Actual numbers are not available due to the Great East Japan Earthquake occurred in 2011.
- Numbers for 2021 onwards are forecast by Post.
- Years are Japanese fiscal year, April - March.

Table – Number of Clean Energy Vehicles
Source: Japan Automobile Manufacturers Association

Table – Refineries of Ethanol for Fuel

Table – PS&D Ethanol Used as Fuel and Other Industrial Chemicals (Unit: Million Liters)
Sources: The World Trade Atlas; Ministry of Economy, Trade and Industry; Ministry of Agriculture, Forestry and Fisheries
Notes:
- *Post's estimates.
- ** The conversion factor for ETBE into ethanol is 0.4237. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (http://www.enecho.meti.go.jp/notice/topics/017/pdf/topics_017_002.pdf).

Table – Key Suppliers of Biodiesel to Japan (Unit: Kilo Liters)
Source: The World Trade Atlas
Note: HS Code 3826-00

Table –PS&D Biodiesel (Unit: Million Liters)
Sources: Japan Organic Recycling Association; The World Trade Atlas; Ministry of Economy, Trade and Industry
Notes:

- Years are Japanese fiscal year, April - March.
- * Post's estimates based on available information.
- ** Numbers are based on the annual survey conducted by the National Biodiesel Fuel Utilization Council.
- *** Post's estimates with the average recycle rate of 91%.

Table – Key Suppliers of Biodiesel to Japan
Source: The World Trade Atlas
Note: HS Code 3826-00

Table – Key Suppliers of Wood Pellets to Japan (Unit: Metric Tons)
Source: The World Trade Atlas
Note: HS Code 4401.31

Table – Japan – Import Price of Wood Pellets
Source: The World Trade Atlas

Table – PS&D Wood Pellets (Unit: 1,000 MT)
Sources: Ministry of Agriculture, Forestry and Fisheries; The World Trade Atlas
Notes:
- *Numbers for 2015 onwards are forecast by Post.
- **Numbers for 2016 onwards are forecast by Post.

Table – Japan –Imports of Palm Kernel Shells
Source: The World Trade Atlas
Note: HS Code 2306.60.000