Required Report: Required - Public Distribution **Date:** November 06,2019

Report Number: JA2019-0183

Report Name: Biofuels Annual

Country: Japan

Post: Tokyo

Report Category: Biofuels

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Report Highlights:

Japan's annual biofuel target of 500 million liters (crude oil equivalent) for the transport sector was reached on time in 2017 and continues unchanged this year. To achieve the biofuel target which remains unchanged through 2022, Japan mostly imports bio-Ethyl Tert-Butyl Ether (ETBE), but a small portion of the requirement is covered by domestic ETBE produced from imported bioethanol. Following a 2018 revision of environmental standards for bioethanol, Japan began importing ETBE made from U.S. corn ethanol for the first time in July 2019, but its ethanol blend rate remains among the lowest of countries with a fuel ethanol program. A number of very small-scale biodiesel plants still operate but the market is virtually non-existent and has no growth prospects. Japan's market for wood pellets is expanding rapidly as biomass and co-fired power plants take advantage of feed-in tariffs. Policy-driven market opportunity for foreign wood pellet suppliers is exceptional, but U.S. suppliers remain on the margin.

Section I. Executive Summary

Since joining the Kyoto protocol in 1997, the Government of Japan (GOJ) has encouraged the use of renewable energy and established a reduction target for greenhouse gas (GHG) emissions. As part of its commitment under the Paris Agreement, Japan's Ministry of Economy, Trade and Industry (METI) published the new Energy Basic Plan (available in English) on July 3, 2018. According to the plan, GOJ will increase its reliance on renewable energy to 13-14 percent of Japan's total energy supply by Japan's fiscal year (FY) 2030.

METI drives the biofuel policy by establishing a target volume, a de facto mandate. As of 2019, the Prime Minister's Office has maintained its 2005 annual biofuel goal of 500 million liters of crude oil equivalent[1] (LOE) in the transportation sector. To meet the target, METI's 2018 Action Plan set the annual biofuel target at 824 million liters through FY 2022. Rather than directly blending bioethanol with gasoline, Japanese oil refineries choose to meet the GOJ target by blending bio-Ethyl Tert-Butyl Ether (ETBE) produced from bioethanol into gasoline. Earlier there was a small market for directly blended E3 which has since largely disappeared. The current national average blend rate for ethanol (via ETBE use) is only 1.6% which is the lowest of any country with a fuel ethanol program.

Up until this year, the bio-ETBE placed on the market was produced only from Brazilian sugarcane-based ethanol and a small faction from domestically produced rice ethanol. On April 2018, METI revised the environmental standards for bioethanol, added GHG emission values for U.S. corn-based ethanol, and opened the Japanese fuel market to U.S. ethanol. The first shipment of bio-ETBE made with U.S. corn-based ethanol arrived to Japan in July 2019 (USGC: July 18, 2019).

In 2018, in addition to transport bioethanol, Japan imported 400 million liters of non-fuel ethanol for food and industrial applications. Of that total, approximately 47 percent went into food use, 17 percent toward cosmetics and medicine, and the remaining 36 percent to other industrial uses. Brazil, Pakistan and the United States are the major industrial bioethanol suppliers to Japan.

Japanese refineries are not pursuing the introduction of biodiesel. Production exceeds demand for diesel, and there is no tax incentive for biodiesel as fuel. Currently, biodiesel is produced from used cooking oil in very small volumes, and its use is limited to municipal vehicles in a few local and regional programs, such as transit buses and garbage trucks. The national average blend rate is only 0.02%.

Japan aims to initiate commercial utilization of advanced bioethanol and bio-jet fuels by the 2020 Tokyo Olympics. In line with the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation, METI plans to include bio-jet fuel under its biofuel target and double count the use of advanced bioethanol toward that target.

As an entirely separate matter, biomass consumption in the electricity sector is driven by renewable energy payments, known as feed-in tariffs (FIT). GOJ allows power companies to charge customers a premium for electricity derived from eligible renewable electricity generators for 10 to 20 years. Different payment rates apply to woody biomass from domestic forest thinning operations and to general

[1] The conversion factor for ethanol into crude oil is 0.607. Thus, 500 million liters (crude oil equivalent) is equal to 824 million liters of ethanol. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (Japanese only).

wood, including imported wood pellets, sawmill residues, palm kernel shell (PKS) and other agricultural residues. Japan imported 1.06 million metric tons (MMT) of wood pellets in 2018, of which 60 percent were from Canada. As biomass power plants are looking for a reliable long-term biomass supply, wood pellet imports to Japan are expected to significantly increase in the near future, and U.S. wood pellet exports to Japan are expected to exceed 3 MMT by 2025[2].

Section II. Policy and Programs

GHG Emissions and Renewable Energy Policy

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Conferences of the Parties (COP) 3 on December 11, 1997 and entered into force on February 16, 2005. GOJ approved the Kyoto Protocol Target Achievement Plan on April 28, 2005. According to the plan, by 2012, Japan committed to reducing its GHG emissions by 6 percent compared to its 1990 GHG emissions levels via (i) carbon sequestration through forest management (3.9 percent), (ii) Kyoto Protocol flexibility mechanisms, such as international emissions trading (1.6 percent), and (iii) use of lower GHG emitting fuel (0.5 percent). Since 2005, Japan has targeted 500 million LOE for transport biofuels.

To improve energy security and revitalize rural areas, Japan's policies under the previous governing party (the Democratic Party of Japan or DOJ) aimed to promote domestically produced renewable energy to meet the 500 million LOE target. Between 2009 and 2012, DOJ implemented the FIT program for biomass consumption and implemented financial supports for a Biofuels Production Establishment Program. However, the 2011 Fukushima nuclear power plant accident and the 2012 election of the Liberal Democratic Party (LDP) sharply changed Japan's energy and environmental policies. METI downscaled the FIT program, while MAFF terminated financial support for domestic bioethanol production.

By 2016, METI and the Ministry of Environment (MOE) announced that Japan had reduced its GHG emissions by 8.4 percent from 1990 and met its goal. In fact, Japan's annual GHG emissions had increased by 1.4 percent but were offset through carbon sequestration programs (3.9 percent) and the use of flexibility mechanisms (5.9 percent). Japan did not join the second Kyoto Protocol commitment. Following the 2015 Paris Agreement, in July 2015, GOJ submitted Japan's Intended Nationally Determined Contribution (INDC) to UNFCCC. According to the INDC plan, by FY 2030, Japan intends to reduce GHG emissions by 26 percent compared to FY 2013.

On July 3, 2018, METI published the 5th Energy Basic Plan, which set direction for achieving the INDC goal. According to GOJ's 2019 Long-Term Strategy under the Paris Agreement, the INDC target specific to transport will be primarily achieved through technological advances in fuel efficiency and promotion of next generation (e.g., fuel cell and electric) vehicles, rather than improvements in biofuel blend rates.

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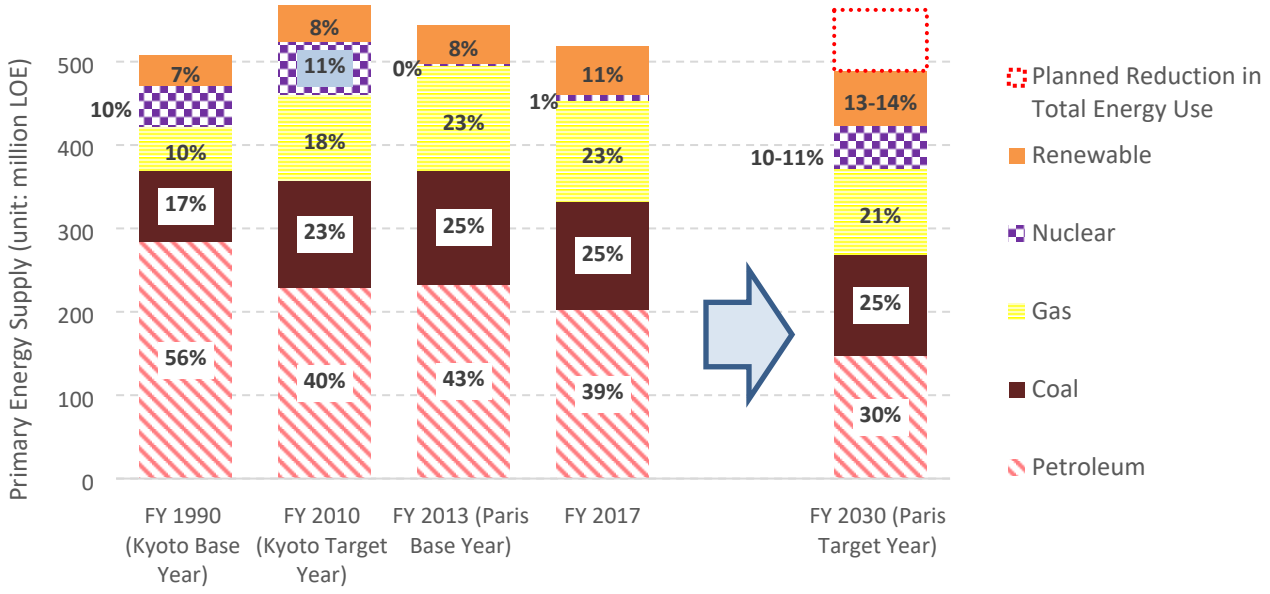
[2] Enviva Business Overview (August 12, 2019)

Figure 1 illustrates the distribution of Japan's energy sources historically and in comparison to the FY 2030 INDC target under Paris Agreement as of October 2019. METI's definition of renewable energy sources includes biomass (including biofuels), solar, wind, geothermal, hydro, and heat energy reutilization. GOJ aims to offset reductions in petroleum use by an overall reduction in energy consumption, as well as greater reliance on nuclear and renewable energy. Japan's transport biofuel target volume is expected to remain 500 million LOE thru 2022, first set in 2005.

Figure 1. Japan's Historical and Target Total Energy Sources

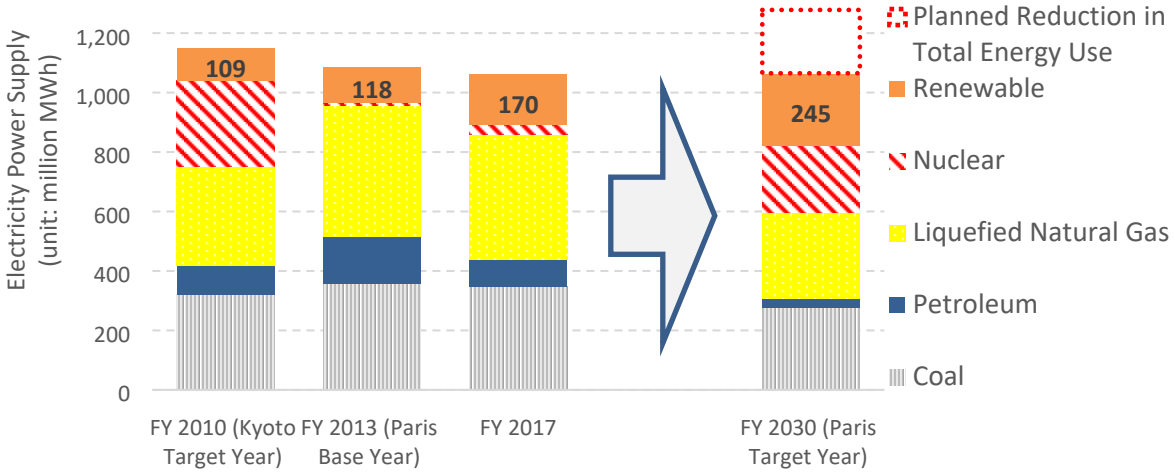


Sources: METI Long-term Energy Supply and Demand Outlook; ANRE Total Energy Statistics

Note: 1 liter crude oil equivalent (LOE) = 38.7 MJ

In July 2015, METI's Agency for Natural Resources and Energy (ANRE) published Long-Term Energy Supply and Demand Outlook. According to that document, by FY 2030, Japan's renewable energy share of the total energy consumption will be approximately 23 percent, while nuclear energy consumption will return to pre-2011 levels (Figure 2).

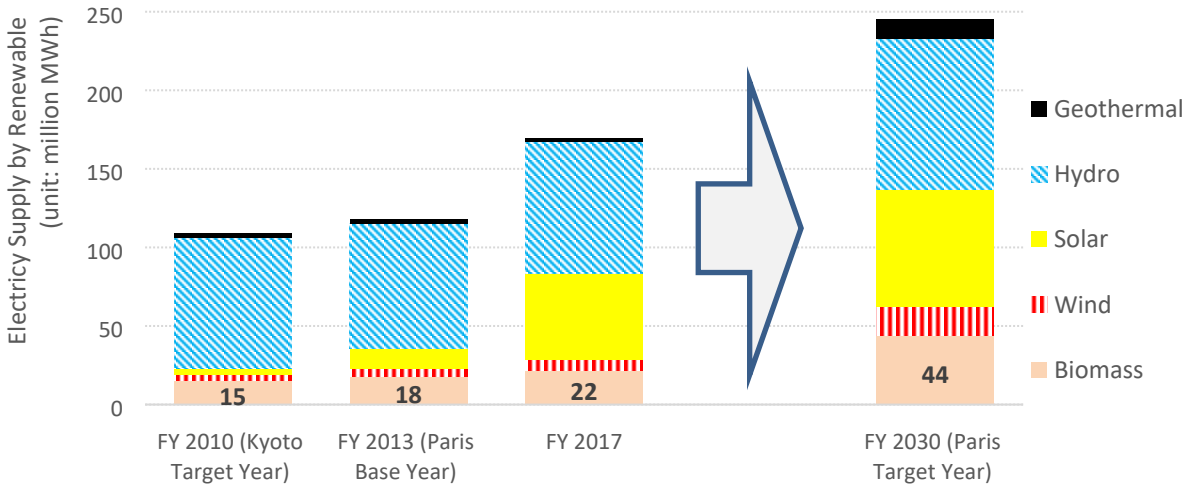
Figure 2. Japan's Historical and Target Electric Energy Consumption by Source



Sources: METI Long-term Energy Supply and Demand Outlook; ANRE Total Energy Statistics

Compared to FY 2017, the overall use of renewable energy sources is expected to increase by 44.3 percent by FY 2030 (Figure 2) as the use of biomass for power generation doubles (Figure 3).

Figure 3. Japan's Historical and Target Renewable Power Supply by Source



Sources: METI Long-term Energy Supply and Demand Outlook; ANRE Total Energy Statistics

Mandates (Voluntary Target Volumes) and Carbon Intensity (CI) Requirements

Bioethanol (Fuel)

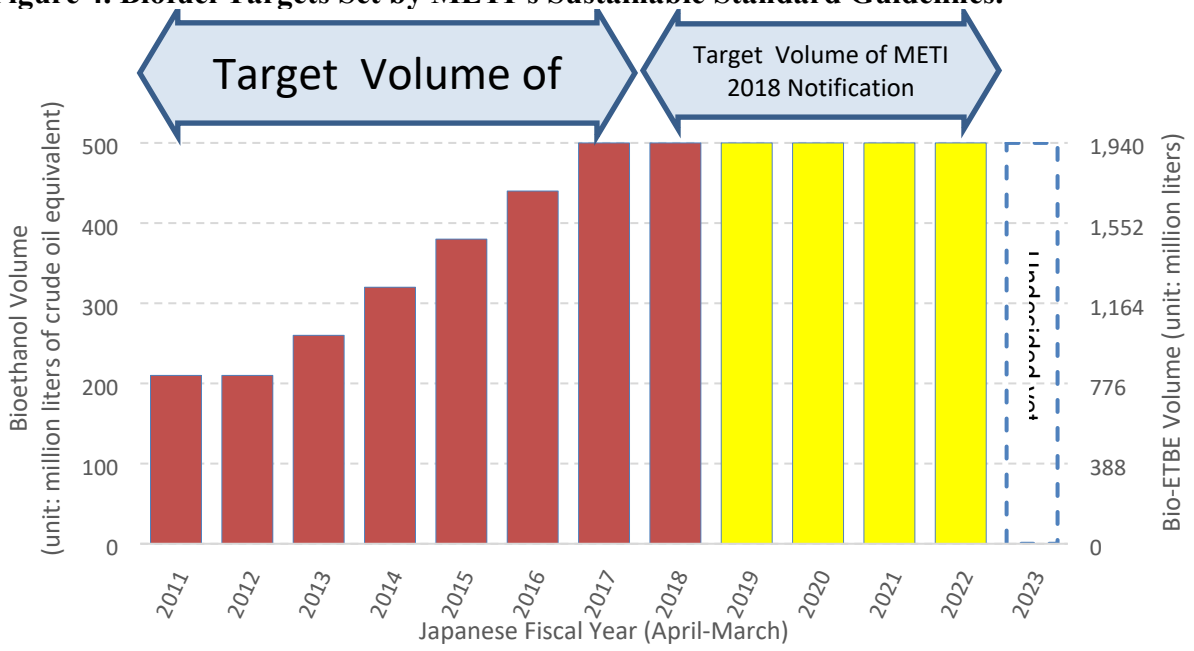
To increase the use of biofuels in 2007, Japanese large oil refinery/distributor companies established Japan Biofuels Supply LLP (JBSL). Due to variable biodiesel quality, higher biofuel production costs, and supply chain infrastructure investments needed, JBSL chose to focus on bioethanol over biodiesel. As blending of bio-ETBE derived from bioethanol required the least infrastructure investment and changes to gasoline refining, JBSL pursued bio-ETBE blending, instead of direct bioethanol blending. JBSL set and achieved a voluntary target of 820 million liters of bio-ETBE (210 million LOE) by FY 2010 blended with gasoline.

In July 2009, METI formulated the Sophisticated Methods of Energy Supply Structure Act (available in Japanese) to encourage the use of renewable energy sources and reduce reliance on fossil fuels by energy suppliers, including JBSL. On November 2010, METI revised the sustainable standard guidelines for bioethanol. In these guidelines, METI (i) specified the GHG emissions (or carbon intensity (CI)) value for gasoline at 81.7 g-CO_2e/MJ, (ii) set the GHG emissions value for Brazilian sugarcane-based ethanol at 32.7 g-CO_2e/MJ, and (iii) set the annual biofuel 500 LOE target for FY 2017. In FY 2017, JBSL announced that they achieved that target through blending with imported bio-ETBE, produced from Brazilian sugarcane-based ethanol (Figure 4). METI's gasoline GHG emissions values were based on the oil industry's life cycle assessments (LCA) from 2000.

On April 17, 2018, METI revised the 2010 sustainable standard guidelines. Due to higher methane and nitrous oxide emissions during transport and manufacturing, METI increased the GHG emissions value of Brazilian sugarcane-based ethanol to 33.61 g-CO_2e/MJ. Moreover, METI set the GHG emissions value for U.S. corn-based ethanol at 43.15 g-CO_2e/MJ. This development facilitated the use of U.S. corn-based ethanol in bio-ETBE production. However, METI's simultaneous increase in the emissions reduction target for transport bioethanol from 50 to 55 percent meant that U.S. corn-based ethanol could replace no more than 44.4 percent (366 million liters) of total annual bioethanol use in bio-ETBE, with the rest filled by Brazilian sugarcane-based bioethanol (see JA8026). Although METI updated the GHG emissions value of gasoline to 84.11 g-CO_2e/MJ to account for methane and nitrous oxide emissions during crude oil production, METI did not apply newly available LCA values to revise its GHG emissions value for Japanese gasoline that dates to 2000. Currently, Japan's GHG emissions value for gasoline is significantly lower than the EU gasoline baseline or the U.S. Environmental Protection Agency's Renewable Fuel Standard values. The 2018 sustainability standard guidelines extended the target goal of 500 million LOE through FY 2022 (Figure 4). Consequently, JBSL anticipates blending approximately 1,940 million liters of bio-ETBE (containing 500 million LOE bioethanol) per year thru FY 2022 as it has done since FY 2017.

As of October 2019, JBSL membership consists of JXTG Nippon Oil & Energy Corporation (ENEOS), Idemitsu Kosan (Idemitsu, Showa Shell), Cosmo Oil, Fuji Oil Company, and Taiyo Oil Company. While the National Federation of Agricultural Cooperative Associations (Zen-noh) also operates an oil distribution and retail business, particularly in rural areas, and accounts for roughly 6 percent of gasoline sales, it is not subject to METI's biofuel target.

Figure 4. Biofuel Targets Set by METI's Sustainable Standard Guidelines.



Source: METI
Note: Red columns represent achieved target values and yellow columns represent future targets.

Financial Supports for Producers

Biofuels

In 2008, to promote bioethanol use, GOJ amended the "Quality Control of Gasoline and Other Fuels Act" to exempt bioethanol from gasoline, oil and coal taxes. However, these financial incentives are insufficient. Under Japan's current fuel tax structure, on a per liter basis, the retail price of bioethanol is comparable to that of gasoline (see Appendix II for further details) even though its energy density is one-third less.

Similarly, no substantial tax incentive exists for biodiesel, which is subject to the same diesel tax as on-road diesel. Biodiesel producers have frequently, though unsuccessfully, petitioned GOJ to revise the tax structure to expand the biodiesel market.

Feed-In Tariff (Electrical Power)

In 2003, METI introduced the Renewables Portfolio Standard (RPS) system as a regulatory mandate for electric companies to increase energy production from renewable sources as an alternative to fossil and nuclear power. Between 2003 and 2011, the RPS system nearly doubled the amount of biomass-generated electricity.

Following the 2011 Fukushima Daiichi nuclear power plant accident, Japan ended its nuclear power use and expanded the FIT program to solar, wind, geothermal, hydro, and biomass power sources (see JA8093 for a full FIT program price schedule). Under Japan's FIT scheme, power utility companies

charge customers a fixed premium (i.e. tariff) for power from eligible renewable power generators for predetermined periods (10-20 years). The FIT program applies only to electric power generation. There is no financial incentive program for biomass heat generation in Japan.

Table 1 summarizes current woody biomass FIT rates. The tariff rates for biomass derived from domestic forest thinning operations are substantially higher than for imported biomass. It should be noted that the definition of "forest thinning operations" is fluid and may occasionally refer to selection harvesting (see JA9098 for further information on Japanese forestry operations). The "general wood" category encompasses imported wood chips, pellets and agricultural residues/biomass, such as imported PKS. To promote smaller biomass power plants, the FIT program introduced facility-based higher tariff rates in 2015 for domestic wood and in 2017 for general wood. In 2018, METI introduced an auction system for general wood power plants with output exceeding 10 megawatt (MW). Biomass power plants utilizing liquid biomass (i.e., palm stearin oil) were separated from general wood category and also became subject to the auction system. Importantly, the auction requirement applies only to newly approved biomass plants, as previously approved/operating power plants already have a fixed tariff for 20 years from the time they were first approved.

Table 1. Biomass Feed-In Tariff by Fuel Category

Fiscal Year	Domestic unutilized wood & thinning		General Wood (e.g., imported pellets, sawmill residue, PKS)			Liquid Biomass (palm oil stearin)	Salvaged Lumber
	< 2Mw	2Mw≤	< 10Mw	10-20Mw	20Mw ≤		
2012	32		24			General Wood	13
2013	32		24			General Wood	13
2014	32		24			General Wood	13
2015	40	32	24			General Wood	13
2016	40	32	24			General Wood	13
2017	40	32	24		21	General Wood	13
2018	40	32	24	Auction		Auction	13
2019	40	32	24	Auction		Auction	13
2020	40	32	TBA	TBA	TBA	TBA	13
2021	40	32	TBA	TBA	TBA	TBA	13

Source: ANRE

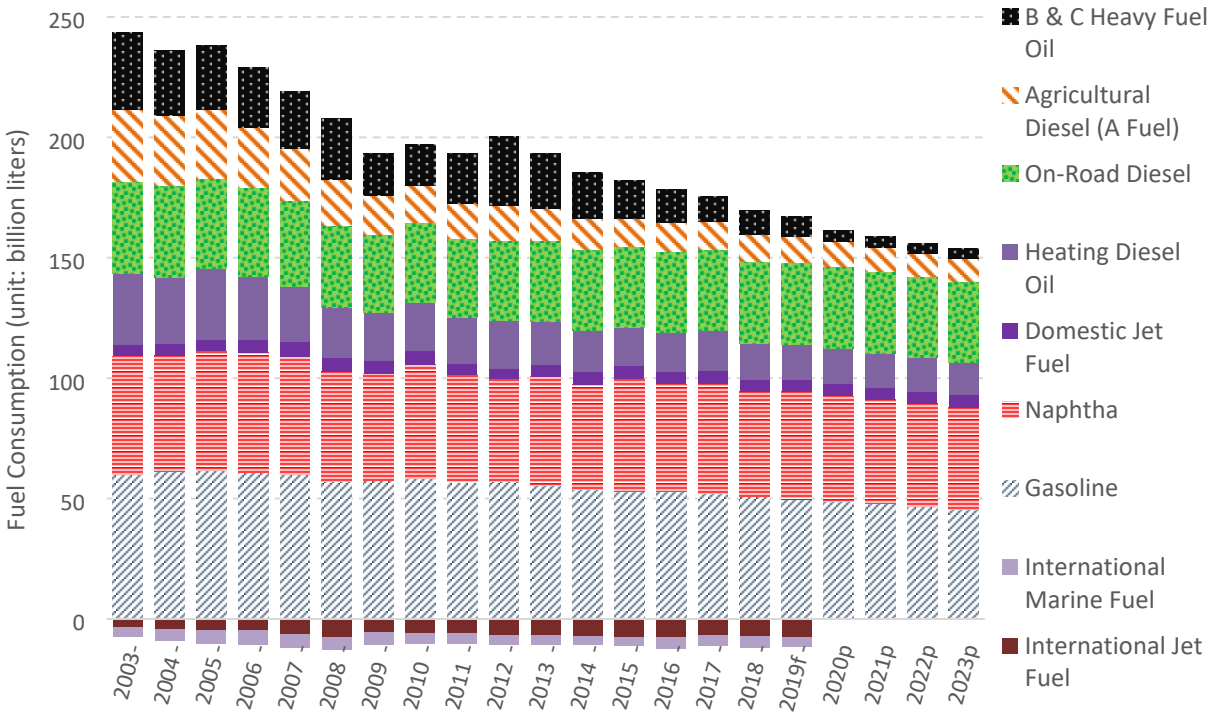
Import Policy Including Duties

In 2008, the GOJ amended the "Customs Tariff Act" and the "Temporary Tariff Measures Act" to eliminate the tariff on bio-ETBE. In 2016, the GOJ amended these Acts to eliminate the 10 percent import tariff on bioethanol for the production of bio-ETBE. The tariff exemption does not apply to bioethanol imports for use other than bio-ETBE production. For example, bioethanol imported for direct blending with gasoline would subject to a 10 percent tariff and has not been imported by Japan. On October 7, 2019, the United States and Japan finalized a limited trade agreement. GOJ agreed to gradually eliminate tariff duty 10 percent on U.S. other industrial ethanol by Year 10 after the trade agreement is effectuated. On the other hand, there is no tariff on ethanol for industrial use. Registered alcohol importers can import these ethanol and production of industrial alcohol is regulated under the Ordinance for Enforcement of the Ethanol Business Act by METI.

Section III. Gasoline and Diesel Pools

According to the Japanese Industrial Standards (JIS) and tax code, fuel is categorized into several product types: gasoline, naphtha, jet fuel, heating diesel oil, on-road diesel fuel, type A fuel oil (agricultural diesel), type B and C heavy fuel oil (primarily for industrial boilers and marine vessels) (Figure 5). "Diesel fuel" in this report refers to on-road diesel (subject to diesel tax of 32.1 yen/liter), type "A" fuel oil for agriculture and fisheries (diesel tax exempted), and heating fuel (diesel tax exempted). In 2018, due to rising crude oil prices, Japanese domestic fuel demand declined by 3.3 percent from the previous year to 167.3 billion liters[3] (Figure 5). According to METI's outlook, despite anticipated annual 1.0-1.4 percent gain in Japan's real gross domestic product (GDP), METI projects total fuel consumption to decrease by 1.5-1.7 percent annually. International Maritime Organization's implementation of new sulfur emissions regulation on January 1, 2020 for marine vessels may further affect the demand for oil products, especially type "B" and "C" fuel oil.

Figure 5. Annual Fuel Consumption by Oil Products



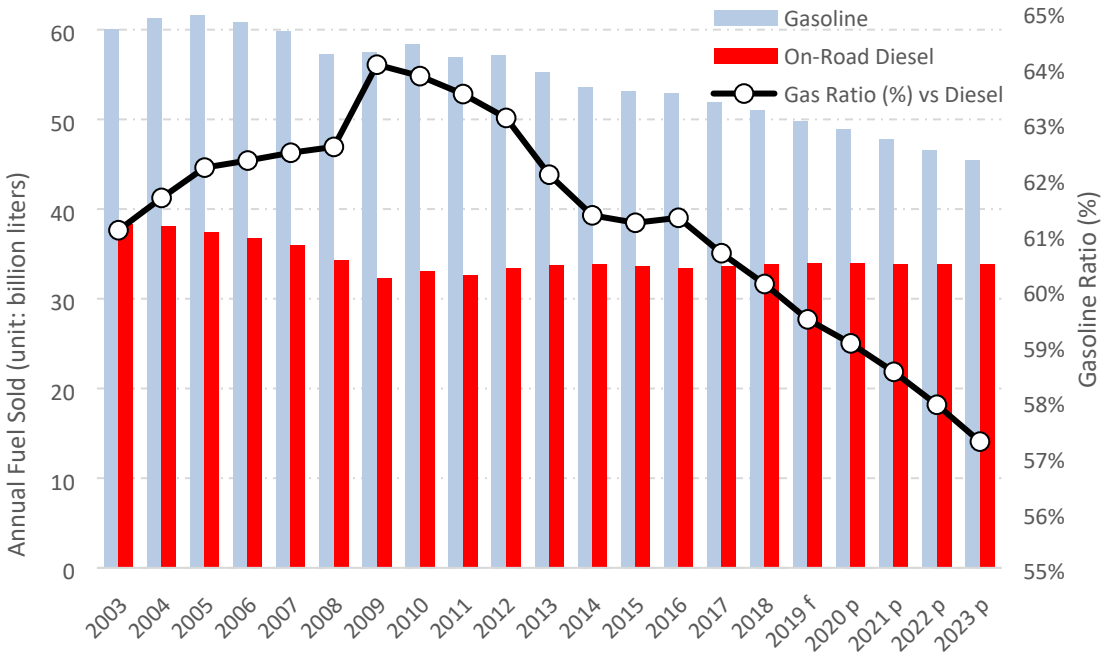
Source: ANRE Petroleum Statistics

Notes: - Japanese fuel consumption statistics and outlook do not include fuel consumption for international flights and vessels. FAS/Tokyo estimated and added these values to chart above as "International Marine Fuel" and "International Jet Fuel."
- f=forecast; p = projection

[3] This value does not include jet fuel provided for international flights at Japan's airports and fuel oil provided for international vessels at Japan's ports. These fuel categories are considered to be exports. The estimated volumes for these categories are presented as "jet fuel international" and "fuel oil international," respectively in Figure 6.

In 2018, Japanese gasoline demand fell to 51 billion liters (or 83 percent of Japan's peak gasoline consumption in 2005, Figure 6). There is a marked, long-term downward trend reflecting technological and societal shifts. Improved fuel efficiency, increased use of hybrid vehicles, urbanization and popularization of car sharing have contributed to declining gasoline consumption in Japan (see JA8093 for more discussion). METI expects this trend to continue at 2.2-2.5 percent annually through FY 2023.

Figure 6. Gasoline and On-Road Diesel Demand in Japan



Source: ANRE Petroleum Statistics
Note: f=forecast; p=projection

On the other hand, on-road diesel demand in Japan has been robust at 33.9 billion liters in 2018 or a 0.6 percent increase over 2017 (Figure 6). Consistent demand in the construction and logistics industry, coupled with a lack of a hybrid truck alternative, underlie a steady outlook for diesel consumption. Compared to gasoline projections, METI expects diesel demand to be resilient. While the 2018 gasoline to on-road diesel ratio was approximately 60 percent, METI forecasts the ratio to decline to 57 percent by 2023.

The difference in price between refined products and crude oil is sensitive to the proportion of oil products produced and market conditions. Japan's petroleum industry's preference for bioethanol over biodiesel is a product of these considerations. When GOJ introduced the transport biofuel target in 2005, biodiesel was not a feasible option as diesel production exceeded diesel demand.

Table 2. Historical Fuel Use in Japan

Fuel Use (Million Liters)										
Calendar Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019f**
Gasoline Total	58,368	56,864	57,094	55,234	53,608	53,113	52,849	51,904	50,999	49,800
Diesel Total	68,923	66,660	67,640	65,192	63,739	61,376	61,885	61,847	60,573	60,100
On-road	33,057	32,658	33,402	33,753	33,789	33,665	33,372	33,664	33,852	34,000
Agriculture & Fisheries	15,626	14,627	14,299	13,428	12,737	11,832	12,170	11,517	11,364	11,100
Heating	20,240	19,376	19,939	18,010	17,214	15,878	16,343	16,666	15,358	15,000
Jet Fuel Total	11,444	10,421	10,529	11,617	12,216	12,948	13,072	12,284	11,910	12,800
Domestic Flights	5,432	4,306	3,965	4,874	5,215	5,407	5,327	5,243	4,848	5,100
International Flights	6,012	6,115	6,564	6,743	7,001	7,541	7,745	7,041	7,062	7,700
Total Fuel Markets	138,734	133,945	135,264	132,043	129,564	127,437	127,805	126,035	123,482	122,700

f=forecast by FAS/Tokyo
Source: ANRE Petroleum Statistics; ANRE Total Energy Statistics; Japan Customs
Notes: - Gasoline total includes bio-ETBE and direct E3 blending.
- Consumption of jet-fuel in ANRE statistics only include jet fuel for domestic flights (noted in row "Domestic Flights"). Jet fuel for international flights is estimated from export statistics reported by Japan Customs. Based on the Petroleum Association of Japan's annual report, international flights account for 70 percent of jet fuel exports.

Table 3. Projected Fuel Use in Japan

Fuel Use Projections by METI (Million Liters)				
Japanese Fiscal Year	**FY2020p**	**FY2021p**	**FY2022p**	**FY2023p**
Gasoline Total	48,870	47,771	46,569	45,382
Diesel Total	58,839	58,028	57,280	56,698
On-road	33,909	33,854	33,815	33,860
Agriculture & Fisheries	10,373	10,008	9,695	9,409
Heating	14,557	14,166	13,770	13,429
Domestic Jet Fuel	5,296	5,287	5,279	5,283
Total Fuel Markets	113,005	111,086	109,128	107,363

p = projection for Japanese fiscal year
Source: METI Oil Products Demand Outlook (2019)
Notes: - Total Fuel Markets values do not include jet fuel for international flights, unlike Total Fuel Markets row in Table 2.
- Per METI projections, years are reported in Japanese fiscal years: April – March (e.g., April 2020 – March 2021 is 2020).

Section IV. Ethanol

Bioethanol (ethyl alcohol) or simply ethanol is made by fermenting the carbohydrate components of plant materials. The most commonly used feedstocks are grains (corn, other coarse grains and wheat kernels) and sugarcane. Production and use of fossil-fuel derived "synthetic" ethanol from ethylene and naphtha is small and declining in Japan. Synthetic alcohol, not included in the balance or discussed this report, is only used as an industrial chemical and not as fuel, and its estimated annual use is 50-100 million liters.

Table 4. Fuel and Industrial Bioethanol Use in Japan (2010-2019)

Bioethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019f**
Beginning Stocks	36	49	36	45	39	40	38	43	40	38
Fuel Begin Stocks	0	0	0	0	0	0	0	0	0	0
Production	22	26	27	20	17	2	1	0.2	0.2	0.2
Fuel Production	22	26	27	20	17	2	1	0.2	0.2	0.2
Imports	658	632	643	723	858	943	1,156	1,218	1,220	1,190
Industrial Use Imports	312	301	305	325	372	323	415	402	400	400
Fuel Imports	347	331	339	398	486	620	741	816	820	790
> of which to make ETBE	50	38	51	65	28	82	53	89	82	90
>of imported as ETBE	296	294	288	334	458	539	688	727	738	700
Exports	5	5	1	0	0	0	0	0	0	0
Fuel Exports	0	0	0	0	0	0	0	0	0	0
Consumption	662	667	660	749	875	947	1,151	1,221	1,222	1,190
Industrial Consumption	294	309	295	331	371	325	410	405	402	400
> for food industry	197	177	178	182	183	188	190	192	190	185
> for med. and cosme.	61	66	65	63	66	67	64	71	70	68
> other industrial uses	36	67	51	85	123	70	156	142	142	147
Fuel Consumption	368	358	365	418	504	622	741	816	820	790
> as bio-ETBE[4]	367	356	363	415	501	620	741	816	820	790
Ending Stocks	49	36	45	39	40	38	43	40	38	38
Fuel Ending Stocks	0	0	0	0	0	0	0	0	0	0

[4] Until 2014, Japan produced a small quantity of bioethanol for bio-ETBE production, which is noted in the "Fuel Production" row of the table.

Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	6	6	5	5	5	3	3	1	1	1
Nameplate Capacity	35	35	35	34	34	34	4	1	1	1
Capacity Use (%)	62%	76%	76%	58%	51%	7%	15%	19%	19%	18%
Feedstock Use for Fuel Ethanol (1,000 MT)										
Rice	2	2	2	2	2	1	1	0.48	0.53	0.49
Molasses	1	2	5	8	8	8	2	-	-	-
Wheat Kernels	31	31	28	25	-	-	-	-	-	-
Sugar Beets	124	116	105	95	-	-	-	-	-	-
Market Penetration (Million Liters)										
Fuel Ethanol Use	368	358	365	418	504	622	741	816	820	790
Gasoline Use	58,368	56,864	57,094	55,234	53,608	53,113	52,849	51,904	50,999	49,800
Blend Rate (%)	0.6%	0.6%	0.6%	0.8%	0.9%	1.2%	1.4%	1.6%	1.6%	1.6%

f = forecast based on year-to-date data by FAS/Tokyo
Sources: Japan Customs; Japan Alcohol Association; Zen-noh; ANRE Total Energy Statistics; ANRE Petroleum Statistics
Note: 1 liter of bio-ETBE contains 0.4237 liters of bioethanol; 1 liter of bioethanol = 0.607 LOE

Consumption

Since major oil refineries only practice bio-ETBE blending, with the exception of Zen-noh stations (representing less than 7 percent of gasoline consumption), bio-ETBE essentially accounts for all bioethanol consumption in Japan (Table 4). In 2018, Japan consumed 820 million liters of bioethanol fuel, of which 738 million liters came from imported bio-ETBE (ETBE volume of 1,742 million liters) and the remaining 82 million liters from 194 million liters of domestically produced bio-ETBE. FAS/Tokyo forecasts Japan's 2019 fuel bioethanol consumption at 790 million liters, a slight decrease from 2018 due to a fire at the U.S.-based bio-ETBE facility exporting to Japan. Accordingly, 2019 bioethanol consumption is expected to be slightly shy of the 824 million liters target volume. As Japan's forecasted gasoline consumption in 2019 is 49.8 billion liters, the effective average bioethanol blend rate will remain at 1.6 percent, unchanged since 2017.

METI will retain the target biofuel volume of 500 million liters (crude oil equivalent) equal to 824 million liters of ethanol at least through 2022. In light of the expected decline in Japan's gasoline demand, ethanol blend rate will gradually increase under the exiting target thru 2022. METI's new plan to count bio-jet fuel and advanced ethanol toward the biofuel target in the future will erode the space for fuel ethanol this possibly negatively impact fuel bioethanol consumption. In addition, METI is planning to double count advanced bioethanol (e.g., cellulosic, algae) in their biofuel calculations. Thus, future levels of Japan's fuel bioethanol consumption depend on the introduction schedules for bio-jet fuel and advanced bioethanol. A METI notification would precede these changes.

In 2018, Japan consumed about 400 million liters of industrial bioethanol, 190 million liters of food-grade bioethanol (e.g., disinfectants, preservatives, miso, soy sauce, vinegar, seasonings etc.), and 70 million liters of bioethanol via drug and cosmetics manufacturing. Use for industrial applications continues to steadily rise, up nearly 30 percent over the past decade, while demand for use in the other non-fuel, non-potable markets has remained mostly flat for some time. Consumption of alcoholic beverages (ethanol) is not included in these Table 4 and is beyond the scope of this report.

Production

After GOJ removed financial supports for bioethanol projects at the end of FY 2014, four of the five Japanese bioethanol plants, including those focused on domestic fuel bioethanol production, eventually closed. By 2017, Japan had one facility annually producing 0.2 million liters of fuel bioethanol from domestic long-grain rice. This Zen-noh-operated refinery, located in the rice-growing Niigata prefecture, uses rice grown specifically for biofuel production. The resulting bioethanol is used for an E3 blend sold at six affiliated local gas stations. As of October 2019, the plant operates three months a year and is not self-sustaining. Also, prior to 2014, a small quantity of domestically produced bioethanol was used in bio-ETBE production, but no longer.

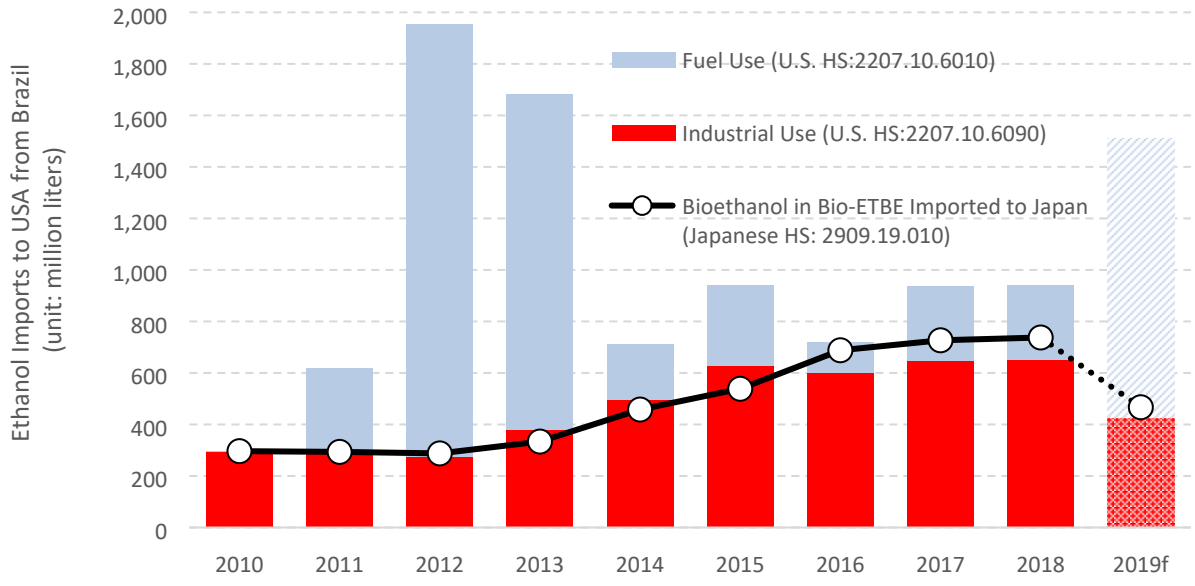
Trade

Japan's bioethanol consumption for fuel and industrial use relies almost entirely on imports (Table 4) especially since 2015. In 2018, Japan imported 1,220 million liters of bioethanol, including 820 million liters for fuel 90% of which was bio-ETBE. In 2019, based on the observed year-to-date trade impacts of the U.S. bio-ETBE facility fire and declining gasoline use, FAS/Japan forecasts Japan's fuel bioethanol imports to decline by 3.7 percent to 790 million liters.

Industrial bioethanol destined for Japan is typically transshipped through South Korea, where it is stored in bonded warehouses until shipping by smaller vessels to Japanese ports. Based on anticipated end use (i.e. industrial, food, bio-ETBE or unknown), imported ethanol is assigned a harmonized tariff schedule code (HS code). For ethanol imports assigned the HS code 2207 10 199 ("unknown and others"), FAS/Tokyo estimated end use based on consumption data from METI. Brazil, Pakistan and the United States are the major suppliers of ethanol to Japan.

Following METI's revision of the GHG emissions value for U.S. corn-based bioethanol, U.S. Grains Council reported that the first shipment of 13.5 million gallons (51.1 million liters) of bio-ETBE produced from 5.7 million gallons (21.6 million liters) of U.S. corn-based bioethanol arrived in Japan in July 2019. U.S. imports of Brazilian ethanol for industrial use (HS: 2207.10.6090) closely track Japanese imports of bio-ETBE (Figure 7). With the opening of Japan's biofuels market to U.S. bioethanol, the overall volume of Brazil's industrial bioethanol exports shipped to the United States is expected to decline.

Figure 7. Bioethanol Imports to the United States from Brazil



Sources: U.S. Census Bureau; Japan Customs

Section V. Biodiesel

Biodiesel, or fatty acid methyl esters, are produced from lipids derived from plants and animals (both virgin and waste-stream sources). Biodiesel use in Japan remains extremely with limited potential for growth. Japan exports very limited volumes to Europe.

Table 5. Biodiesel Production and Use in Japan (2010-2019)

Biodiesel (Million Liters)										
Calendar Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019f
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Production	9	9	9	10	16	17	15	17	17	18
Imports	0	0	0	1	1	1	1	1	1	1
Exports	N/A	N/A	2	3	3	4	6	6	7	9
Consumption	9	9	7	7	13	15	11	13	11	10
Ending Stocks	0	0	0	0	0	0	0	0	0	0
Production Capacity (Million Liters)										
Number of Biorefineries	58	58	46	46	43	43	44	41	41	41
Nameplate Capacity	21	21	21	21	37	34	35	35	35	35
Capacity Use (%)	40%	41%	43%	45%	43%	50%	43%	49%	49%	51%
Feedstock Use for Fuel (1,000 MT)										
Used Cooking Oil	8	8	9	9	15	16	14	16	16	17
Rapeseed Oil	1	0	0	1	1	0	0	-	-	-
Market Penetration (Million Liters)										
Biodiesel, on-road use	7	7	5	6	11	12	9	10	9	8
Diesel, on-road use	33,057	32,658	33,402	33,753	33,789	33,665	33,372	33,664	33,852	34,000
Blend Rate (%)	0.02%	0.02%	0.02%	0.02%	0.03%	0.03%	0.03%	0.03%	0.03%	0.02%
Diesel, total use	68,923	66,660	67,640	65,192	63,739	61,376	61,885	61,847	60,573	60,100

Note: f=forecast by FAS/Tokyo
Sources: Annual surveys by National Biodiesel Fuel Utilization Promotion Council; METI; Japan Customs

Biodiesel has been excluded from GOJ's biofuels agenda. However, many municipalities have small-scale, highly localized environmental projects focused on biodiesel production from used cooking oil (UCO), essentially the only feedstock used. FAS/Tokyo estimates Japan's 2018 biodiesel production at 17 million liters based on the National Biodiesel Fuel Utilization Promotion Council's annual survey results. Biodiesel production levels are expected to remain steady in 2019.

In 2015, the Ministry of Land, Infrastructure and Transport introduced stricter emissions standards on diesel vehicles. Industry experts express concerns that engines of newly compliant vehicles may not be technologically able to utilize biodiesel.

In 2018, Japan exported 6.9 million liters of biodiesel primarily to the European Union and Switzerland. Based on available 2019 trade data, 2019 biodiesel exports are expected to reach 9 million liters. Double counting provisions for UCO-based biodiesel established under the EU's Renewable Energy Directive and applied by many European countries incentivize this trade. Since 2013, Japan has imported roughly 1 million liters of biodiesel, mostly from Malaysia.

Section VI. Advanced Biofuels

As of October 2019, Japan does not commercially produce or consume any advanced biofuels.

To achieve the industry-set goal of bio-jet fuel use by the 2020 Olympic and Paralympic Games in Tokyo, METI promised a road map for advanced (i.e. cellulosic) bioethanol introduction by FY 2020. METI also intends to introduce and enforce new bio-jet fuel and advanced bioethanol regulations by FY 2023. Blend rates (or target volumes) remain to be determined.

Nevertheless, ALL Nippon Airlines (ANA) has already used bio-jet fuel overseas. In 2019, ANA purchased 70,000 gallons of bio-jet fuel at the San Francisco International Airport and contracted with LanzaTech for future bio-jet fuel transactions.

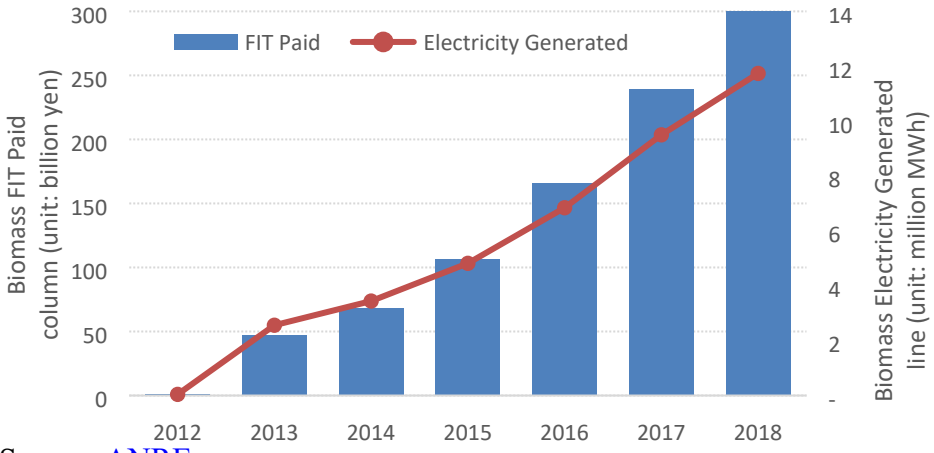
By 2018, Euglena completed its demonstration bio-refinery plant in Yokohama. The facility can produce up to 125 thousand liters of bio-jet fuel and biodiesel out of algae and waste oil. The company intends to expand its production capacity to 250 million liters by 2025. ANA has partnered with Euglena with the ambition to utilize advanced biofuels in Japan for commercial flights by 2020.

Section VII. Biomass for Power and Heat

Consumption

GOJ's biomass goal is to meet at least 4.6 percent of Japan's electricity demand by 2030. Japan's biomass consumption, reflected in the FIT payments, for power generation is clearly on the rise. In 2018, total biomass FIT payments exceeded 302 billion yen ($2.74 billion[5]), a 26 percent increase over 2017 utilization (Figure 8). These 2018 payments represent 11.7 million MWh of biomass-generated electricity.

Figure 8. Annual FIT paid to biomass energy producers and electricity generated



Source: ANRE

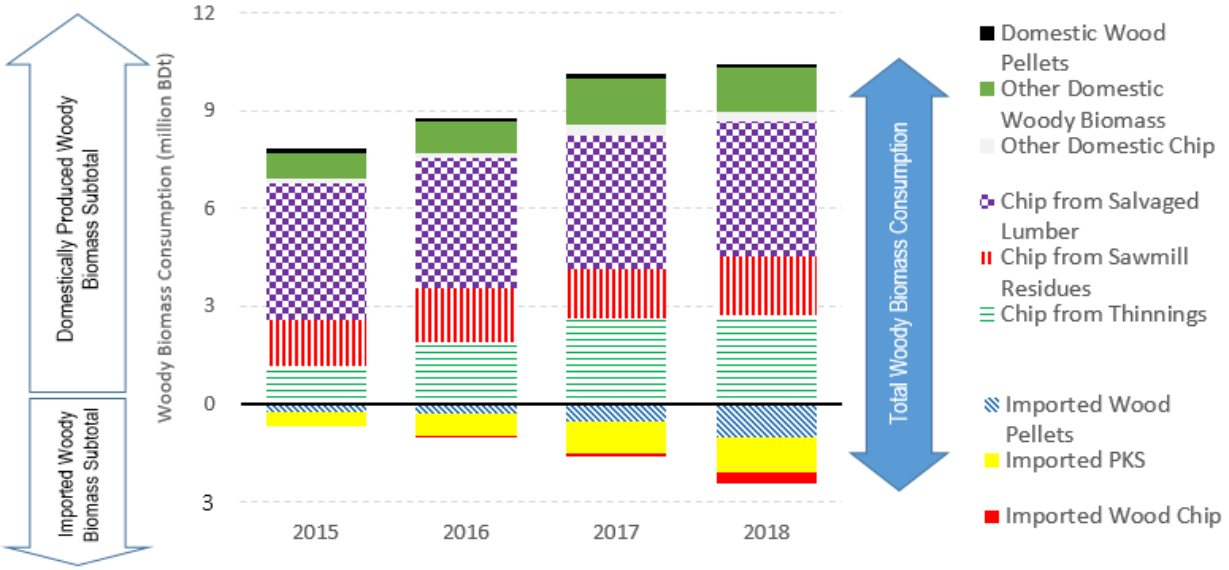
According to ANRE, only five woody biomass power plants with a total capacity of 42.7 MW were in operation by the end of 2013. By the end of 2018, 156 woody biomass power plants[6] generated electricity at 1,690 MW. An additional 199 biomass plants were approved by December 2018 with total operating capacity of 7,000 MW, thus nearly quadrupling Japan's total operational capacity. While many companies are eager to take advantage of the generous tariff rates for biomass, securing woody biomass feedstock is challenging. Thus, Japan's biomass market holds enormous potential for woody biomass suppliers, both domestic and foreign. The demand will be even higher if biomass is utilized more widely in heat generation.

Since 2015, MAFF's Forestry Agency has collected biomass consumption data on Japanese power plants, co-generation plants and boilers. Since 2015, the total consumption has increased by more than 50 percent to 12.9 million bone-dry metric tons (BDt) (Figure 9). So far, salvaged lumber is the most common source of biomass for power generation. Yet, due to a stagnant construction market, the supply of salvaged lumber is not expected to increase. Similarly, as lumber production levels off, chips from

[5] Based on Bank of Japan 2018 average exchange rate
[6] The total includes 69 unutilized domestic wood power plants, 54 general wood power plans, and 33 salvaged lumber power plants.

lumber production are not expected to meet the projected rise in biomass demand. Although Japan continues to harvest more trees for forest thinning, the rapidly growing biomass demand is forecasted to outstrip the domestic supply. Woody biomass imports will be needed to meet Japan's growing demand in the long term.

Figure 9. Woody Biomass Consumption for Electricity and Heat in Japan



Sources: Forestry Agency; Japan Customs

Note: FAS/Tokyo estimated bone-dry metric ton (BDt) values from trade statistics under the assumption of 15 percent moisture in imported biomass and 20 percent moisture in PKS.

Production

GOJ's 2020 GHG emissions target largely relies on domestic forest thinning operations. Japan set aside 120 billion yen ($1.1 billion[7]) per year for thinning and selective logging on about 520,000 hectares of private and public land. Wood yielded from these operations is used in construction and power generation (see JA9098 for details on forestry policy).

According to the Forestry Agency data, Japan's woody biomass production reached 10.7 million BDt in 2018 (Figure 9). Resulting wood chips fuel biomass power plants, cogeneration power plants, and

[7] Based on Bank of Japan 2018 average exchange rate

boilers. Domestic wood pellets are commonly used for residential wood stoves in Japan's northern regions. Japan produced 131 thousand metric tons (MT) of wood pellets in 2018. As Japan's pellet production is largely supplied by small producers in mountainous regions, large power plants do not have a steady supply of domestic wood pellets. As Japan's demand for woody biomass has significantly outpaced domestic wood chip production, many biomass power plants are looking to wood pellet imports to fill the gap.

Trade

In 2018, Japan more than doubled its wood pellet imports (Table 6). Sixty percent of the imported 1.06 million MT of wood pellets came from Canada. Imports of cheaper wood pellets from fast-growing species (e.g., eucalyptus, acacia) from other Asian countries, especially Vietnam, Malaysia and China, are also on the rise. Since 2012, when specific trade data for wood pellets first became available, Canada and Vietnam have accounted for the vast majority of Japan's expanding wood pellet imports. U.S. suppliers have not contributed to Japan's expanding imports thus far. Enviva, the world's largest wood pellet manufacturer, announced plans to export over 3 million MT of U.S. wood pellets a year to Japan by 2025. If fully realized, this would propel U.S. suppliers into a prominent position.

Since the introduction of the FIT program, PKS imports have increased exponentially (see JA9033 and JA8019 for more details the effects of FIT program on PKS and palm oil stearin). Medium-sized biomass power plants use PKS as a constant and inexpensive biomass fuel to qualify for the FIT program. Japan's 2018 PKS imports increased 11 percent from 2017 to reach 1.27 million MT. However, due to greater reliability of the wood pellet supply, large biomass power plants prefer wood pellets over PKS. METI's plans to require sustainable certification for PKS may also adversely impact PKS imports in the near future.

Table 6. Supply and Demand of Wood Pellets

Wood Pellets (1,000 MT)								
Calendar Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019f**
Beginning Stocks	5	7	8	9	15	19	26	50
Production	98	110	126	120	120	127	131	135
Wood Pellets Imports	72	84	97	232	347	506	1,060	1,440
Exports	3	5	4	0	0	0	0	0
Consumption	165	188	218	346	462	626	1,168	1,559
Ending Stocks	7	8	9	15	19	26	50	66
Production Capacity								
Number of Plants	109	120	141	142	148	147	154	155

Note: f=forecast by FAS/Tokyo
Unit is wet metric ton, not dry ton: 1000 MT of wood pellets = 850 BDt
Sources: Forestry Agency; Japan Customs

Section VII. Notes on Statistical Data

Appendix I

General Terms

Bioethanol: ethanol produced from agricultural feedstock
Biodiesel: fatty acid methyl ester produced from agricultural feedstock (such as used cooking oils)
Bio-ETBE: ETBE made from bioethanol
B100: blend of petroleum diesel and biodiesel with the number indicating the percentage of biodiesel in the blend, this case is 100% biodiesel.
CI Value: carbon intensity value, a value measuring GHG emissions released when consuming products (e.g., ethanol, gasoline). This value is derived from LCA. The unit of value is t-CO2e/MJ.
ETBE: Ethyl Tert-Butyl Ether
FIT: Feed-in Tariff
FY: Japanese fiscal year (April-March), for example, FY 2019 is April 2019 – March 2020.
GHG: greenhouse gas
LCA: life cycle assessment
LCI: life cycle inventory
HC: harmonized system of tariff schedule codes
INDC: intended nationally determined contribution
JIS: Japanese Industrial Standards
PKS: palm kernel shell
RPS: renewable portfolio standard
UCO: used cooking oil
YTD: year-to-date

Abbreviation and Units

BDt: bone-dry metric ton, Bone-dry means 0 percent moisture content in the product. We assume wood pellets contain 15 percent and palm kernel shell contain 20 percent moisture.
g-CO_2e: grams of carbon dioxide equivalent
GJ: gigajoule, 1 GJ = 1,000,000,000 joule = 1,000 MJ
GW: gigawatt
l: liter, 1l = 0.264 gallon
LOE: liters of crude oil equivalent
ha: hectares, 1 ha = 2.471 acre
kW: kilowatt
kWh: kilowatt hour, 1 kWh = 1 kW x 1 hour
MJ: megajoule, 1 MJ = 1,000,000 joule
MT: metric ton, 1 MT = 1,000 kg = 2,204.6 pounds = 1.1 short ton
MMT: million metric ton
MW: megawatt 1 MW= 1,000 kW
MWh: megawatt hour, 1 MWh = 1 MW x 1 hour

Organizations and Companies
ANA: All Nippon Airline
ANRE: The Agency for Natural Resources and Energy of METI
COP: The Conferences of the Parties
FAS/Tokyo: Tokyo Office of Agricultural Affairs of the Foreign Agriculture Service
GOJ: The Government of Japan
ICAO: The International Civil Aviation Organization
IMO: International Maritime Organization
JA: Japan Agricultural Cooperatives
JBSL: Japan Biofuels Supply LLP
MAFF: Ministry of Agriculture, Forestry and Fisheries
METI: Ministry of Economy, Trade and Industry
MOE: Ministry of Environment
UNFCCC: The United Nations Framework Convention on Climate Change
USGC: U.S. Grains Council
Zen-noh: National Federation of Agricultural Co-operative Associations

Conversion Factors
1 liter crude oil equivalent (LOE) = 9,250 kcal = 38.7 MJ
1 liter of bio-ETBE contains 0.4237 liters of bioethanol
1 liter of bioethanol = 0.607 LOE
1 kWh = 3.6 MJ = 1,000 joule/second x 3,600 seconds (primary energy). To generate 1 kWh of electricity (secondary energy) higher primary energy inputs are required. For example, if the energy conversion efficiency is 40 percent, 9.0 MJ (or 0.233 LOE) of feedstock (i.e., primary energy) is required to generate 1 kWh of electricity.
1 GJ = 1,000 MJ = 1,000,000,000 J
1 GW = 1,000 MW = 1,000,000 kW = 1,000,000,000 W

Energy Content
Gasoline 43.10 GJ/MT
Bioethanol 26.90 GJ/MT
Diesel 42.80 GJ/MT
Biodiesel 37.50 GJ/MT

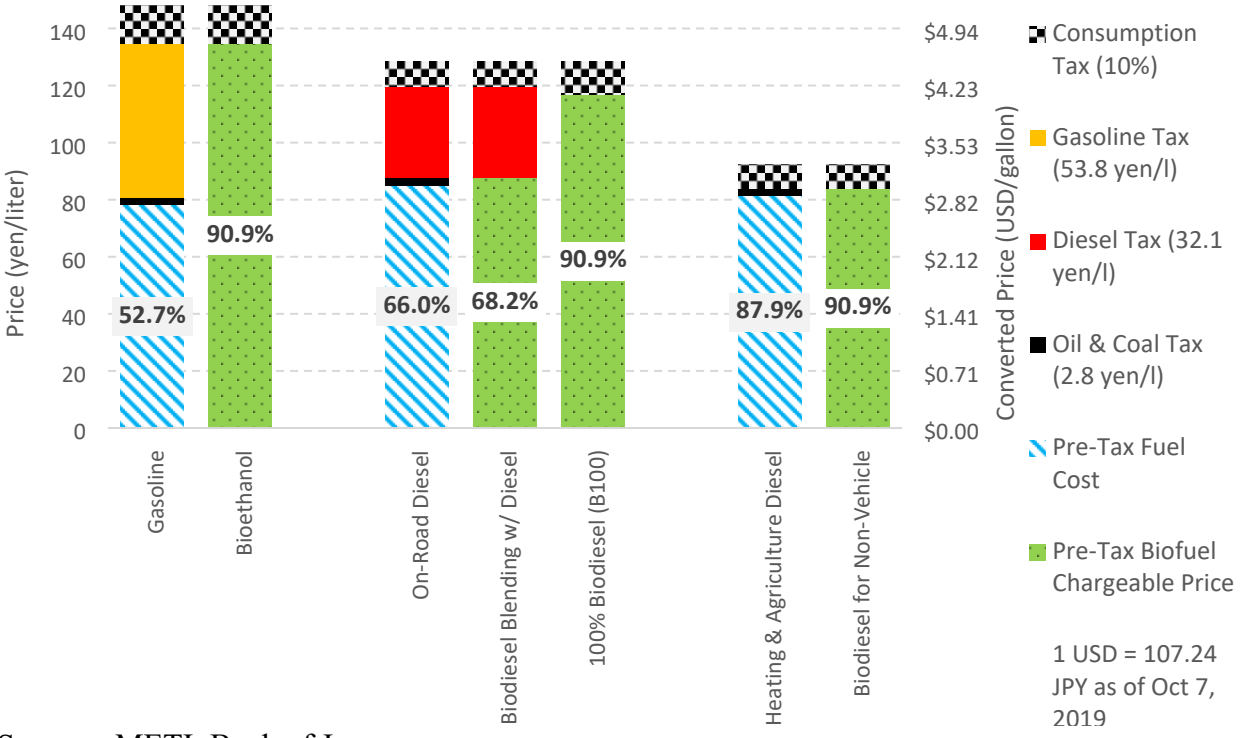
Domestic Feedstock-to-Biofuel Conversion Rates
Bioethanol
Rice: 1 MT = 371 liters (actual value by Zen-noh in 2019)

Biodiesel
UCO: 1 MT = 1,043 liters

Appendix II – Japan's Tax Structure Affecting Fuels and Biofuels

The following example highlights the lack of financial incentives for greater adoption of biofuels in Japan (Figure A-II). Under the current tax structure, price incentive for biodiesel is smaller than for bioethanol.

Figure A-II. Japan's Tax Structure of Fossil Fuels and Biofuels



Sources: METI; Bank of Japan
Note: Average retail prices reported for gasoline (148.1 yen/l), on-road diesel (128.5 yen/l) and heating oil (92.5 yen/l) on October 7, 2019.

Attachments:

No Attachments