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Report Highlights:

FAS/Tokyo expects Japan's imports of bioethanol to stay steady in line with Japan's long-standing annual target for on-road biofuel of 500 million liters crude oil equivalent which is entirely fulfilled by bioETBE. There is no national program for biodiesel, and it is therefore in effect absent from the market except in a few localized cases. Japan has yet to realize a market for sustainable aviation fuel (SAF), although sustained movement in this direction is now evident. As for the use of biomass in stationary power applications, Japan will see an increase in wood pellet imports as new large biomass power plants, supported by a feed-in tariff, become operational.

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Section I. Executive Summary

In 2020, Japan's Prime Minister (PM) Yoshihide Suga pledged that Japan would become carbon neutral by 2050 and reduce its greenhouse gas (GHG) emissions by 46 percent by Japanese fiscal year (FY: April-March) 2030. In response, in 2021, the Agency of Natural Resources and Energy (ANRE) of the Ministry of Economy, Trade and Industry (METI) updated the Strategic Energy Plan (SEP) to increase the use of renewable energy sources (biomass, solar, wind, geothermal and hydro) to approximately 20 percent of Japanese primary energy supply sources by FY 2030. The new SEP does not call for an increase in the utilization of biofuels used in road transport to achieve Japan's GHG reduction commitment.

Japan's only existing transport biofuel commitment, a *de facto* mandate, of 500 million liters of crude oil equivalent[1] (LOE) for on-road transportation runs through FY 2022. To meet this target, Japan uses imported bioethanol-derived Ethyl Tert-Butyl Ether (ETBE), which is blended with gasoline by Japanese oil refineries. Japan's 2020 ETBE use represented a 1.9 average ethanol blend rate, or 850 million liters of bioethanol, derived from U.S. corn-based ethanol and Brazilian sugarcane-based ethanol. FAS/Japan forecasts Japan's 2021 transport bioethanol consumption at 823 million liters, in line with the Japan's biofuel target. Japan's on-road biodiesel use remains very limited at less than 15 million liters in FY 2019, the latest available data, derived domestically from used cooking oil. Japan aims to commercially utilize domestically produced sustainable aviation fuel (SAF) by 2030. Up to now, METI has supported some SAF application in Japan on a trial basis.

METI's feed-in tariff (FIT) program for renewable energy drives biomass consumption in the power sector. Under the program, power companies charge customers a premium for electricity derived from eligible biomass sources for 20 years. In 2020, Japan imported 2.02 million metric tons (MT) of wood pellets, and FAS/Tokyo forecasts imports to reach 3 million MT in 2021 as FIT-supported large-scale biomass power plants have come online. In 2021, Japan began to import commercial shipments of U.S. wood pellets. Since 2017, METI has lowered the FIT premium for the utilization of imported wood pellets, so the outlook for new multi-year contracts for wood pellets remains poor.

Section II. Policy and Programs

Renewable Energy and GHG Emissions

During his October 26, 2020 address at the Extraordinary Diet Session, PM Suga[2] pledged that Japan would become carbon neutral by 2050. On April 22, 2021, at the Leaders' Summit on Climate hosted by the United States, PM Suga declared that Japan would aim to reduce its GHG emissions by 46 percent in FY 2030 from FY 2013 levels. In order to achieve PM Suga's emission goals, Japanese ministries needed to develop more ambitious plans compared to policies derived from Japan's Long-term Strategy

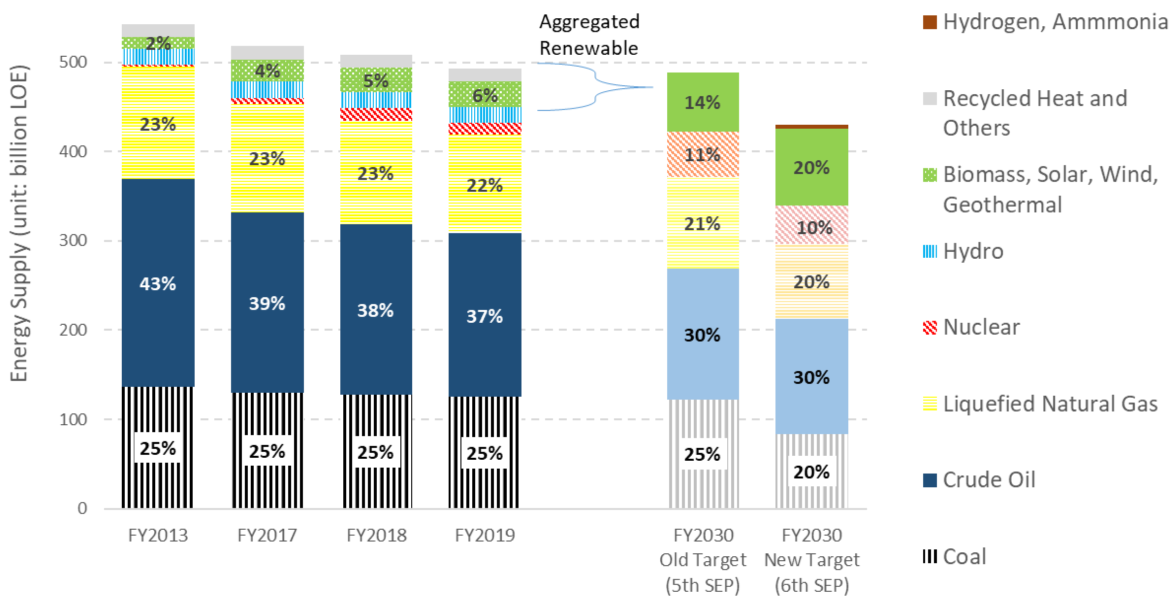
[1] The conversion factor for ethanol into crude oil equivalent is 0.607. Thus, 500 million liters of crude oil equivalent (LOE) is equal to 823.4 million liters of ethanol. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (Japanese only).

[2] In early October 2021, Yoshihide Suga stepped down as PM after a year in office. On October 4, 2021, Fumio Kishida was elected as the new PM. Both Suga and Kishida belong to the same Liberal Democratic Party.

under the Paris Agreement submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in June 2019. Under the 2015 Paris Agreement, Japan's Intended Nationally Determined Contribution (INDC) was a 26 percent GHG emission reduction by FY 2030 compared to FY 2013 levels.

On October 22, 2021, the Cabinet approved the 6th Strategic Energy Plan (SEP). ANRE's SEP lays out Government of Japan's medium- to long-term energy policy and is revised every 3-4 years. To achieve Japan's 46 percent GHG reduction target by 2030, ANRE's expert committee began reviewing a proposed 6th SEP in October 2020 (for details about the 5th SEP approved by the Cabinet in 2018, please see 2020 Japan Biofuels Annual). On July 21, 2021, ANRE released the draft of the new 6th Strategic Energy Plan (JA2021-0113) and opened the public comment period (JA2021-0126). With the adoption of the 6th SEP, METI expects local governments and the private sector, including utility companies and refineries, to integrate the Plan's elements into their operational plans.

Figure 1. Actual and Intended Japan's Primary Energy Supply by Source



Sources: Summary of Draft SEP; Long-term Energy Supply and Demand Outlook; ANRE

Notes:
- 1 liter crude oil equivalent (LOE) = 38.7 megajoules (MJ)
- FY 2019 energy data is the most current data.
- Following ANRE's categorization, SEPs reference aggregated renewables (i.e., solar, biomass, wind, geothermal, hydro and recycled heat), while actual ANRE Energy Statistics break out these categories.

The 6th SEP contains METI's provisional energy mix for FY 2030[3]. Specifically, ANRE plans to reduce the total primary energy supply to approximately 430 billion LOE by FY 2030 from the 5th SEP target (Figure 1) by improving energy efficiency and reducing energy use. Several other key changes

[3] ANRE will update and release the new long-term energy outlook. The provisional values may be revised in the final document.

from the 5th SEP to the 6th SEP include (details in Figure 1): (i) increase in the use of renewables (biomass, solar, wind, geothermal and hydro) to 20 percent; (ii) reduction in reliance on petroleum (to 30 percent) and coal (to 20 percent); and (iii) contribution of hydrogen and ammonia as new energy sources (approximately 1 percent).

According to the 6th SEP, ANRE aims to reduce GHG emissions from the transportation sector by 32 percent from FY 2019 to FY 2030 (Table 1) by expanding the use of electric vehicles (EV) including fuel cell vehicles (FCV), and introducing electrofuels (e-fuels) made from carbon dioxide and hydrogen. By 2035, METI intends to (i) ban new sales of petrol-fueled passenger vehicles[4] and (ii) have 20-30 percent of new sales of commercial vehicles weighing less than 8 tons for vehicles using an electric propulsion system (e.g., hybrid electric truck, FCV truck). To that end, for the next decade, Japan will emphasize research and development of e-fueled vehicles to be commercialized by 2040. The 6th SEP does not offer details on Japan's plans to utilize transport biofuels to reduce GHG emission. Presently, the Government of Japan (GOJ) offers subsidies of up to 800,000 yen (approximately $7,200) to encourage consumers to purchase clean energy vehicles. METI, the Ministry of Environment and local governments also have established programs to support the introduction of hydrogen refueling and EV charging stations throughout Japan.

Table 1. GHG Emission by Sectors (Unit: million metric tons CO_2 equivalent (MMT-CO_2eq))

	FY 2013* Actual	FY 2019 Actual (latest available data)	FY 2030 New Goal (6th SEP)	6th SEP vs FY 2013	6th SEP vs FY 2019
Energy-derived GHG	1,239	1,031	680	**-45%**	-34%
Industrial Sector	463	384	290	-37%	-24%
Business Sector	238	193	120	-50%	-38%
Household Sector	208	159	70	-66%	-56%
Energy Conversion Sector	106	89	60	-43%	-33%
Transportation Sector	**224**	**206**	**140**	**-38%**	**-32%**
of road transportation	*195*	*179*	-	-	-
of domestic aviation	*10*	*11*	-	-	-
of domestic navigation	*11*	*11*	-	-	-

Sources: Summary of Draft SEP; Long-term Energy Supply and Demand Outlook; ANRE
* Reference point used by ANRE to measure progress toward its GHG emission target.

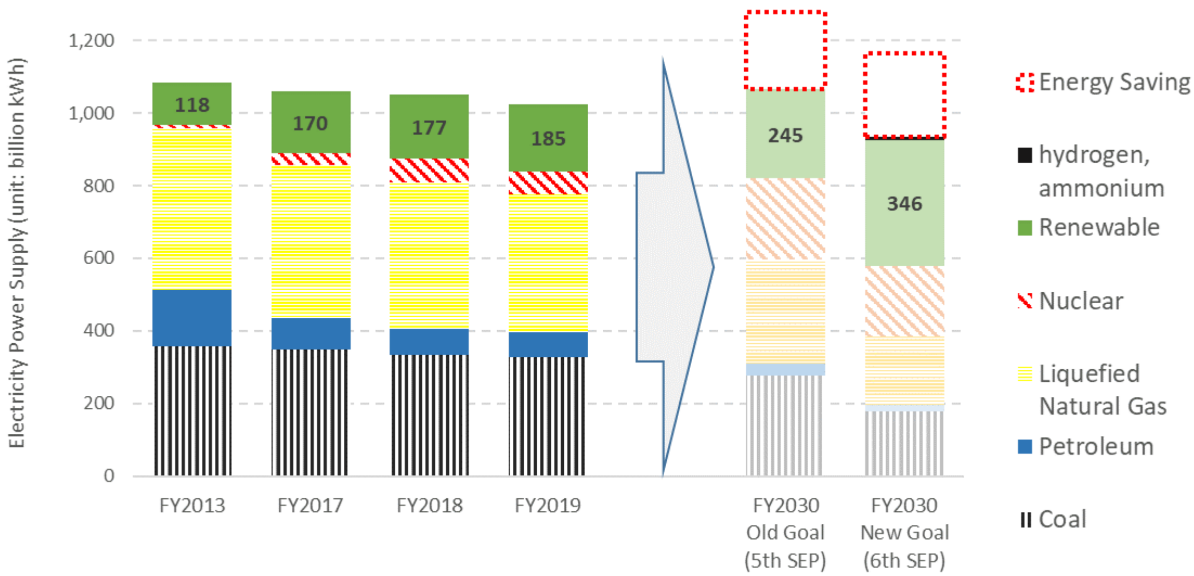
Electricity Generation

In FY 2019, Japan's electricity generation accounted for 46 percent of Japan's primary energy supply. The gradual restart of nuclear power generation since the 2011 Fukushima disaster and expansion of renewable energy and energy efficiency gains have reduced the demand for imported fossil fuels and contributed to a continuous decline in GHG emissions. Electric power generation from renewable sources has been on the rise in Japan over the past several years. In the 6th SEP, ANRE plans to increase its reliance on renewable energy from 18 percent (185 billion kilowatt hour (kWh)) in FY 2019 to 36-38

[4] Hybrid vehicles will not be subject to the ban.

percent (approximately 346 billion kWh) by FY 2030 (Figure 2). Thus, renewables would become the single largest source of electricity in Japan.

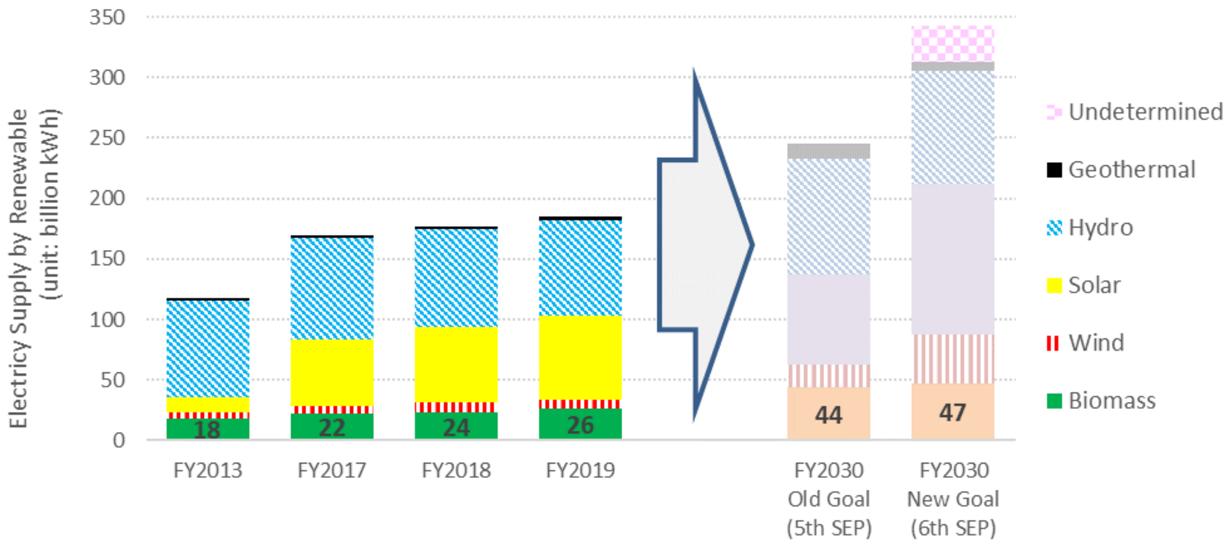
Figure 2. Japan's Historical and Target Electric Energy Consumption by Source



Sources: Summary of Draft SEP; Long-term Energy Supply and Demand Outlook; ANRE

The 6th SEP calls for nearly doubling energy generation from biomass from FY 2019 to FY 2030 (Figure 3). In addition to specifying targets for different renewable types, the 6th SEP aims to add 20-40 billion kWh from renewables of a yet undetermined source.

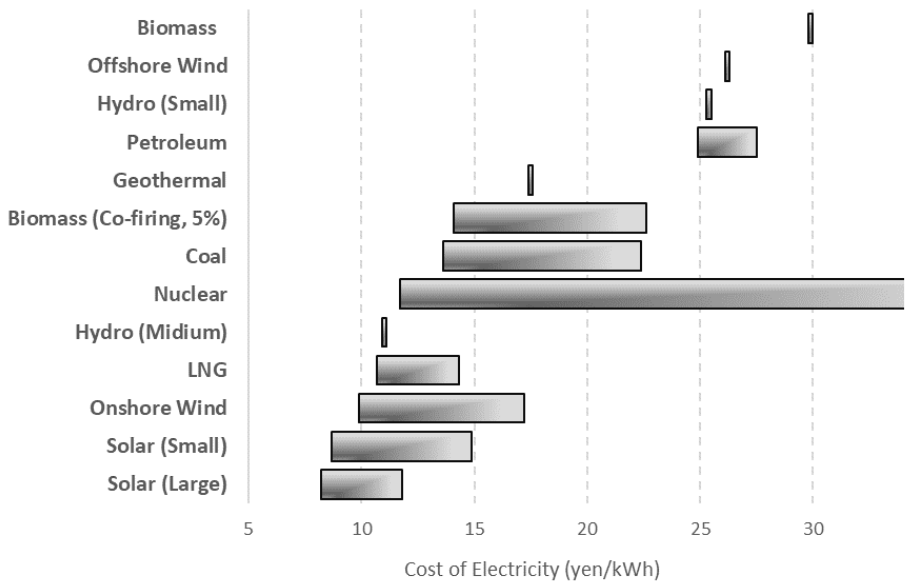
Figure 3. Comparison of FY 2030 Targets for Renewable Use for Energy Generation



Sources: Summary of Draft SEP; Long-term Energy Supply and Demand Outlook; ANRE

In addition to GHG emission reduction, energy cost reduction is a key focus for METI. According to its August 3 2021 outlook for electricity cost by source for 2030, at around 29.8 yen per kWh (Figure 4), biomass will be among the most expensive energy sources due to the feedstock price, which accounts for over 70 percent of the cost. By contrast, METI expects solar energy cost to range between 8.2 to 11.8 yen per kWh (Figure 4). Nevertheless, METI's plan to shut down inefficient coal-fired power plants by 2030 to achieve carbon neutrality can create new opportunities for wood pellets through co-firing. In its April 23, 2021 phase-out plan for coal-fired power plants, METI will require a minimum of 43 percent total system efficiency[5] on average.

Figure 4. METI's 2030 Forecast for Electricity Costs[6] by Source



Source: METI

Biofuel Policy Framework and Execution

Japan's transport biofuel consumption is driven by the Sophisticated Methods of Energy Supply Structure Act (hereafter abbreviated as "Sophisticated Act") that set a steady annual target of 500 million LOE between FY 2018-2022. In addition to the target, the Sophisticated Act established the following guidelines (i) GHG emission value for gasoline at 88.74 g-CO_2eq/MJ (JA2020-0162), (ii) GHG emission value for U.S. corn-based ethanol at 43.15 g-CO_2eq/MJ (JA8026), (iii) GHG emission value for Brazilian sugarcane-based ethanol at 33.61 g-CO_2eq/MJ, and (iv) GHG emission reduction target for transport bioethanol at 55 percent. METI plans to introduce a new Sophisticated Act in 2022.

Japanese oil refineries have collectively decided to meet the biofuel target by focusing on bioethanol (delivered in the form of bio-ETBE) over biodiesel due to variable biodiesel quality, higher biodiesel production costs, supply chain infrastructure investments required, and Japanese petroleum fuel demand.

[5] ANRE's basic calculation is total system efficiency = net useful electric output / (total fuel energy input – total biomass energy input), but expert committee is currently debating the details in the interim report (available in Japanese).

[6] Throughout this report, the currency exchange rate is estimated at $1=110 Japanese yen.

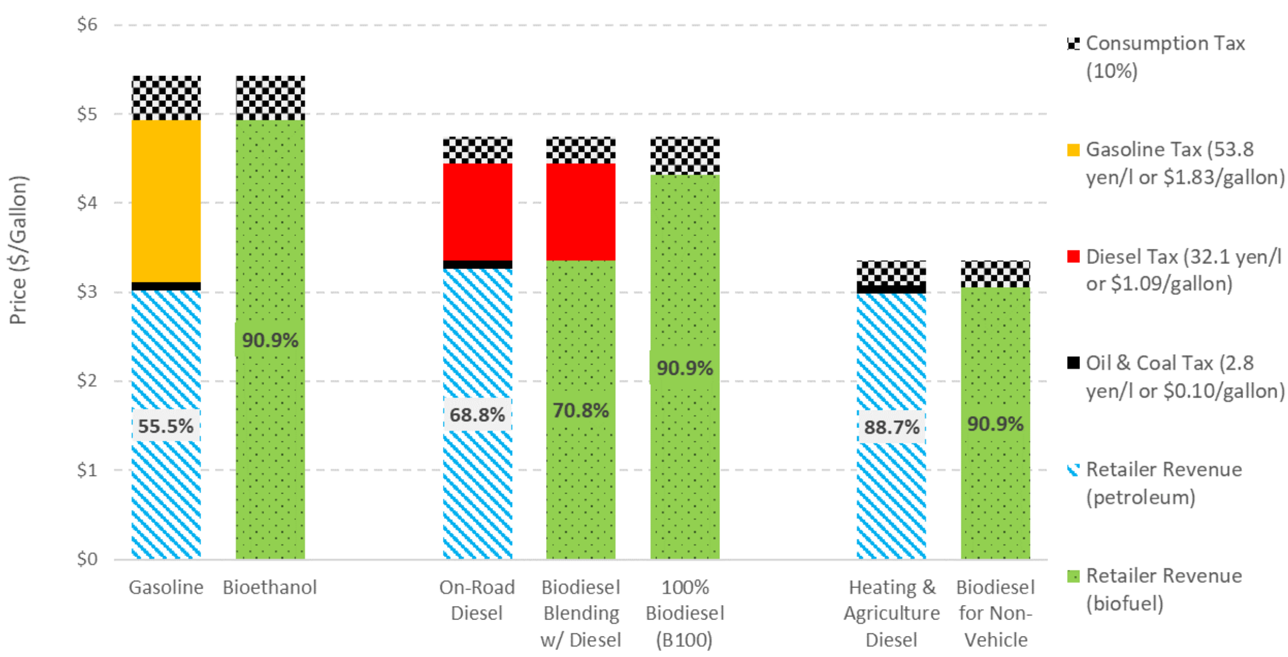
The Japan Biofuels Supply LLP[7] (JBSL) represents large Japanese oil companies and blends 1,940 million liters of bio-ETBE (containing 823.7 million liters of bioethanol) a year to meet Japan's biofuel target. Since the established ETBE supply chain requires no additional investments in delivery infrastructure, JBSL has no interest in moving to a direct bioethanol blending system, which would require investments in a new supply chain. Due to the Quality Control of Gasoline and Other Fuels Act (hereafter referred to as the "Quality Control Act"), the ETBE blend rate for gasoline cannot exceed approximately 8.3 percent (equivalent to a 3.5 percent direct ethanol blend rate)[8].

Financial Supports for Biofuels

Biofuels Tax Policy

Since 2008, Japan exempts fuel bioethanol from the gasoline tax (53.8 yen/liter) and oil and coal tax (2.8 yen/liter) under the Quality Control Act. Under Japan's current fuel tax structure, on a per liter basis, the retail price of bioethanol is comparable to that of gasoline (Figure 5) even though its energy density is 33 percent less.

Figure 5. Japan's Tax Structure of Liquid Fossil Fuels and Biofuels



Sources: METI; Bank of Japan ($1 = 111.62 yen as of October 6, 2021)

Note: Average retail prices reported on October 6, 2021 for gasoline (160.0 yen/l or $5.43/gallon), on-road diesel (139.9 yen/l or $4.74/gallon) and heating oil (99.1 yen/l or $3.36/gallon).

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[7] As of October 2021, JBSL membership consists of JXTG Nippon Oil & Energy Corporation (ENEOS), Idemitsu-Showa Shell, Cosmo Oil, Fuji Oil Company, and Taiyo Oil Company.

[8] The Quality Control Act limits the maximum oxygen content to 1.3 percent or less.

Although Japan exempts biodiesel from the oil and coal tax (2.8 yen/liter), biodiesel is subject to the on-road diesel local tax (32.1 yen/liter) when blended with on-road diesel (e.g., B3, B5)[9]. Biodiesel producers have frequently, though unsuccessfully, petitioned METI and the Ministry of Finance to revise the tax structure to expand the biodiesel market.

Feed-in Tariff (FIT) for Biomass Used in Electrical Power

The FIT program applies only to electric power generation (Table 2). The tariff rates for unutilized woody biomass derived from domestic forest thinning operations are substantially higher than for imported biomass. The "general wood" category encompasses imported wood pellets, wood chips and agricultural residues/biomass, such as imported palm kernel shell (PKS). To promote smaller biomass power plants in rural community, the FIT program introduced facility-based higher tariff rates in 2015 for domestic unutilized wood and in 2017 for general wood.

Table 2. Biomass Feed-in Tariff by Fuel Category (unit: yen/kWh)

<table>
<tr><th rowspan="2">Fiscal Year</th><th colspan="2">Domestic Unutilized Wood & Thinning</th><th colspan="3">General Wood (e.g., imported pellets, sawmill residue, PKS)</th><th rowspan="2">Liquid Biomass (palm oil)</th><th rowspan="2">Salvaged Lumber</th></tr>
<tr><th>< 2MW</th><th>2MW≤</th><th>< 10MW</th><th>10-20MW</th><th>20MW ≤</th></tr>
<tr><td>2012</td><td colspan="2">32</td><td colspan="3">24</td><td rowspan="6">General Wood</td><td>13</td></tr>
<tr><td>2013</td><td colspan="2">32</td><td colspan="3">24</td><td>13</td></tr>
<tr><td>2014</td><td colspan="2">32</td><td colspan="3">24</td><td>13</td></tr>
<tr><td>2015</td><td>40</td><td>32</td><td colspan="3">24</td><td>13</td></tr>
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<tr><td>2017</td><td>40</td><td>32</td><td colspan="2">24</td><td>21</td><td>13</td></tr>
<tr><td>2018</td><td>40</td><td>32</td><td>24</td><td colspan="2">Auction (20.6*)</td><td>Auction (20.6*)</td><td>13</td></tr>
<tr><td>2019</td><td>40</td><td>32</td><td>24</td><td colspan="2">Auction (19.6*)</td><td>Auction (19.6*)</td><td>13</td></tr>
<tr><td>2020</td><td>40</td><td>32</td><td>24</td><td colspan="2">Auction (19.6*)</td><td>Auction (19.6*)</td><td>13</td></tr>
<tr><td>2021</td><td>40</td><td>32</td><td>24</td><td colspan="2">Auction</td><td>Auction</td><td>13</td></tr>
<tr><td>2022</td><td>40</td><td>32</td><td>24</td><td colspan="2">Auction</td><td>Auction</td><td>13</td></tr>
</table>

Source: ANRE
Note: * represents maximum acceptable prices, disclosed after the auctions.

In 2018, METI introduced an auction system for general wood power plants with output exceeding 10 megawatt (MW) and separately for biomass power plants utilizing liquid biomass (i.e., palm stearin oil). To achieve FIT eligibility, bidders need to offer a bid lower than an undisclosed maximum acceptable price. The price is based on the type of feedstock (e.g,, domestic wood, general wood, palm oil, etc.)

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[9] The Quality Control Act limits the maximum biodiesel content in on-road diesel to 5 percent (B5) or less. Yet, 100 percent biodiesel falls outside the scope of the Quality Control Act, and some municipalities own B100 cars.

without consideration for the relevant carbon intensity or emission values. Since the introduction of the auction system, no new biomass project has been deemed eligible for FIT. Experts explain that it is unlikely that new large scale biomass projects will be proposed under the current FIT price.

The 2020 Energy Supply Resilience Act included three FIT-related revisions: (i) under a new feed-in premium (FIP) scheme, renewable energy producers can receive a premium on top of the market price under FIP, in addition to the fixed price under FIT; (ii) FIT and FIP can be used to finance power grid enhancement to connect scattered renewable energy power plants all over Japan; and (iii) METI can revoke FIT eligibility from approved power plants that do not become operational within a certain time frame (JA2020-0165). These changes will take effect on April 2022.

Japan plans to phase out low efficiency coal power plants in the near future. Yet, METI has not approved any new co-firing coal plants under the FIT program since April 2019[10].

Environmental Sustainability and Certification

To meet the biofuel target established under the Sophisticated Act, METI requires a proof of sustainability. JBSL typically relies on the International Sustainability and Carbon Certification program.

For FIT-eligible biomass, Japan's Forestry Agency publishes guidelines (in Japanese only) for verification of sustainability/legality of forestry products (JA2019-0124). METI's expert panel (in Japanese only) is currently reviewing biomass sustainability requirements, such as chain-of-custody certification programs and life-cycle GHG emissions.

Earlier, the same expert panel recommended tightening environmental and social standards for palm oil and PKS. METI initially announced that the FIT program will only accept the Roundtable on Sustainable Palm Oil (RSPO) certification for FIT-eligible palm oil from April 2021 and the Roundtable on Sustainable Biomaterials (RSB) certification for FIT-eligible PKS and palm trunks from April 2023. However, METI postponed enforcement by a year to 2022 and 2024, respectively. METI will also accept the Green Gold Label (GGL) as another FIT-eligible PKS and palm trunk certification scheme.

Import Policy: Tariff

Japan does not impose a tariff on bio-ETBE imports, imports of bioethanol for the production of bio-ETBE, or imports of industrial ethanol. Under the 2020 U.S.-Japan Trade Agreement (USJTA), by FY 2028, Japan will eliminate the 10 percent tariff on ethanol imports for "other" uses (Harmonized System (HS): 2207.10-199), including fuel ethanol for direct blending. The tariff rate on ethanol imports for other uses from the United States is 6.3 percent in FY 2021 and will be 5.4 percent in FY 2022. METI's Ordinance for the Enforcement of the Ethanol Business regulates ethanol sales in Japan.

The tariff on biodiesel imports is 3.9 percent for WTO members, including the United States. Japan eliminated tariff on biodiesel for a number of countries with free trade agreements (e.g., United

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[10] Prior to April 2019, METI permitted FIT classification for coal power plants that co-fired biomass. As a result, there are approximately 40 FIT-eligible co-firing power plants in Japan.

Kingdom, Switzerland, EU, Comprehensive and Progressive Agreement for Trans-Pacific (CPTPP), and ASEAN). Nevertheless, Japan currently does not import biodiesel for on-road use.

Japan has no tariff on wood pellets and major agricultural residues, including palm kernel shell (PKS). Japan does not impose a duty on palm stearin oil from ASEAN countries per their trade agreements.

Section III. Ethanol

Bioethanol (ethyl alcohol) is made by fermenting the carbohydrate components of plant materials. Fossil-fuel derived "synthetic" ethanol[11] from ethylene and naphtha, is not used for fuel and is outside of the scope of this report. Table 3 lists fuel ethanol (and industrial ethanol to balance the table) use volumes and market penetration (average national blend rates).

Consumption

All major Japanese oil refineries that belong to the Petroleum Association of Japan (PAJ) blend only bio-ETBE, rather than directly ethanol, and sell ETBE blended gasoline in their retail gas stations. Due to a fire incident at the bio-ETBE production facility in Texas in early 2019, Japanese bioethanol fuel consumption fell 34 million liters short of the annual target volume in calendar year 2019. As the Sophisticated Act requires refineries to make up the shortage in the following fiscal year, in 2020 Japan's bioethanol fuel consumption reached 850 million liters[12]. Imported bio-ETBE represented approximately 94 percent of 2020 bioethanol fuel consumption, domestically produced bio-ETBE made from Brazilian ethanol was 6 percent, and a very small amount came from domestically produced rice bioethanol. With the year-over-year gasoline demand decline during COVID-19 in 2020 and rise in ETBE blending the same year, the year-over-year average national blend rate of ethanol rose from 1.6 percent to 1.9 percent.

As of September 2021, Japan has imported both bio-ETBE and bioethanol to produce bio-ETBE on schedule to reach the target volume, and FAS/Tokyo forecasts Japan to consume 823 million liters of bioethanol fuel in 2021, which is equivalent to the annual target volume. As gasoline demand recovered slightly from 2020 but still remains well below pre-Covid 2019 levels due to the COVID-19 pandemic, FAS/Tokyo forecasts the average national blend rate will remain elevated at 1.8 percent in 2021.
The distribution channels for fuel and non-fuel ethanols are completely separate. To learn more about Japan's industrial ethanol market, please see JA2021-0072. Ethanol consumption for alcoholic beverages is beyond the scope of this report.

[11] In addition of domestic production, Japan imports synthetic ethanol from South Africa and European countries. Trade statistics do not separate synthetic ethanol and bioethanol.
[12] Since Japanese target volume is on the Japanese fiscal year basis, the estimation based on calendar year shows some discrepancies.

Table 3. Fuel and Industrial Bioethanol Use in Japan (2011-2020)

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021f**
Beginning Stocks	46	72	62	95	82	89	84	60	78	61
Fuel Begin Stocks	10	27	23	55	44	46	44	22	23	16
Production	27	20	17	2	1	0.2	0.2	0.2	0.2	0
Fuel Production	27	20	17	2	1	0.2	0.2	0.2	0.2	0
Imports	653	719	890	938	1,160	1,197	1,181	1,171	1,386	1,292
Industrial Imports	305	325	372	329	417	383	383	380	543	465
Fuel Imports	348	394	518	609	743	814	798	791	843	827
>of which to make ETBE	60	60	60	70	55	87	60	66	54	67
>imported as ETBE	288	334	458	539	688	727	738	725	789	760
Exports	1	0	0	0	0	0	0	0	0	0
Consumption	653	749	875	953	1,154	1,202	1,205	1,153	1,403	1,283
Non-Fuel Consumption	295	331	371	331	412	386	385	363	553	460
>for food industry	178	182	183	188	190	186	202	209	205	205
>for other uses	117	148	188	143	222	200	183	154	348	255
Fuel Consumption	358	418	504	622	741	816	820	790	850	823
>as bio-ETBE	356	415	501	620	741	816	820	790	850	823
Ending Stocks	72	62	95	82	89	84	60	78	61	70
Fuel Ending Stocks	27	23	55	44	46	44	22	23	16	20
Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	5	5	5	3	3	1	1	1	1	1
Nameplate Capacity	35	34	34	34	4	1	1	1	1	1
Capacity Use (%)	76%	58%	51%	7%	15%	19%	19%	20%	15%	0%
Feedstock Used for Fuel Ethanol (1,000 MT)										
Rice	2	2	2	1	1	0	1	0	0	-
Market Penetration (Million Liters)										
Fuel Ethanol Use	358	418	504	622	741	816	820	790	850	823
Gasoline Pool	57,094	55,234	53,608	53,113	52,849	51,904	50,999	49,651	45,500	46,000
Blend Rate (%)	0.6%	0.8%	0.9%	1.2%	1.4%	1.6%	1.6%	1.6%	1.9%	1.8%

Sources: Japan Customs; Japan Alcohol Association; ANRE Total Energy Statistics; ANRE Petroleum Statistics

Note: *f* = forecast based on year-to-date data by FAS/Tokyo

1 liter of bio-ETBE contains 0.4237 liters of bioethanol; 1 liter of bioethanol = 0.607 LOE

Production

Between 2017 and 2020, the National Federation of Agricultural Cooperative Associations (JA Zen-noh) operated the only domestic bioethanol production plant. In 2020, JA Zen-noh produced 0.15 million liters of fuel bioethanol from 0.5 million metric tons of domestic high-yield long-grain rice in Niigata Prefecture. The plant operated only three months a year and was not self-sustaining. The six local JA Zen-noh Niigata gas stations[13] sold the resulting E3 blend. As of October 2021, JA Zen-noh is renovating the bioethanol plant and has not produced any ethanol since the start of 2021.

Trade

Japan's fuel bioethanol consumption relies virtually entirely on imports (Table 3). In 2020, Japan imported 54 million liters from Brazil to produce bio-ETBE in Japan, in addition to 789 million ethanol-equivalent liters imported as bio-ETBE. As of October 2021, the United States has not exported ethanol directly to Japan for fuel. Direct U.S. ethanol exports are destined for industrial use and first shipped to bonded warehouses in South Korea. Therefore, there is a substantial difference between U.S. export trade data and Japan's import data for ethanol (see JA2021-0072 for details).

Japan assigns a different HS code to imported ethanol based on anticipated end use (i.e., industrial, bio-ETBE, production of alcoholic beverage, or unknown). For ethanol imports assigned HS code 2207.10-199 ("miscellaneous and undetermined"), FAS/Tokyo estimated end use (Table 3) based on METI's consumption data.

According to industry experts, some food manufacturers that utilize ethanol request sugarcane-based ethanol. Brazil dominates the ethanol market for "industrial" use, including the food industry market, at 95 percent in 2020. In 2020, Japan increased imports of synthetic ethanol from European countries, South Africa and China under "miscellaneous and undetermined" ethanol. On the other hand, the 2020 market share of Pakistan's sugarcane-based ethanol decreased.

[13] JA Zen-noh does not refine crude oil and is not a member of PAJ. The share of gas station in Japan: ENEOS 45 percent, Idemitsu-Showa Shell 22 percent, Cosmo 10 percent and JA Zen-noh 7 percent.

Section V. Biodiesel

Biodiesel, or fatty acid methyl esters, is produced from lipids derived from plants and animals (both virgin and waste-stream sources).

Table 4. Biodiesel Production and Use in Japan (2011-2020)

Biodiesel (Million Liters)										
Calendar Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020e**	**2021f**
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Production	9	10	16	17	15	17	20	23	23	22
Imports	0	1	1	1	1	1	1	1	1	1
Exports	2	3	3	4	6	6	7	9	9	8
Consumption	7	7	13	15	11	13	14	15	15	15
Ending Stocks	0	0	0	0	0	0	0	0	0	0
Feedstock Use (1,000 MT)										
Used Cooking Oil	9	9	15	16	14	16	19	22	22	22
Rapeseed Oil	0	1	1	0	0	0	0	0	0	0
Market Penetration (Million Liters)										
Biodiesel, on-road use	5	6	11	12	9	10	11	13	13	13
Diesel Pool, on-road use	33,402	33,753	33,789	33,665	33,372	33,664	33,852	33,977	31,889	32,000
Blend Rate (%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Diesel Pool, total	67,640	65,192	63,739	61,376	61,885	61,847	60,573	58,953	55,992	56,000

Note: *e*=estimate and *f* = forecast by FAS/Tokyo
Sources: National Biodiesel Fuel Utilization Promotion Council; METI; Japan Customs

Japanese oil industry does not expect biodiesel to become a major motor fuel in Japan. Still, some municipalities have small-scale, localized environmental projects focused on biodiesel production from used cooking oil (UCO), essentially the only feedstock used as of 2021. The Quality Control Act limits direct biodiesel blend up to 5 percent direct blend (B5) on road transportation. As the Quality Control Act does not regulate non-fossil fuels, B100 is allowed as METI does not classify it as fossil fuel.

The City of Kyoto has the largest biodiesel project in Japan with a daily capacity of 5,000 liters. The City of Kyoto collaborates with citizen volunteers to collect UCO used to manufacture biodiesel at the facility. As of March 2018, the latest available data, the City of Kyoto owned 70 B100 garbage collection vehicles, 97 B5 garbage collection vehicles and 108 B5 buses. In FY 2018, the City of Kyoto fleet consumed 570,000 liters of biodiesel.

In FY 2019 (the most recent available energy statistics), Japan consumed 14.8 million liters of biodiesel. Based on the National Biodiesel Fuel Utilization Promotion Council's consistent annual survey results, FAS/Tokyo estimates Japan's biodiesel consumption at 15 million for on-road diesel in 2020 and 2021.

In 2020, Japan exported 9 million liters of biodiesel to Switzerland. Since 2013, Japan has imported roughly 1 million liters of biodiesel (HS code 3826.00-000) per year, mostly palm oil from Malaysia and jatropha oil from the Philippines for uses other than on-road fuel.

Section VI. Advanced Biofuels

As of October 2021, Japan does not commercially produce or consume any advanced biofuels despite some demonstrations with domestically produced and imported advanced biofuels. However, GOJ plans to promote sustainable aviation fuel (SAF) as a way to reduce GHG emissions from domestic and international flights.

For international flights, in line with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)[14] of the International Civil Aviation Organization (ICAO), by 2030, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Civil Aviation Bureau estimates Japanese airports will use 10.9-12.3 billion liters of jet fuels, of which 2.5-5.6 billion liters should be SAF. In FY 2019, Civil Aviation Bureau of MLIT estimated international flights (both inbound and outbound) by Japanese carriers consumed 6.05 billion liters of jet fuels. There is no publicly available data on SAF consumption by Japan-bound international flights.

For domestic flights, METI aims to introduce new SAF measures in the 2022 version of the Sophisticated Act and to commercialize domestically produced SAF by 2030. In FY 2019, Japanese domestic flights consumed 4.19 billion liters of jet fuels, which accounted for approximately 5 percent of GHG emissions in Japan's transportation sector (Table 1).

Japanese airliners have begun utilizing SAF in international flights as a proof of concept. In 2018-2019, both All Nippon Airline (ANA) and Japan Airline (JAL) used SAF for inbound flights from San Francisco. On October 2020, ANA used SAF produced by Neste and imported from Finland for outbound flights from Tokyo Haneda and Narita airports. In the near future, ANA expects to establish a stable SAF supply line from Neste's Singaporean facility.

Table 5. Ongoing Japanese SAF Projects Supported by NEDO

Company Name	Feedstock	Technology	Projected Commercialization
Mitsubishi Power	Paper sludge, sawdust	Gasification, FT	2030
Biomaterial in Tokyo (Bits)	Wasted pulp	ATJ	2030
IHI	Botryococcus (algae)	Algae cultivation	2030
Chitose Laboratory	Chlorella (algae)	Algae cultivation	2030
Euglena	Euglena (protozoa)	Algae cultivation	2030
J-Power	Diatoms (algae)	Algae cultivation	2030

Note: FT means Fischer-Tropsch process, ATJ means Alcohol-to-Jet process

In FY 2021, METI provided 5.58 billion yen ($51 million) to the bio-jet fuel technology research and development projects (Table 5) of the New Energy and Industrial Technology Development

[14] ICAO adopted CORSIA in October 2016. CORSIA uses market-based policy instruments to offset GHG emissions. Aircraft operators have to purchase carbon credits from the carbon market. The scheme is voluntary for all member countries including Japan until 2027.

Organization (NEDO). The projects funded trial utilization of domestically produced SAFs in a few domestic commercial flights[15].

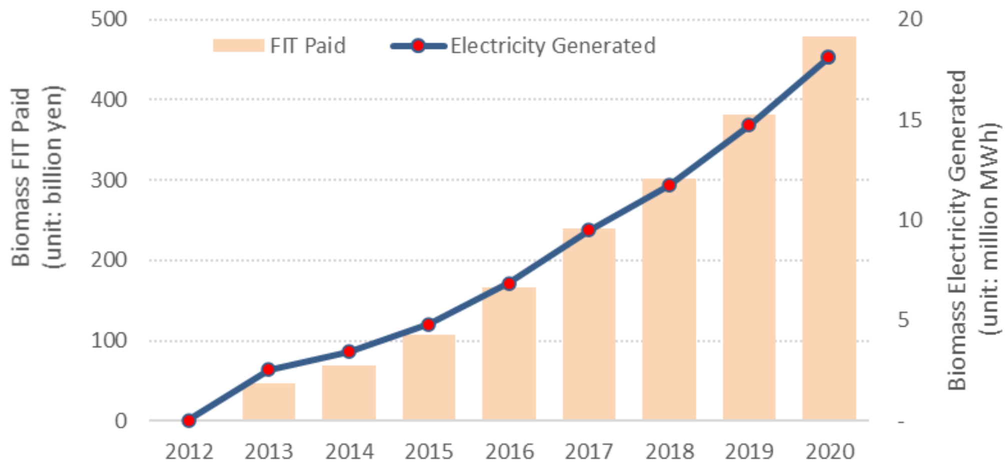
METI plans to utilize the 2 trillion yen (approximately $18 billion) Green Innovation Fund to support research, development and commercialization of environmentally innovative projects, such as developing e-fuels and SAF, for 10 years. GOJ aims to commercialize e-fuels by 2040.

Section V. Biomass for Power and Heat

Consumption

Japan's biomass consumption, reflected in FIT payments, is growing. In 2020, total biomass FIT payments reached 480 billion yen ($4.36 billion[16]) (Figure 6). These 2020 payments represent 18.1 million MWh of biomass-generated electricity. Since 2017, FIT payment has increased about 26 percent each year.

Figure 6. Annual FIT Paid to Biomass Energy Producers and Electricity Generated



Source: ANRE

According to ANRE, by the end of March 2021, 201 woody biomass power plants[17] generated 2,888 MW of electricity. ANRE approved an additional 193 biomass plants by March 2021, the latest available information. Together existing and approved biomass power plants would bring the total operational capacity to 7,394 MW.

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[15] These included: JAL flight 515 from Tokyo-Haneda to Sapporo with algae-based SAF (938 liters included 1 liter neat SAF) and woody cellulose-based SAF (2,195 liters included 283 liters of neat SAF) and ANA flight 031 from Tokyo-Haneda to Osaka-Itami with algae-based SAF (988 liters included 38 liters of neat SAF). The SAF used met international standards ASTM D7566 and D1655.

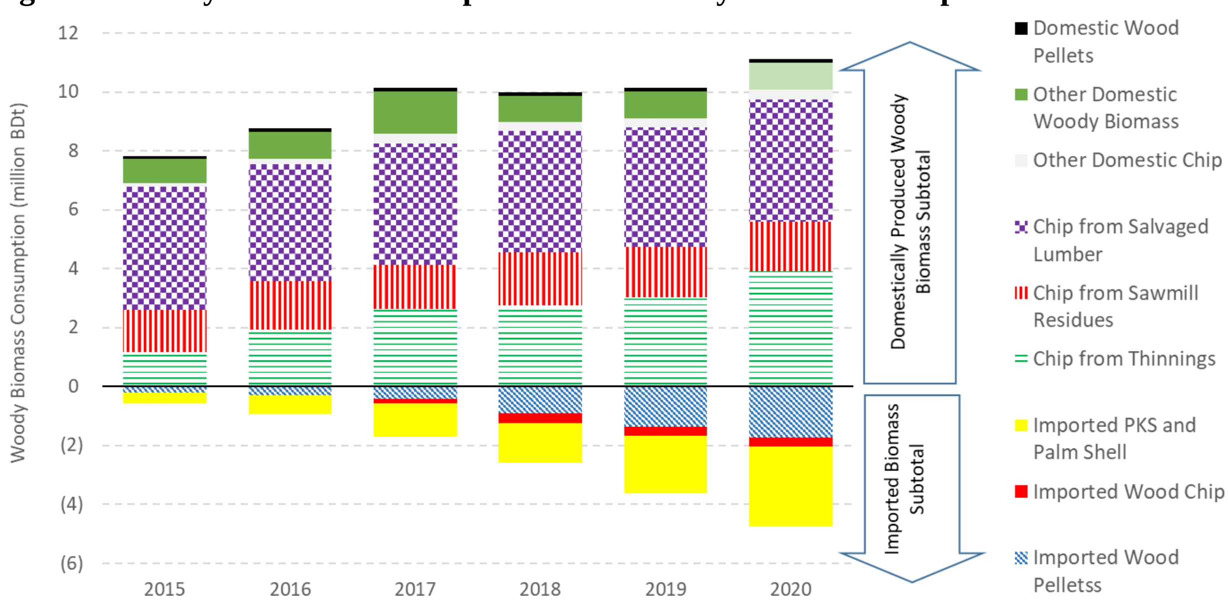
[16] $1USD =110 yen

[17] The total includes 90 unutilized domestic wood power plants, 76 general wood power plans, and 35 salvaged lumber power plants.

When a company requested financing for a new biomass power plant, banks typically asked the company to make a long-term contract to procure biomass from a large Japanese trading house to mitigate operational risk. Therefore, large biomass power plants have already largely contracted their biomass feed stock for the next 15-20 years. Industry experts believe that it is unlikely that new large-scale biomass power projects will be proposed under the lower FIT rate in place since 2017.

Ministry of Agriculture, Forestry and Fisheries (MAFF)'s Forestry Agency collects biomass consumption data from Japanese power plants, co-generation plants and boilers. Between 2015 and 2020, total biomass consumption increased by around 90 percent to 15.9 million bone-dry metric tons (BDt) (Figure 7). 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 grow. Similarly, as lumber production levels off, chips from lumber production are not expected to meet the projected rise in biomass demand. Although Japan continues to harvest more trees for forest thinning, the Forestry Agency forecasts that the rapidly growing biomass demand will outstrip the domestic supply. Woody biomass imports will be critical to meet Japan's growing demand in the long term.

Figure 7. 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.
They are consumed not only by power plants, but also by co-generation plants and boilers.
Other domestic woody biomass data for 2020 is unavailable as of October 2021 so FAS/Tokyo estimated using past average.

Production

GOJ's GHG emission target largely relies on carbon sink by land use, land use change, and forestry (LULUCF) through domestic forest thinning operations. Japan set aside 120 billion yen ($1.1 billion) 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). Japan more than tripled its consumption of wood chips from thinnings, mostly by small-scale biomass power plants and boilers, from 2015 to 3.9 million BDt in 2020.

Domestic pellet production relies on small producers in mountainous regions targeting residential wood stoves in Japan's northern regions. Japan produced 149,000 MT of wood pellets in 2020. On November 9, 2021, MAFF proposed a new Japanese Agricultural Standard (JAS) for non-commercial wood pellet fuel (see JA2021-0148).

Trade

Japan's growing wood pellet imports reflect more large-scale biomass power plants becoming operational. In 2020, Japan imported 2.02 million MT of wood pellets (Table 6), of which 58 percent came from Vietnam and 29 percent came from Canada. Imports of cheaper wood pellets from fast-growing species (e.g., acacia, eucalyptus) from plantation forests in Asian countries, especially Vietnam and Malaysia, have been on the rise. The average import prices for wood pellets (HS: 4401.31-000) are $207.74/MT from the United States, $204.68/MT from Canada, $162.35/MT from Vietnam and $156.46/MT from Malaysia[18]. In January 2021, Japan received the first commercial shipment of U.S. wood pellets. 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 the United States into a leading position in the Japanese wood pellet market.

Since the introduction of the FIT program, PKS imports have increased exponentially (see JA2020-0110). Medium-sized biomass power plants use PKS as a stable and inexpensive biomass fuel to qualify for the FIT program. Japan's 2020 PKS and palm shell imports increased 41.8 percent from 2018 to reach 3.4 million MT. Japan will require RSB and GGL certification on FIT-eligible PKS from April 2024[19].

Some large efficient power plants pulverize feedstock so prefer wood pellets and cannot accept PKS or wood chip. Japan also uses palm stearin oil for power generation under the FIT program (see Japan Oilseeds Annual for more detail).

[18] Heating values of acacia pellets vary, but they are typically lower than those of North American wood pellets.
[19] Since PKS suppliers were not ready to adopt stricter certification, METI postponed this from April 2023 in order to avoid procurement disturbance.

Table 6. Supply and Demand of Wood Pellets

Wood Pellets (1,000 MT)										
Calendar Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021f**
Beginning Stocks	5	7	8	9	15	19	26	50	75	95
Production	98	110	126	120	120	127	131	147	149	150
Imports	72	84	97	232	347	506	1,060	1,614	2,028	3,000
Exports	3	5	4	0	0	0	0	0	1	1
Consumption	165	188	218	346	463	626	1,167	1,736	2,156	3,134
Ending Stocks	7	8	9	15	19	26	50	75	95	110
Production Capacity										
Number of Plants	109	120	142	142	148	147	154	147	137	135
Reference: Estimated Non-Wood Biomass Imports for Power Generation (1,000 MT)										
Palm Kernel Shell	26	121	250	468	797	1,430	1,706	2,452	3,396	4,020
Palm Stearin Oil	0	0	0	21	31	94	120	137	49	0

Note: f=forecast by FAS/Tokyo. Unit is wet metric ton, not dry ton.
Palm kernel shell includes HS codes 2306.60-000 and 1404.90-200 from Malaysia and Indonesia.
Palm stearin oil for human consumption was estimated and subtracted from the above figures.
Sources: Forestry Agency; Japan Customs

Section VII. Notes on Statistical Data

General Terms

ATJ: alcohol-to-jet process to produce SAF
Bioethanol: ethanol produced from biomass, forestry and other biomass feedstock
Biodiesel: fatty acid methyl ester produced from both animal or plant lipids, both virgin (first time use) or waste streams (such as used cooking oils)
Bio-ETBE: ETBE made from bioethanol
B3, B5: blend of biodiesel with petroleum diesel with the number indicating the maximum percentage by volume of biodiesel in the blend.
B100: 100 percent pure biodiesel.
CCUS: carbon capture, utilization and storage
CPTPP: Comprehensive and Progressive Agreement for Trans-Pacific Partnership
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 g-CO2e/MJ.
CORSIA: Carbon Offsetting and Reduction Scheme for International Aviation
E3: blend of 97 percent gasoline and 3 percent bioethanol
E10: blend of 90 percent gasoline and 10 percent bioethanol
e-fuels: electrofuels made from carbon dioxide and hydrogen
EPA: economic partnership agreement
ETBE: Ethyl Tert-Butyl Ether
EV: electric vehicle
FCV: fuel cell vehicle
FIT: Feed-in Tariff
FIP: Feed-in Premium
FT: the Fischer–Tropsch process to produce SAF
FY: Japanese fiscal year (April-March), for example, FY 2021 is April 2021 – March 2022.
GHG: greenhouse gas
LCA: life cycle assessment
LULUCF: land use, land-use change, and forestry
HS: harmonized system of tariff schedule codes
INDC: intended nationally determined contribution
JAS: Japanese Agricultural Standard
JIS: Japanese Industrial Standard
PKS: palm kernel shell
RPS: renewable portfolio standard
SAF: sustainable aviation fuel
UCO: used cooking oil
USJTA: U.S.-Japan Trade Agreement

Units

BDt: bone-dry metric ton, bone-dry means 0 percent moisture content in the product. We assume wood pellets contain 15 percent (i.e., 1MT of wood pellet = 0.85 BDt) and PKS contain 20 percent moisture (i.e., 1MT of PKS = 0.8 BDt).
g-CO_2eq: grams of carbon dioxide equivalent of GHG emission
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
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
MT-CO2eq: metric ton CO2 equivalent of GHG emission
MMT: million metric ton
MW: megawatt 1 MW= 1,000 kW
MWh: megawatt hour, 1 MWh = 1 MW x 1 hour
TJ: terajoule, 1 TJ = 1000 GJ

Organizations and Companies

ANA: All Nippon Airline
ANRE: The Agency for Natural Resources and Energy of METI
ASEAN: Association of South-East Asian Nations
EU: European Union
FAS/Tokyo: Tokyo Office of Agricultural Affairs of the Foreign Agriculture Service
GGL: Green Gold Label
GOJ: The Government of Japan
ICAO: The International Civil Aviation Organization
IMO: International Maritime Organization
JA Zen-noh: National Federation of Agricultural Co-operative Associations
JAL: Japan Airline
JBSL: Japan Biofuels Supply LLP
MAFF: The Ministry of Agriculture, Forestry and Fisheries
METI: The Ministry of Economy, Trade and Industry
MLIT: The Ministry of Land, Infrastructure, Transport and Tourism
NEDO: New Energy and Industrial Technology Development Organization
PAJ: Petroleum Association of Japan
RSB: The Roundtable on Sustainable Biomaterials
RSPO: The Roundtable on Sustainable Palm Oil
UNFCCC: The United Nations Framework Convention on Climate Change

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

Rice to bioethanol: 1 MT = 371 liters (actual value by Zen-noh in 2019)
UCO to biodiesel: 1 MT = 1,043 liters

Biomass Conversion Rates

1000 MT of wood pellets yields 850 MT BDt
1000 MT of PKS yields 800 MT BDt
Softwood chip weight-to-volume conversion: 1 MT = 2.2 m^3
Hardwood chip weight-to-volume conversion: 1 MT = 1.7 m^3

Attachments:

No Attachments