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Report Highlights:

Japan is updating its transport biofuel standards, which will expire in March 2023. In May 2022, Japan pledged to take all available measures to double demand for bioethanol by 2030. Boosting domestic production of sustainable aviation fuel (SAF), including alcohol-to-jet SAF, is Japan's primary focus for meeting that commitment.

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Section I. Executive Summary

On May 23, 2022, during President Biden's visit to Japan, President Biden and Prime Minister Kishida issued the Japan-U.S. Joint Leaders' Statement, where they "welcomed Japan's commitment to take all available measures to double demand for bioethanol, including for sustainable aviation fuel and on-road fuel, by 2030 to reduce dependence on imported petroleum."

Since 2017, Japan's only transport biofuel target, a *de facto* annual mandate, has stood at 500 million liters of crude oil equivalent (LOE) or approximately 823.4 million liters of bioethanol[1]. Japanese oil refineries have met this target largely through imports of bio-Ethyl Tert-Butyl Ether (ETBE) derived from bioethanol, as well as some domestically produced bio-ETBE from imported bioethanol. FAS/Japan estimates Japan's bioethanol consumption in the form of bio-ETBE for on-road fuel at 832 million liters in 2021 and 850 million liters in 2022. Due to the prescriptive nature of the biofuel target and the 2022 Government of Japan's (GOJ) subsidy to Japanese refiners to stabilize gasoline prices, Japan's biofuel consumption and blend rate have been stable. FAS/Tokyo approximates the ethanol blend rate in gasoline at 1.9 percent in both 2021 and 2022.

As Japan's current biofuel target and standards will expire on March 31, 2023, the Ministry of Economy, Trade and Industry (METI) is in the process of updating Japan's biofuel standards. METI expects the process to focus on revising the greenhouse gas emission values for bioethanol and to conclude in time for April 1, 2023 implementation.

Longer term, adoption of sustainable aviation fuel (SAF) is a key component of GOJ's plan to increase utilization of biofuels in the transportation sector. On October 4, 2022, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) published the draft Basic Policy for Promoting Decarbonization of Aviation. By 2030, MLIT aims to replace 10 percent of jet fuel with SAF. GOJ and industry sources anticipate Japan's SAF feedstock eligibility and procurement to be driven by the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)'s default life cycle CO_2 emissions values.

To facilitate SAF introduction, GOJ has provided funding to the private sector to stimulate domestic SAF production, likely from imported feedstocks. Some oil refineries have announced plans to launch Japan-based production of CORSIA-eligible alcohol-to-jet SAF by 2027 (with estimated annual bioethanol demand for 600 million liters) and by 2030 (with estimated bioethanol demand of 1.3 billion liters per year).

By contrast, Japan's on-road biodiesel use remains very limited at approximately 15 million liters in 2021. By and large, the biodiesel is derived domestically from used cooking oil and other fats and oils.

[1] The conversion factor for ethanol into crude oil equivalent is 0.607. Thus, 500 million 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).

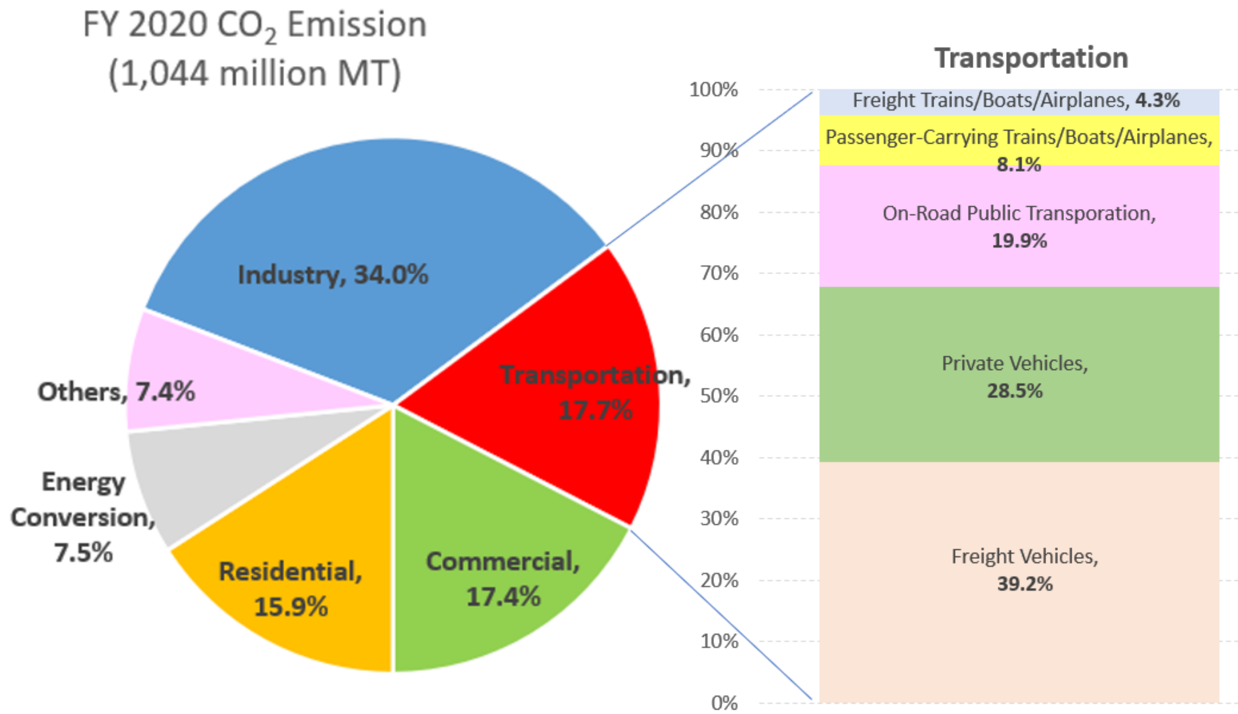
Section II. Policy and Programs

Japanese Energy Policy and GHG Emissions

The Government of Japan (GOJ) roots its energy policy in the "S+3E" principle: safety, energy security, economic efficiency and environmental sustainability. In the most recent 6th Strategic Energy Plan published in 2021[2], the Ministry of Economy, Trade and Industry (METI)'s Agency for Natural Resources and Energy (ANRE) emphasizes the S+3E as the key premise of Japan's energy policy.

Following the 1997 adoption of the Kyoto Protocol by the 3rd Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC), Japan pledged to reduce greenhouse gas (GHG) emissions by 6 percent by 2020 compared to GHG emission levels in 1990. Under the 2015 Paris Agreement, GOJ's Intended Nationally Determined Contribution was a 26 percent GHG emission reduction by Japanese fiscal year (FY: April-March) 2030 compared to FY 2013 levels. In October 2020, GOJ declared its aim to become carbon neutral by 2050. In April 2021, GOJ further pledged to reduce its FY 2030 GHG emissions by 46 percent, rather than the initially promised 26 percent, compared to FY 2013 levels.

Figure 1. Japan's FY 2020 CO_2 Emissions by Sector



Note: The figure does not include other GHG emissions: CH_4 (28.4 million metric tons (MT) CO_2 equivalent (CO_2eq), N_2O (20 million MT CO_2eq, and CFC substitutes (57.5 million MT CO_2eq). In addition, Japanese forests sequestered approximately 44.5 million MT CO_2eq.
Source: MOE

To achieve this goal, on June 18, 2021, GOJ released the "Green Growth Strategy Through Achieving Carbon Neutrality in 2050." In this document, GOJ emphasized GHG emission reductions via increased

[2] See JA2021-0113.

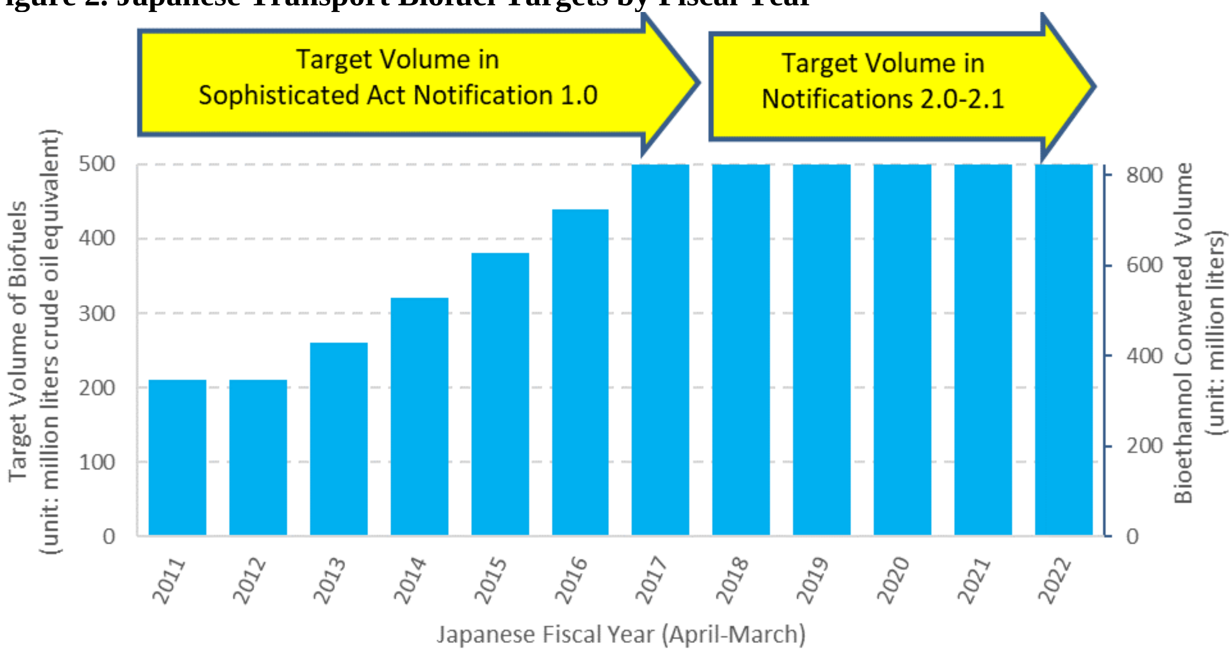
use of (i) electric vehicles and electrofuels (synthetic fuel or e-fuel) for on-road transportation, and (ii) sustainable aviation fuel (SAF) by the aviation industry. The Strategy places little importance on readily available technologies, such as bioethanol and biodiesel.

According to the Ministry of Environment (MOE), in FY 2020[3] (latest data available), Japan released 1.15 billion MT of CO_2eq GHG emissions, of which 1.04 billion MT were CO_2 emissions (Figure 1). Emissions from the transportation sector totaled 185 million MT or 17.7 percent of Japan's CO_2 emissions. In FY 2020 freight vehicles emitted 72 million MT of CO_2, private vehicles emitted 53 million MT, on-road public transportation vehicles emitted 37 million MT, and trains/boats/airplanes emitted 23 million MT (Figure 1 with some rounding errors).

Biofuel Policy Framework

In 2009, to encourage replacement of fossil fuels with renewable energy sources, Japan enacted the "Act on Promotion of Use of Non-Fossil Energy Sources and Effective Use of Fossil Energy Raw Materials by Energy Suppliers," also known as the Sophisticated Methods of Energy Supply Structure Act (hereafter referred to as "the Sophisticated Act"). The Sophisticated Act[4] directed the METI Minister to develop basic policies and guidelines for each energy segment (e.g., oil refineries, gas suppliers, power companies).

Figure 2. Japanese Transport Biofuel Targets by Fiscal Year



[3] Due to the COVID-19 pandemic restrictions, Japan's GHG emissions in FY 2020 were 5.1 percent below FY 2019 GHG emissions.

[4] For liquid fuel, the scope of the Sophisticated Act is limited to fuel produced by the Petroleum Association of Japan (PAJ) member companies. Although oil refineries with PAJ membership are the primary suppliers of on-road fuel distributed in Japan, there are some gas stations not affiliated with PAJ. As such the fuel distributed by these companies is not subject to the Sophisticated Act and their biofuel use does not count toward Japan's biofuel target.

In 2010, METI published its first biofuel standards in Notification 1.0, which was in effect from FY 2011 to FY 2017 and laid the groundwork for Japan's decision to use bioethanol to fulfil its biofuel commitment in on-road transportation[5]. Notification 1.0 introduced an annual biofuel target volume, a *de facto* mandate, and a default GHG emission value for Brazilian sugarcane-based ethanol. The FY 2011 annual target was 210 million liters of crude oil equivalent (LOE) or approximately 346 million liters of bioethanol. By FY 2017, the target gradually increased to 500 million LOE (approximately 823.7 million liters of bioethanol) (Figure 2).

In 2018, the METI Minister developed the FY 2018-FY 2022 biofuel standards in Notification 2.0. In it, METI retained the annual biofuel target of 500 million LOE (equivalent to about 823.7 million liters of bioethanol) and added a default GHG emission value of U.S. corn-based ethanol, which opened the Japanese fuel market to U.S. bioethanol.

In September 2020, METI updated its guidelines in Notification 2.1. In addition to reconfirming Japan's only concrete biofuel commitment of 500 million LOE target (equivalent to approximately 824 million liters of bioethanol), Notification 2.1 established: (i) GHG emission value for gasoline at 88.74 g-CO_2eq/MJ (JA2020-0162), (ii) GHG emission default value for U.S. corn-based ethanol at 43.15 g-CO_2eq/MJ (JA8026), (iii) GHG emission default 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.

Since September 2022, ANRE has held technical meetings to review biofuel use in Japan and to draft Notification 3.0 scheduled to go into effect from FY 2023, when Notification 2.1 will expire (JA2022-0077). The primary focus of this process is to update the default GHG emission values for bioethanol.

Recent Political Direction on Biofuel Utilization

On May 23, 2022, President Biden and Prime Minister Kishida issued the Japan-U.S. Joint Leaders' Statement, in which they "welcomed Japan's commitment to take all available measures to double demand for bioethanol, including for sustainable aviation fuel and on-road fuel, by 2030 to reduce dependence on imported petroleum." On October 24, 2022, Prime Minister Kishida launched the Diet Member Coalition for Promoting Domestic Biofuels and Synthetic Fuels for Carbon Neutrality.

On November 29, 2022, GOJ announced plans to develop a carbon emission trading system around FY 2026. Under such a carbon pricing mechanism, oil refineries and other carbon emitters would be charged fees for GHG emissions.

Gasoline Standards and Practices in Japan

Under the Quality Control of Gasoline and Other Fuels Act (hereafter referred to as the "Quality Control Act"), METI sets gasoline standards. Since 2003, METI's standard for "regular gasoline" allows direct blending of ethanol for up to 3 percent by volume. Also, the Quality Control Act limits oxygen content

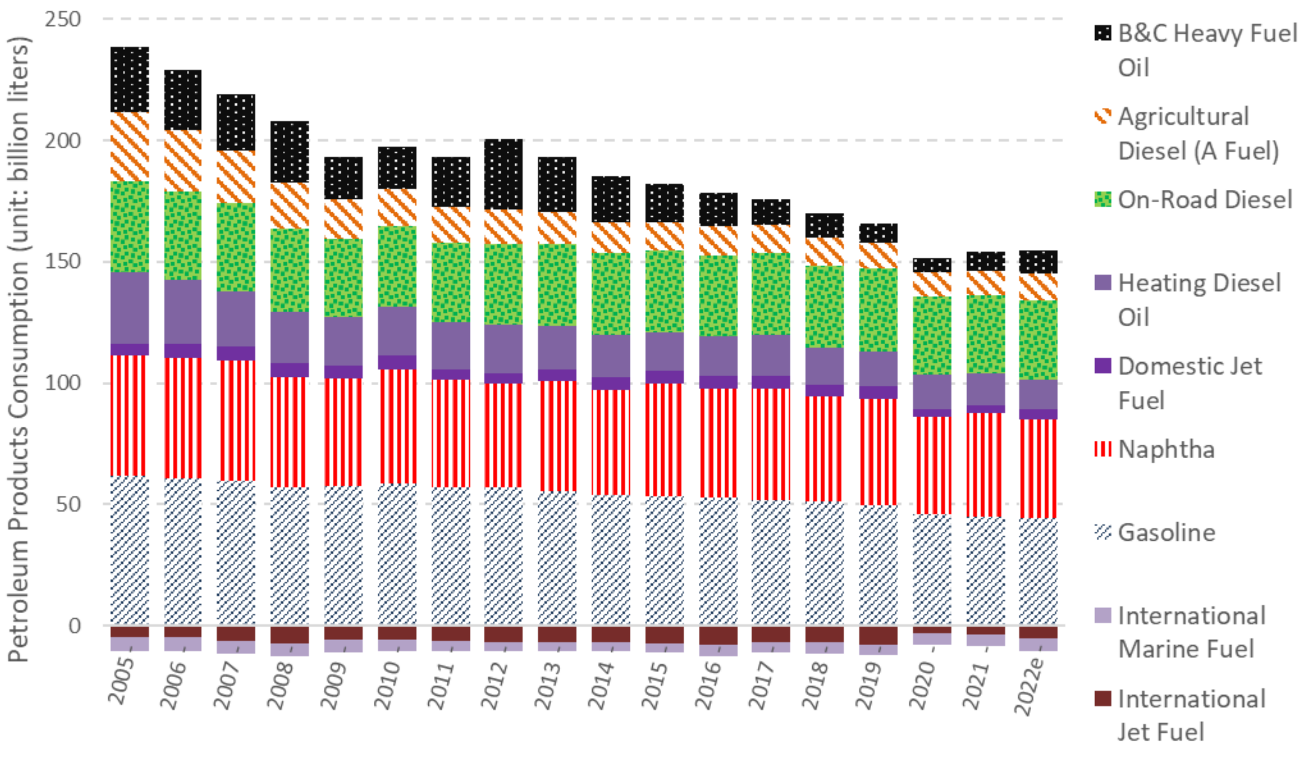
[5] Japan's preference for bioethanol over biodiesel is rooted in a strong demand for petroleum fuel, variable biodiesel quality, and the cost differential between production and distribution of biodiesel and bioethanol-based fuel in Japan.

in regular gasoline to 1.3 percent in weight (8.3 percent of ETBE, equivalent to 3.5 percent of directly blended ethanol in gasoline). Separately, the Quality Control Act established an "E10 gasoline[6]" standard for vehicles that the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has certified as E10/ETBE22 compatible. Nevertheless, in practice, many vehicle fleets in Japan are not E10 certified, and there is presently no commercial distribution of E10 gasoline.

Since 2011, the Petroleum Association of Japan (PAJ), which represents Japanese oil refineries, has chosen to fulfil the biofuel mandate by blending bioethanol-derived bio-Ethyl Tert-Butyl Ether (ETBE), rather than directly bioethanol, with gasoline. The Japan Biofuels Supply LLP[7] (JBSL) represents large Japanese oil companies and blends approximately 1,940 million liters of bio-ETBE (containing approximately 823.7 million liters of bioethanol) a year to meet Japan's biofuel target. Industry sources indicate that there is also limited distribution of directly blended E3 gasoline by small gas stations not affiliated with the PAJ.

Fuel Pool Size

Figure 3. Japan's Consumption of Petroleum-Derived Products



Notes: "2022e" represents year-to-date estimate for 2022 based on monthly data through September 2022. "A Fuel Oil" contains 90 percent diesel and 10 percent fuel oil and is prohibited for on-road use. "B Heavy Fuel Oil" contains 50 percent diesel and 50 percent fuel oil. "C Heavy Fuel Oil" contains 10 percent of diesel and 90 percent of fuel oil.

Source: ANRE

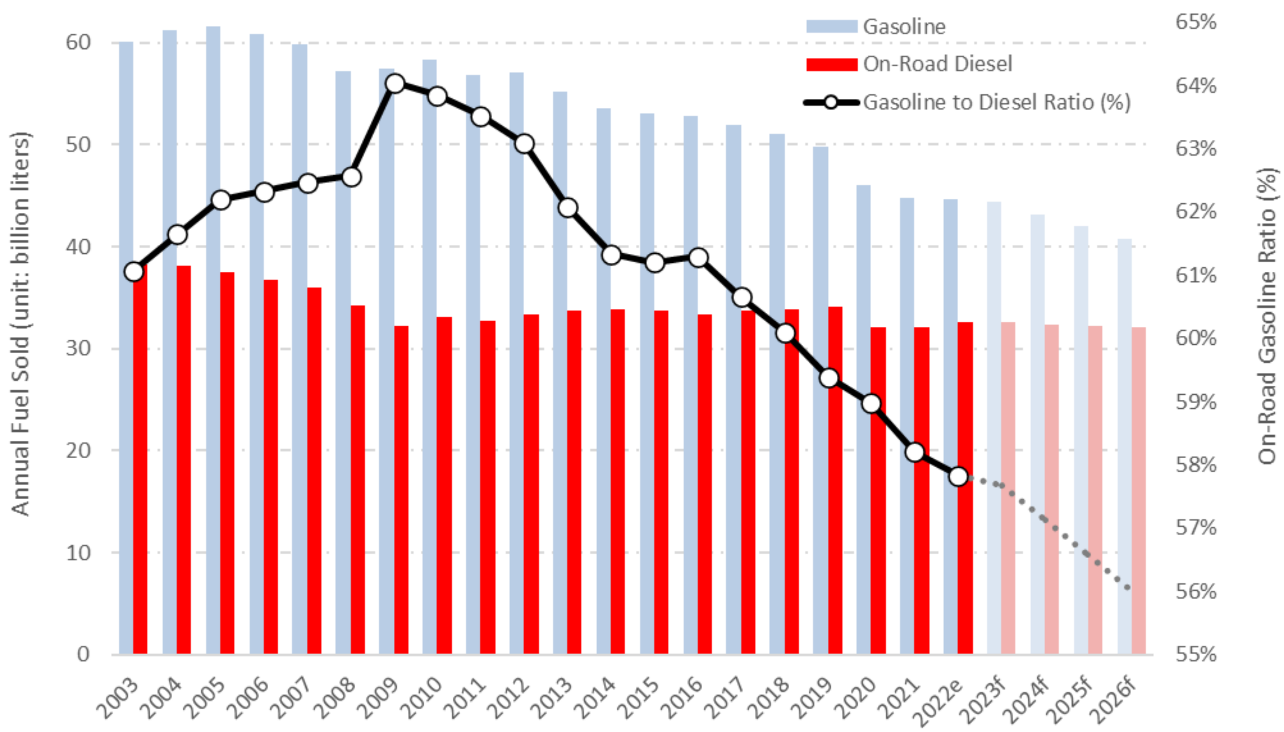
[6] E10 gasoline contains between 3 to 10 percent of directly blended ethanol. The maximum blend level specification for ETBE is approximately 22 percent (ETBE22) under the E10 gasoline standard.

[7] As of November 2022, JBSL consists of ENEOS, Idemitsu/ShowaShell, Cosmo Oil, Fuji Oil, and Taiyo Oil.

Japan's petroleum consumption has been in a long-term decline, exacerbated by the COVID-19 pandemic (Figures 3 and 4). Japan's gasoline consumption fell 7.5 percent to 46.1 billion liters in 2020 and a further 2.8 percent in 2021 to 44.8 billion liters (Figure 4). Even with a gradual recovery in gasoline demand in 2022, METI forecasts gasoline consumption to decrease approximately 2.7 percent a year through 2026 due to greater fuel efficiency of new vehicles (e.g., hybrid engine). METI estimates that gasoline will constitute 57.8 percent of Japan's on-road fuel in 2022 (Figure 4).

In 2021, Japan consumed 32.6 billion liters of on-road diesel. METI forecasts on-road diesel consumption to marginally fall 0.2-0.6 percent a year through 2026 (Figure 4).

Figure 4. Japan's Past and Expected Consumption of Gasoline and On-Road Diesel

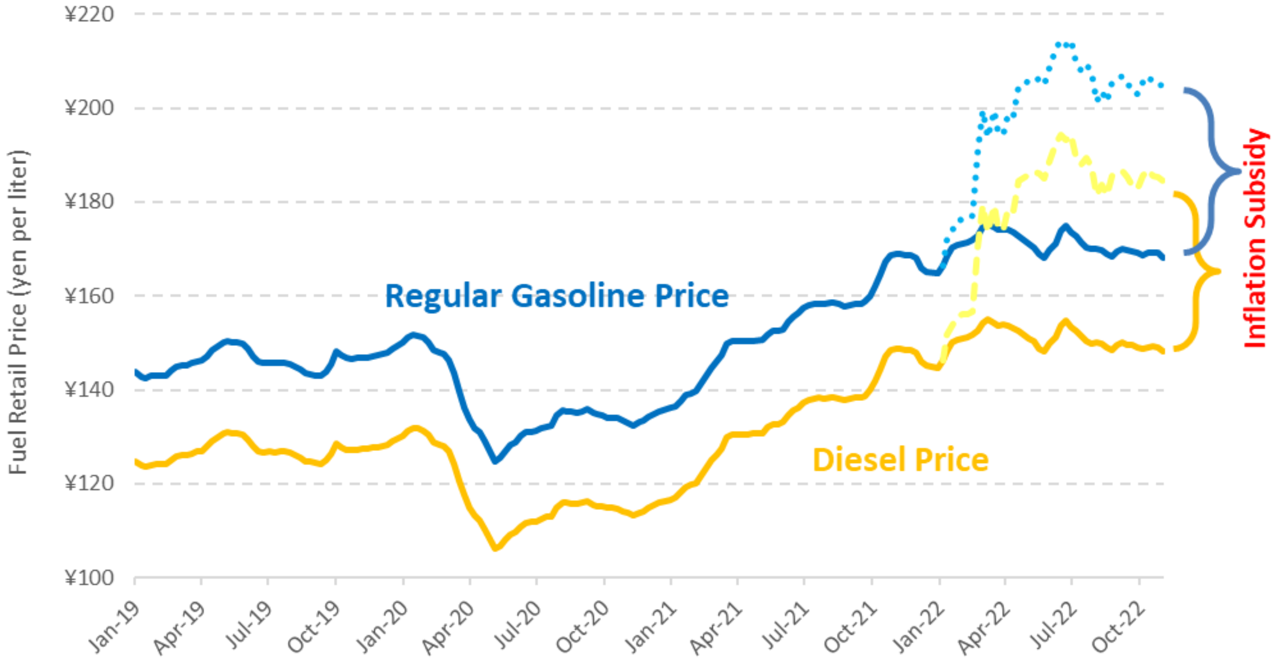


Note: The graph contains METI's year-to-date estimate for 2022 consumption and forecasts for 2023-2026 consumption.
Sources: ANRE, METI

In addition to these long-term trends in on-road fuel consumption, in 2022, Japan faced global commodity price hikes and a historically weak Japanese yen. In response, since January 27, 2022, GOJ has implemented a subsidy program to minimize fuel price spikes (Figure 5). The program, which has stabilized fuel demand, covers gasoline, on-road diesel, heating oil and fuel oil, and will likely[8] continue through September 2023. As a result of the subsidy program, Japanese retail price for gasoline has hovered around 170 yen per liter and for on-road diesel around 150 yen per liter (Figure 5).

[8] On November 8, 2022, GOJ approved a supplementary FY 2022 budget to finance a comprehensive economic package targeting inflation.

Figure 5. Gasoline and On-Road Diesel Retail Price and Subsidy Program



Note: Dotted lines represent METI's forecast for fuel prices in the absence of a fuel subsidy program.
Sources: ANRE, METI

SAF as an Emerging Biofuel Opportunity

In 2016, the International Civil Aviation Organization (ICAO) adopted a global market-based mechanism, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), to address CO_2 emissions from international aviation.

Adoption of SAF is a key component of GOJ's plan to reduce GHG emissions from aviation. On April 22, 2022, MLIT and METI jointly launched a public-private partnership to facilitate the development of reliable domestic production of SAF (JA2022-0041). In the summer of 2022, METI held SAF production and supply working group meetings, while separately MLIT organized SAF distribution working group meetings.

On October 4, 2022, MLIT published the draft Basic Policy for Promoting Decarbonization of Aviation (JA2022-0085). In the proposed Basic Policy, there are three targets for airlines: (i) stabilization of CO_2 emissions (i.e., carbon-neutral growth) from international flights at FY 2020 levels, (ii) reduction in CO_2 emissions per unit transport from domestic flights by 16 percent by FY 2030 compared to FY 2013 levels, and (iii) carbon neutrality for both international and domestic flights by FY 2050. By 2030, Japan aims to replace 10 percent of conventional jet fuel with SAF. MLIT estimates that by 2030 Japanese airports will require 2.5-5.6 billion liters of SAF out of a total of 10.9-12.3 billion liters of jet fuel to meet the CORSIA goal[9].

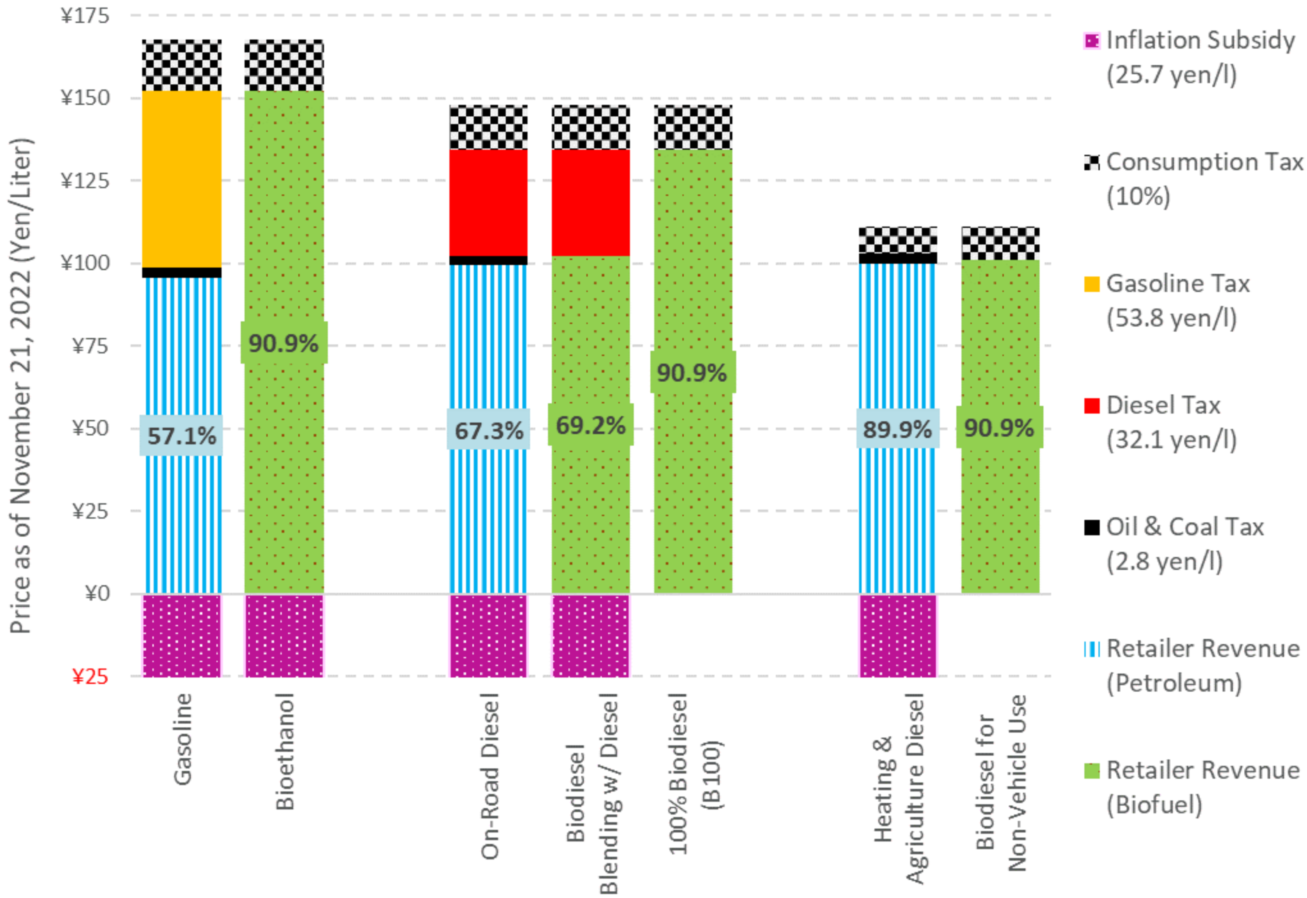
[9] https://www.mlit.go.jp/common/001407977.pdf (Japanese only)

Unlike its pessimistic outlook on Japan's on-road biofuel demand[10], Japanese industry sees SAF as a real opportunity to expand Japan's liquid biofuel demand. For its part, GOJ has focused on stimulating domestic neat SAF production over SAF imports and has repeatedly identified bioethanol as the most promising feedstock for neat SAF production in Japan. Industry and GOJ sources indicate that CORSIA's default life cycle emissions values for fuels will likely inform Japan's criteria for eligible SAF feedstocks.

Financial Supports for Biofuels

Biofuels Tax Policy

Figure 6. Japan's Tax and Subsidy Structure for Liquid Fossil Fuels and Biofuels



Note: Due to the historic volatility of the Japanese yen in 2022, the price structures are presented in yen, rather than dollars.
Sources: ANRE, METI

[10] Gasoline demand in Japan has declined approximately 2 percent a year since 2012 (Figure 4).

Since 2008, Japan has exempted fuel bioethanol from the gasoline tax (53.8 yen/liter) and oil and coal tax (2.8 yen/liter) under the Quality Control Act. This system facilitates price competitiveness of bioethanol relative to gasoline (Figure 6), which has a 33 percent higher energy density.
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)[11]. Biodiesel producers have frequently, though unsuccessfully, petitioned METI and the Ministry of Finance to revise the tax structure to expand the biodiesel market.

On November 21, 2022, the average retail price of regular gasoline was 167.6 yen/liter (about $4.52/gallon), of on-road diesel was 147.8 yen/liter (about $3.99/gallon), and of heating oil was 111.2 yen/liter (about $3.00/gallon)[12]. Bioethanol blended with gasoline and biodiesel blended with on-road diesel are also eligible for GOJ's recent subsidy program to reduce the impact of fuel price inflation. Inflation subsidy was 25.7 yen/liter on November 21, 2022 (Figure 6).

Financial Supports for Advanced Biofuel, SAF and e-fuel Projects

In 2020, METI introduced a 2 trillion yen (approximately $14.4 billion[13]) Green Innovation Fund to support research, development and commercialization of environmentally innovative projects through the New Energy and Industrial Technology Development Organization (NEDO). E-fuels and SAF are key targets for this initiative. For e-fuels, GOJ aims to achieve a liquid fuel yield of 80 percent of produced hydrocarbons in pilot projects by 2030 and commercialization by 2040. For alcohol-to-jet (ATJ) SAF, NEDO announced plans for commercial production by 2030 with a liquid fuel yield of at least 50 percent and production cost of 100 yen per liter.

As part of METI's Green Innovation Fund, on April 19, 2022, NEDO awarded 114.5 billion yen (about $830 million[13]) grants to pilot projects to develop e-fuels, SAF and other renewable fuels. In FY 2022, METI separately provided 5.18 billion yen ($37.4 million[13]) to NEDO's bio-jet fuel technology research and development projects.

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 (ISCC) program.

[11] The Quality Control Act, which limits biodiesel content to 5 percent (B5) in on-road diesel, only sets out requirements for fossil fuels and does not extend to B100 or 100 percent biodiesel.

[12] $1 USD = 140.3 yen (as of Nov 21, 2022)

[13] $1 USD = 138.6 yen (as of Nov 29, 2022)

Import Policy and Tariff

METI's Ordinance for the Enforcement of the Ethanol Business strictly regulates ethanol imports and sales in Japan.

Japan does not impose a tariff on bio-ETBE imports, imports of bioethanol for the production of bio-ETBE, or imports of industrial "crude" ethanol destined for Japanese distilleries. 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 (Table 1). Ethanol imports from the European Union (EU) and the United Kingdom (UK) (receive similar tariff treatment, and Japanese ethanol importers noted a recent increase in Japan's imports of synthetic (i.e., ethylene-derived) ethanol from the EU and UK. Japan Customs does not proactively or retroactively apply the preferential tariff schedule under the USJTA unless importers specifically request it prior to import.

Table 1. Tariff Reduction Staging Table under USJTA (HS: 2207.10-199)

HS:2207.10-199	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028
United States	5.4%	4.5%	3.6%	2.7%	1.8%	0.9%	0%

Source: Japan Customs

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., UK, Switzerland, EU, Comprehensive and Progressive Agreement for Trans-Pacific (CPTPP), and Association of Southeast Asian Nations (ASEAN)). Japan currently does not import biodiesel for on-road use.

Section III. Ethanol

Bioethanol (ethyl alcohol) is made by fermenting the carbohydrate components of plant materials, such as corn, sugarcane or rice. Table 2 breaks down bioethanol consumption for fuel and industrial[14] purposes and provides FAS/Japan's estimate of Japan's average national blend rate.

Consumption

Fuel Use

All major Japanese oil refineries (PAJ members) blend gasoline with bioethanol-derived ETBE, rather than directly with bioethanol. As Notifications 2.0 and 2.1 set an annual 500 million LOE target, Japan consumes on average 823 million liters of bioethanol (entirely in the form of ETBE). FAS/Tokyo estimates Japan's on-road bioethanol consumption at 830 million liters in 2021 and at 850 million liters in 2022. In 2021, Japan imported approximately 92 percent of its consumed ETBE and produced the remainder domestically with Brazilian ethanol. Some local gas stations in Niigata and Nagoya sell E3 gasoline (i.e., directly blended ethanol), but the total consumption of bioethanol in these projects is under half a million liters and is not counted toward the biofuel target. At the height of the COVID-19 pandemic, decreased gasoline demand coupled with a set biofuel volume target resulted in a higher average ethanol blend rate at 1.9 percent.

Industrial Use

The COVID-19 pandemic has boosted industrial ethanol demand by 47 percent in 2020 to 547 million liters, especially for sanitization purposes. FAS/Tokyo estimates the consumption of industrial bioethanol dropped to 461 million liters in 2021, but still exceeded 2019 consumption by 24 percent. FAS/Tokyo forecasts that the industrial bioethanol consumption will stay at the 2021 level in 2022 based on year-to-date trade statistics.

For details about Japan's distribution structure for non-fuel ethanol, please see JA2021-0072. Consumption of imported bioethanol in the production of alcoholic beverages is outside of the scope of the present report.

Production

Since the National Federation of Agricultural Cooperative Associations (JA Zen-noh) halted its bioethanol production in 2021, Japan has not produced domestic fuel ethanol in 2022. Japan's annual production of 80-100 million liters of synthetic ethanol is not included in Table 2.

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[14] The provided data excludes (i) approximately 200-260 million liters of bioethanol imported annual for alcoholic beverage production and (ii) domestically manufactured and imported synthetic ethanol used in chemical manufacturing and in other industrial applications.

Table 2. Fuel and Industrial Bioethanol Use in Japan (2013-2022)

Ethanol Used as Fuel and Other Industrial Chemicals (Million Liters)										
Calendar Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022f**
Beginning Stocks	72	62	95	82	89	84	60	78	62	64
Fuel Begin Stocks	27	23	55	44	46	44	22	23	16	18
Fuel Production	20	17	2	1	0.2	0.2	0.2	0.2	0	0
Imports	721	843	946	1,143	1,194	1,198	1,173	1,381	1,293	1,310
Industrial Imports	327	325	347	385	412	373	388	538	461	460
Fuel Imports	394	518	599	758	782	825	785	843	832	850
>of which to make ETBE	60	60	60	70	55	87	60	54	66	60
>imported as ETBE	334	458	539	688	727	738	725	789	766	790
Exports	0	0	0	0	0	0	0	0	0	0
Consumption	751	827	961	1,137	1,199	1,222	1,155	1,397	1,291	1,314
Non-Fuel Consumption	333	324	349	380	415	375	371	547	461	464
>for food industry	182	183	188	190	186	202	209	246	240	240
Fuel Consumption	418	503	612	757	784	847	784	850	830	850
Ending Stocks	62	95	82	89	84	60	78	62	64	60
Fuel Ending Stocks	23	55	44	46	44	22	23	16	18	18
Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	5	5	3	3	1	1	1	1	0	0
Nameplate Capacity	34	34	34	4	1	1	1	1	0	0
Capacity Use (%)	59%	50%	6%	25%	19%	20%	18%	20%	N/A	N/A
Feedstock Use for Fuel Ethanol (1,000 MT)										
Molasses	8	8	8	2	-	-	-	-	-	-
Rice	2	2	1	1	0.5	0.5	0.5	0.5	-	-
Market Penetration (Million Liters)										
Fuel Ethanol Use	418	503	612	757	784	847	784	850	830	850
Gasoline Pool	55,234	53,608	53,113	52,849	51,904	50,999	49,785	46,052	44,768	44,620
Blend Rate (%)	0.8%	0.9%	1.2%	1.4%	1.5%	1.7%	1.6%	1.8%	1.9%	1.9%

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
Bioethanol imported for alcoholic beverage production and estimated imports of synthetic ethanol are excluded.

Sources: Japan Customs; Japan Alcohol Association; ANRE

Trade

Japan's fuel bioethanol consumption relies entirely on imports (Table 2). In 2021, Japan imported 1.8 billion liters of bio-ETBE derived from approximately 766 million liters of bioethanol. In addition, Japanese oil refineries produced ETBE from 66 million liters of ethanol from Brazil. Most U.S. ethanol exports to Japan are for industrial use and usually transshipped through South Korea. Therefore, there is a substantial difference between U.S. export data and Japan's import data for ethanol (see JA2021-0072 for details).

According to industry experts, some food manufacturers that utilize ethanol request sugarcane-based ethanol. Thus, Brazil dominates the ethanol market for "industrial" use, including the food industry market. Although the United States lost some ethanol market share in Japan to Brazil in 2021 due to a higher price, it has since recovered.

Section IV. Biodiesel

METI and Japanese oil refineries have not promoted on-road biodiesel use due to limited demand (Figure 4)[15], variable biodiesel quality and feedstock availability.

Table 3. Biodiesel Production and Use in Japan (2013-2022)

Biodiesel (Million Liters)										
Calendar Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021e**	**2022f**
Beginning Stocks	0	0	0	0	0	0	0	0	0	0
Production	13	18	20	21	20	21	24	22	21	21
Imports	1	1	1	1	1	1	1	1	1	1
Exports	3	3	4	6	6	7	9	9	7	5
Consumption	11	16	17	16	15	15	16	14	15	17
Ending Stocks	0	0	0	0	0	0	0	0	0	0
Production Capacity										
Number of Producers	46	43	49	44	41	33	31	36	36	36
Feedstock Use (1,000 MT)										
Used Cooking Oil	9	11	12	12	12	13	15	13	12	13
Other Fat and Oil	4	7	8	9	8	8	9	9	9	8
Market Penetration (Million Liters)										
Biodiesel, on-road use	10.2	15.5	16.8	15.1	14.9	14.1	15.9	13.4	*14*	*15*
On-Road Diesel Pool	33,753	33,789	33,665	33,372	33,664	33,852	34,042	32,037	32,140	32,581
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	65,192	63,739	61,376	61,885	61,847	60,573	59,017	56,140	55,648	56,226

Note: *e*=estimate and *f* = forecast by FAS/Tokyo

Total Diesel Pool includes on-road diesel, heating oil, and agricultural diesel ("A" fuel oil).

Sources: National Biodiesel Fuel Utilization Promotion Council; ANRE; Japan Customs

[15] However, on-road diesel use to gasoline has been increasing as gasoline demand has steadily declined over the last decade.

Some municipalities have small-scale, highly localized environmental projects focused on biodiesel production from used cooking oil (UCO) and vegetable oils. For example, the City of Kyoto has the largest biodiesel project in Japan with a daily capacity of 5,000 liters. In 2021, the City of Kyoto used about 0.4 million liters of biodiesel.

In FY 2020 (ANRE's latest available energy statistics), Japan consumed 13.4 million liters of biodiesel, a drop from the 15.9 million liters in FY 2019. The COVID-19 pandemic reduced both UCO generated from restaurants and biodiesel demand. According to Japan Organics Recycling Association (JORA)'s annual survey results, Japan's biodiesel use was split between B5 (approximately 75 percent) and B100 (25 percent) in 2020 (latest data available). FAS/Tokyo forecasts Japan's biodiesel consumption will recover to 17 million liters for on-road diesel in 2022.

Since 2011, Japan has exported biodiesel to Europe. In 2020 and 2021, Switzerland was the only export market for biodiesel from Japan and these exports fell 22 percent in 2021, compared to 2020. 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.

According to UCO Japan, in 2021, Japan generated 0.5 million MT of UCO, of which 0.2 million MT went toward animal feed, 0.12 million MT was exported for foreign SAF production, 50,000 MT used in chemical manufacturing (e.g., soap and detergent), and 10,000 MT for biodiesel feedstock. Japanese feed manufacturers experienced a UCO shortage in 2021 and had to import 0.2 million MT of palm oil for compound feed. For further information about Japanese UCO and vegetable oil market, please see Japan Oilseeds and Products Annual.

Section V. Advanced Biofuels

Table 3. Current Major SAF Projects in Japan

Company Name	Feedstock	Technology	Projected Commercialization
Mitsubishi Power, JERA	Paper sludge, sawdust	Gasification, FT	2030
Biomaterial in Tokyo (Bits)	Wasted pulp	ATJ	2030
Idemitsu	Ethanol	ATJ	2026
Cosmo & Mitsui	Ethanol	ATJ	2027
Sekisui	Municipal solid waste	ATJ	2025
Nikki, REVO, Cosmo	UCO	HEFA	2025
J-Oil Mills	Jatropha oil	HEFA	2030
ENEOS & Mitsubishi	UCO	HEFA	2027
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 stands for Fischer-Tropsch process, ATJ stands for Alcohol-to-Jet process, HEFA stands for Hydroprocessed Esters and Fatty Acids process.

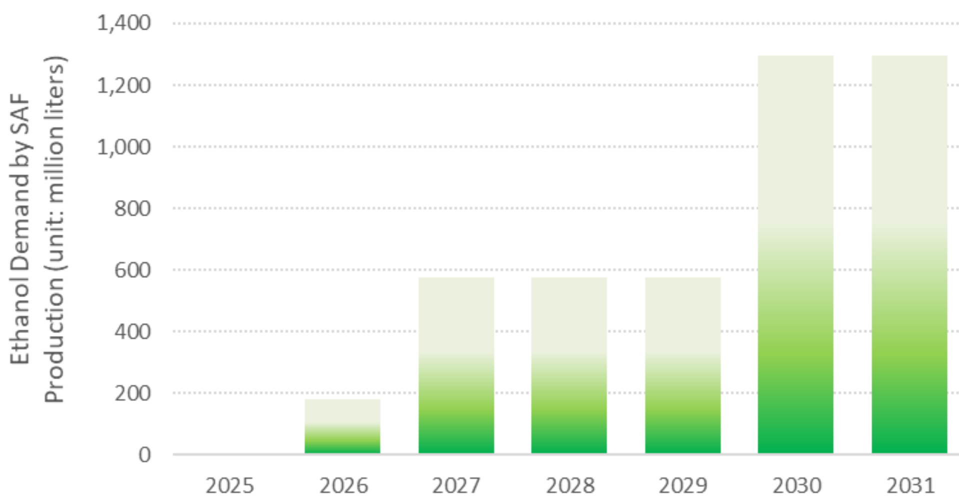
As of November 2022, Japan does not produce advanced biofuels on a commercial scale. However, NEDO and MOE fund a number of pilot SAF projects (Table 3).

On April 19, 2022, the Idemitsu Kosan Company received 29.2 billion yen (about $211 million[16]) for a 5-year project to develop and commercialize its SAF supply chain using the ATJ technology. According to an Idemitsu press release, the company will procure 180 million liters of bioethanol a year to produce 100 million liters of neat SAF. This pilot production is slated to start by 2026 in Chiba Prefecture. By 2030, Idemitsu aims to launch a second SAF plant and expects the combined production capacity of both facilities to reach 500 million liters a year of ATJ SAF (JA2022-0041).

Separately, on July 28, 2022, Cosmo Oil and Mitsui & Co. announced joint plans for a Japan-based ATJ SAF manufacturing facility using LanzaJet's technology. They aim to produce 220 million liters of SAF per year by FY 2027.

If the Idemitsu and Cosmo-Mitsui projects unfold as planned, Japan will require approximately 1.3 billion liters of CORSIA-eligible bioethanol by 2030 (Figure 7), in addition to bioethanol for on-road use.

Figure 7. Ethanol Demand Projected by SAF Manufacturers



Sources: Press releases by Cosmo Oil, Mitsui & Co. and Idemitsu.

Before domestic SAF production will launch on a commercial scale, Japanese airliners will likely rely on imported SAF. In 2022, Itochu Corporation entered into an exclusive Branded Distribution Marketing Agreement in Japan with Neste. With support from MLIT, from early 2023, Itochu will import approximately 5,000 liters of neat SAF to blend with jet fuel and supply the Nagoya Centralia Airport.

[16] $1 USD = 138.6 yen (as of Nov 29, 2022)

Section VI. 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
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-CO_2e/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 (synthetic fuels) made from carbon dioxide and hydrogen
ETBE: ethyl tert-butyl ether
FT: the Fischer–Tropsch process to produce SAF
FY: Japanese fiscal year (April-March), for example, FY 2022 is April 2022–March 2023
GHG: greenhouse gas
LCA: life cycle assessment
HEFA: hydroprocessed esters and fatty acids
HS: harmonized system of tariff schedule codes
SAF: sustainable aviation fuel
UCO: used cooking oil
USJTA: U.S.-Japan Trade Agreement

Organizations and Companies

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
GOJ: The Government of Japan
ICAO: The International Civil Aviation Organization
JA Zen-noh: National Federation of Agricultural Co-operative Associations
JORA: Japan Organics Recycling Association
JBSL: Japan Biofuels Supply LLP
METI: The Ministry of Economy, Trade and Industry
MLIT: The Ministry of Land, Infrastructure, Transport and Tourism
MOE: The Ministry of the Environment
NEDO: New Energy and Industrial Technology Development Organization
PAJ: Petroleum Association of Japan
UK: United Kingdom
UNFCCC: The United Nations Framework Convention on Climate Change

Units

$g\text{-}CO_2eq$: grams of carbon dioxide equivalent of GHG emission
LOE: liters of crude oil equivalent; unit of energy used by METI
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

Conversion Factors

1 liter = 0.264 gallon
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

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 and Vegetable Oil to biodiesel: 1 MT = 1,043 liters
Ethanol to neat SAF: 1.8 liter of bioethanol = 1 liter of neat SAF

Attachments:

No Attachments