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Prepared By: Daisuke Sasatani

Approved By: Craig Elliott

Report Highlights:

In 2024, Japanese oil refineries have continued supplying ethyl tert-butyl ether (ETBE), which is made from approximately 824 million liters of bioethanol and reflects the annual target volume set by the Government of Japan (GOJ). The GOJ has recently proposed to commercially introduce E10 gasoline by 2030. The future scaling of domestic sustainable aviation fuel (SAF) production, including alcohol-to-jet (ATJ) SAF, is Japan's primary focus for increasing biofuel consumption. To remove operational uncertainties for the private sector, the GOJ is currently developing a separate SAF target volume prior to it being commercially available at scale. Currently, there is no market for biodiesel or renewable diesel due to limited domestic feedstock availability.

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Section I. Executive Summary

Since 2017, the Government of Japan (GOJ)'s biofuel standards have included an annual biofuel target volume, a *de facto* mandate, of 500 million liters of crude oil equivalent (LOE)[1] or approximately 824 million liters of bioethanol. Japanese oil refineries have met this target largely through the imports of bio-ethyl tert-butyl ether (ETBE) derived from bioethanol, as well as a small volume of domestically produced bio-ETBE from imported bioethanol.

On March 31, 2023, the Agency for Natural Resources and Energy (ANRE) within the Ministry of Economy, Trade and Industry (METI) released Japan's new biofuel standards, called Notification 3.0 under the Sophisticated Act, which are in effect from Japan's fiscal year (FY, April to March) 2024 to FY2028. ANRE has maintained an annual target volume of 500 million LOE (i.e., 824 million liters of bioethanol). In addition, ANRE improved the default greenhouse gas (GHG) emissions for Brazilian sugarcane-based ethanol to 28.59 g-CO_2e/MJ and for U.S. corn-based ethanol to 36.86 g-CO_2e/MJ. ANRE also maintained the GHG emission reduction target for transport bioethanol at a current 55 percent for a while. However, ANRE is now reviewing the GHG emission value for gasoline and the GHG emission reduction target is going to change to 60 percent when ANRE releases a new value, possibly in 2025.

FAS/Japan estimates Japan's bioethanol consumption in the form of bio-ETBE for on-road fuel at 811 million liters in 2023, resulting in a 1.8 percent ethanol blend rate for gasoline. It is expected that Japanese oil refineries will continue supplying bioethanol-containing ETBE at the target volume; however, gasoline consumption is expected to slightly decrease. As a result, FAS/Tokyo forecasts Japan's ethanol blend rate to increase marginally to 1.9 percent for 2024.

On November 11, 2024, METI announced plans to increase bioethanol consumption for on-road vehicles in the near future. Japan is planning to commercially introduce E10 gasoline by FY2030. This E10 gasoline could include direct ethanol blending or may continue to incorporate ETBE. Furthermore, to facilitate the stated FY2040 commercial introduction of E20 gasoline, the Japanese government is planning to develop new gasoline standards and vehicle certification systems for E20.

In the longer term, the adoption of sustainable aviation fuel (SAF) is a key component of GOJ's plan to increase the utilization of biofuels in the transportation sector. The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is aiming to replace 10 percent of conventional jet fuel with SAF by 2030. To meet this goal, the GOJ aims to stimulate the domestic production of neat SAF[2], likely from imported feedstocks. Although the GOJ does not specify such a requirement, it is expected that Japanese airliners will seek to use Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) eligible fuel as defined by the International Civil Aviation Organization (ICAO). To remove operational uncertainty for the private sector, METI is now developing a new SAF standard separate from the current biofuel standards under the Sophisticated Act.

[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 823.7 million liters of ethanol. Reference: METI's "Provisions related to the Sophisticated Methods of Energy Supply Structure Act" (Japanese only).

[2] Neat SAF is unblended SAF component. Neat SAF must be blended with fossil-based jet fuel to be used in an airplane. In this report, SAF means neat SAF unless otherwise specified.

To facilitate SAF introduction, the GOJ has provided funding to the private sector to stimulate SAF production and has organized multiple workshops. Some oil refineries have announced plans to launch the production of CORSIA-eligible alcohol-to-jet (ATJ) SAF in Japan. It is expected that the annual bioethanol consumption used for ATJ SAF production will reach 1 billion liters by 2028, contingent upon the announced projects proceeding as planned.

In contrast, Japan's on-road biodiesel use remains very limited at about 10 million liters. By and large, the biodiesel is derived domestically from used cooking oil (UCO) in addition to other fats and oils. As the competition to procure UCO intensifies, biodiesel manufacturers have had difficulty securing sufficient UCO supplies. In short, the planned hydro-processed esters and fatty acids (HEFA) SAF projects as well as the future drop-in marine biodiesel projects will require very large volumes of UCO and other fats or vegetable oils.

On April 10, 2024, during then-Prime Minister Kishida's official visit to Washington DC, President Biden and the Japanese Prime Minister issued the [United States-Japan Joint Leaders' Statement.] The statement language includes that, "we intend to advance widespread adoption of innovative new clean energy technologies, and seek to increase the globally available supply of sustainable aviation fuel or feedstock, including those that are ethanol-based, that show promise in reducing emissions."

Section II. Policy and Programs

Japanese Energy Policy and Greenhouse Gas Emissions

Following the 1997 adoption of the Kyoto Protocol by the 3rd Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC), Japan pledged to reduce the country's greenhouse gas (GHG) emissions by 6 percent by 2020 from its 1990 level. Under the 2015 Paris Agreement, the Government of Japan's (GOJ) [Intended Nationally Determined Contribution] (INDC) included a 26 percent GHG emission reduction goal by Japanese fiscal year (FY: April-March) 2030 compared to 2013 levels. In October 2020, the GOJ declared a target to become carbon neutral by 2050. In April 2021, the GOJ further pledged to reduce its FY2030 GHG emissions by 46 percent, rather than the initially promised 26 percent, from FY2013 levels.

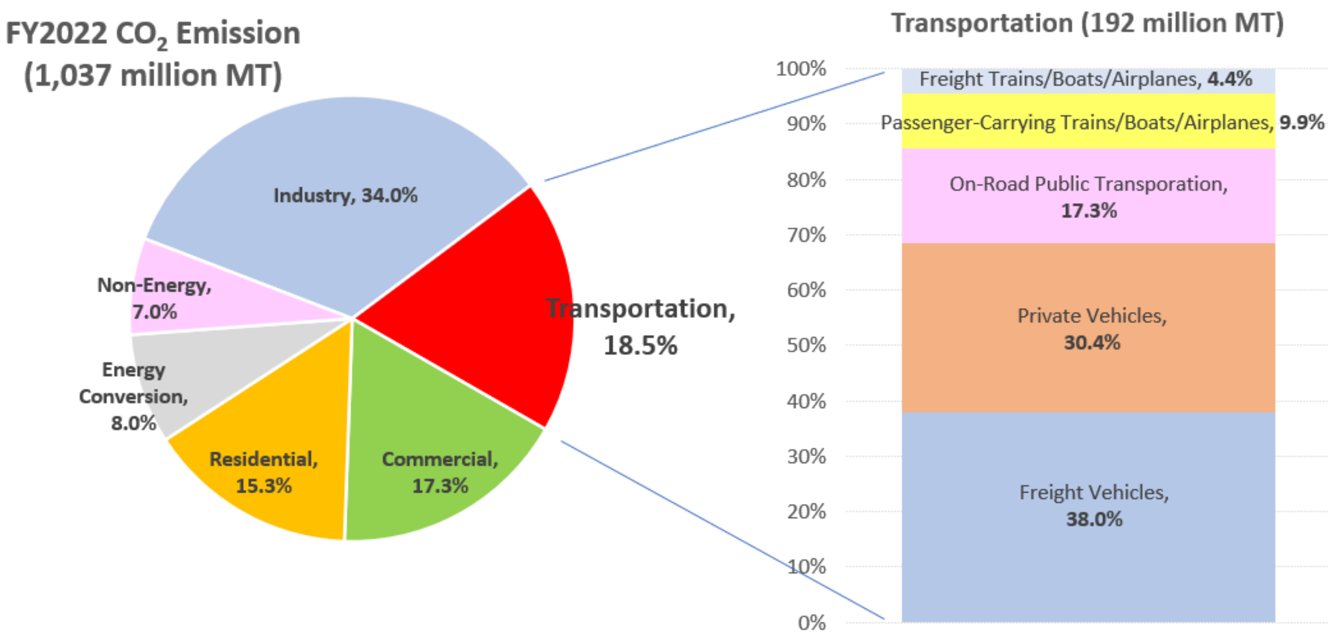
According to the [Ministry of Environment] (latest data available), Japan's net FY2022 GHG emissions decreased 2.3 percent from the previous fiscal year, specifically 1.09 billion CO_2-equivalent (CO_2e) metric tons (MT), of which 1.04 billion MT were CO_2 emissions. CO_2 emissions from the transportation sector increased 3.9 percent to 192 million MT or 18.5 percent of Japan's CO_2 emissions in FY2022 (see Figure 1). As Japan recovered from the COVID-19 pandemic and traveling returned, CO_2 emissions from passenger-carrying trains/boats/airplanes increased 18.8 percent from the previous year, resulting in 19 million MT. Freight vehicles emitted 73 million MT (-0.9 percent from the previous year), private vehicles emitted 58 million MT (+7.2 percent), passenger-carrying vehicles emitted 33 million MT (+2.8 percent), and freight train/boats/airplanes emitted 8 million MT (+0.5 percent) of CO_2 (Figure 1).

To achieve the GOJ's GHG reduction goals, in February 2023, the government approved [the Basic Policy for the Green Transformation (GX) Realization]. This policy emphasizes GHG emission reductions via increased use of next generation vehicles, such as electric vehicles (EV) for on-road transportation and via the commercial development of electrofuels (synthetic fuel or e-fuel). The policy also emphasizes the production and use of sustainable aviation fuel (SAF) by the aviation industry. The

GX Basic Policy places little importance on existing commercialized options, such as biofuels marketed today.

On May 12, 2023, just before then-Prime Minister Kishida hosted the G7 Hiroshima Summit, the GX Promotion Act was enacted. This Act introduced carbon pricing in Japan. The GOJ estimates that achieving carbon neutrality will require an investment of 150 trillion yen over the next ten years, of which 20 trillion yen will be covered by a "fossil fuel surcharge." From FY2028, the GOJ plans to impose the surcharge on fossil fuel importers and others. In advance of this compliance market scheme, the Tokyo Stock Exchange started trading J-Credits from October 11, 2023 in order to support the voluntary carbon market.

Figure 1. Japanese CO_2 Emissions by Sector in FY2022



Note: The figure does not include other GHG emissions: CH_4 (29.9 million MT CO_2e), N_2O (17.3 million MT CO_2e), and CFC substitutes (51.7 million MT CO_2e). Separately, carbon sinks mainly through land use, land-use change and forestry (LULUCF) were 50.2 million MT CO_2e.
Source: Japan Ministry of the Environment

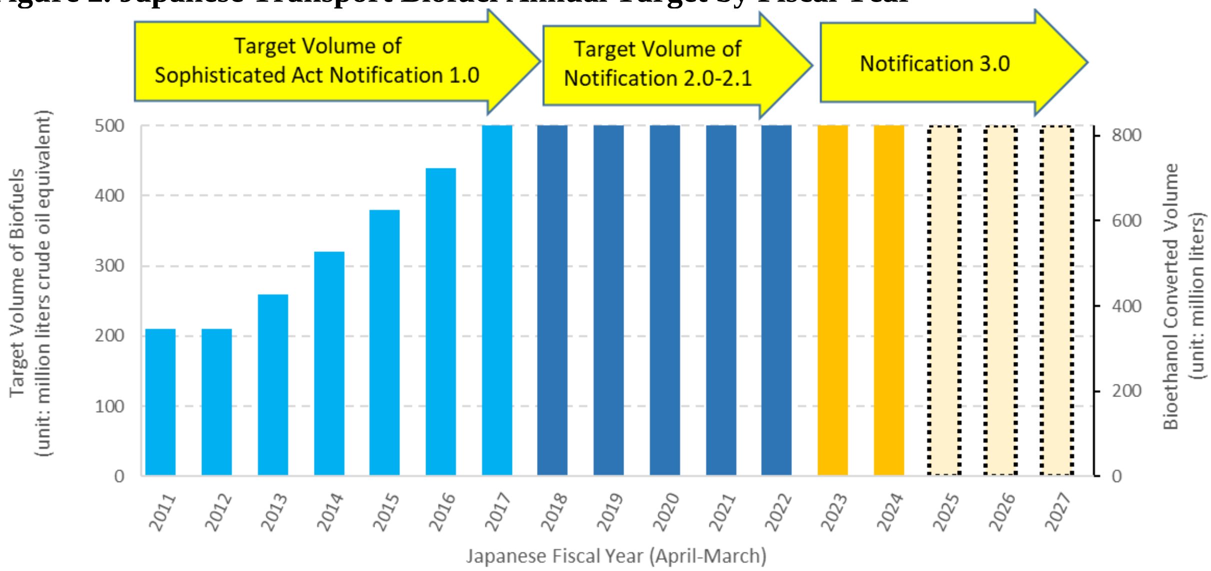
Biofuel Policy Framework

In 2009, to encourage the replacement of fossil fuels with renewable energy sources, 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”) was enacted. The Sophisticated Act directed the Ministry of Economy, Trade and Industry (METI) Minister to develop basic policies and guidelines (i.e., METI notifications) for each energy sector (e.g., oil refineries, gas suppliers, and power companies).

In 2010, METI published its first biofuel standards (Notification 1.0), which were in effect from FY2011 to FY2017 and laid the groundwork for the GOJ’s decision to use bioethanol to fulfil its biofuel commitment for on-road transportation. Japan’s preference for bioethanol over biodiesel is rooted in a strong demand for gasoline, variable biodiesel quality, and production costs. Notification 1.0 introduced an annual biofuel target volume, a *de facto* mandate. The target volume in FY2011 was 210 million liters of crude oil equivalent (LOE) or approximately 346 million liters of bioethanol. By FY2017, the annual targets had gradually increased to 500 million LOE (823.7 million liters of bioethanol) (see Figure 2).

In 2018, the METI Minister released the second biofuel standards, Notification 2.0, which were in effect from FY2018 to FY2022. METI mainly updated the default ethanol GHG emission values but retained the annual biofuel target of 500 million LOE. In September 2020, METI updated the gasoline GHG emission value in Notification 2.1.

Figure 2. Japanese Transport Biofuel Annual Target by Fiscal Year



On March 31, 2023, METI's Agency for Natural Resources and Energy (ANRE) published Notification 3.0 (unofficial translation in JA2023-0014), which mainly updated ethanol's default GHG emission values. ANRE has maintained the annual target volume of 500 million LOE. Per Table 1 below, Notification 3.0 established the following: (i) GHG emission value for gasoline temporally maintained at 88.74 g-CO_2e/MJ, (ii) GHG emission reduction target for transport bioethanol temporarily maintained at 55 percent, iii) GHG emission default value for U.S. corn-derived ethanol improved to 36.86 g-CO_2e/MJ, and (iv) GHG emission default value for Brazilian sugarcane-derived ethanol improved to 28.59 g-CO_2e/MJ. The consumption of next generation biofuel (e.g., cellulosic bioethanol and SAF) counts twice toward the target volume, although Japan has not used any next generation biofuel as of November 2023.

ANRE is updating the GHG emission value for gasoline and ANRE will raise the GHG emission reduction target to 60 percent once they publish the new GHG emission value for gasoline in Notification 3.1 (JA2023-0012) in the near future (see Table 1).

Notification 3.0 considers certain types of SAF as next generation biofuel and counts them twice toward the annual target volume for transport biofuels. During expert committee meetings on Notification 3.0, some experts recommended a separate SAF target from the on-road ethanol target. On May 26, 2023, ANRE presented a draft interim report on SAF introduction in Japan and announced plans to set a new separate target volume for SAF beyond current 500 million LOE for the transportation sector under the Sophisticated Act and before SAF's commercial availability (JA2023-0050).

Table 1. Comparison of Old, New, and Future Planned Biofuel Standard

	New Biofuel Standard	Future Biofuel Standard
Version	Notification 3.0	Notification 3.1
Introduced	March 2023	2025 or later?
Covered Period	April 2023-March 2028	Till March 2028
Annual Target Volume of Ethanol	823.7 million Liters	823.7 million Liters
Gasoline Carbon Intensity (CI) Value	88.74 g-CO_2e/MJ	Recalculating
Reduction Target	55%	60%
Brazilian Sugarcane Ethanol	28.59 g-CO_2e/MJ	Unchanged?
U.S. Corn Ethanol	36.86 g-CO_2e/MJ	Unchanged?
Next Gen. Biofuels including SAF	Count Twice	Count Twice

The scope of the series of Notifications are limited to fuel produced by the Petroleum Association of Japan (PAJ) member companies. Since 2011, the Petroleum Association of Japan (PAJ), representative for Japanese oil refineries, has chosen to fulfil the biofuel mandate by blending bioethanol-derived bio-Ethyl Tert-Butyl Ether (ETBE), rather than directly blending bioethanol with gasoline. The Japan Biofuels Supply LLP[3] (JBSL) represents the major Japanese oil companies and blends approximately 1,940 million liters of ETBE (containing approximately 823.7 million liters of bioethanol) a year to meet Japan's biofuel target.

There are some gas stations not affiliated with the PAJ. As such, the fuel distributed by these companies is not subject to the Sophisticated Act and their biofuel use which is extremely small does not count toward Japan's biofuel target. There is a limited distribution of directly blended E3 and E10 gasoline by small gas stations not affiliated with the PAJ.

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 the gasoline standards. Since 2003, the regular gasoline standard allows for the direct blend of ethanol up to 3 percent in volume. Also, the oxygen content in regular gasoline is limited to less than 1.3 percent in weight (8.3 percent of ETBE, which is equivalent to a 3.5 percent of directly blended ethanol).

Separately, the Quality Control Act established an "E10 gasoline" standard for vehicles that the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has certified as "E10/ETBE22" compatible. E10 gasoline can contain 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. The

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

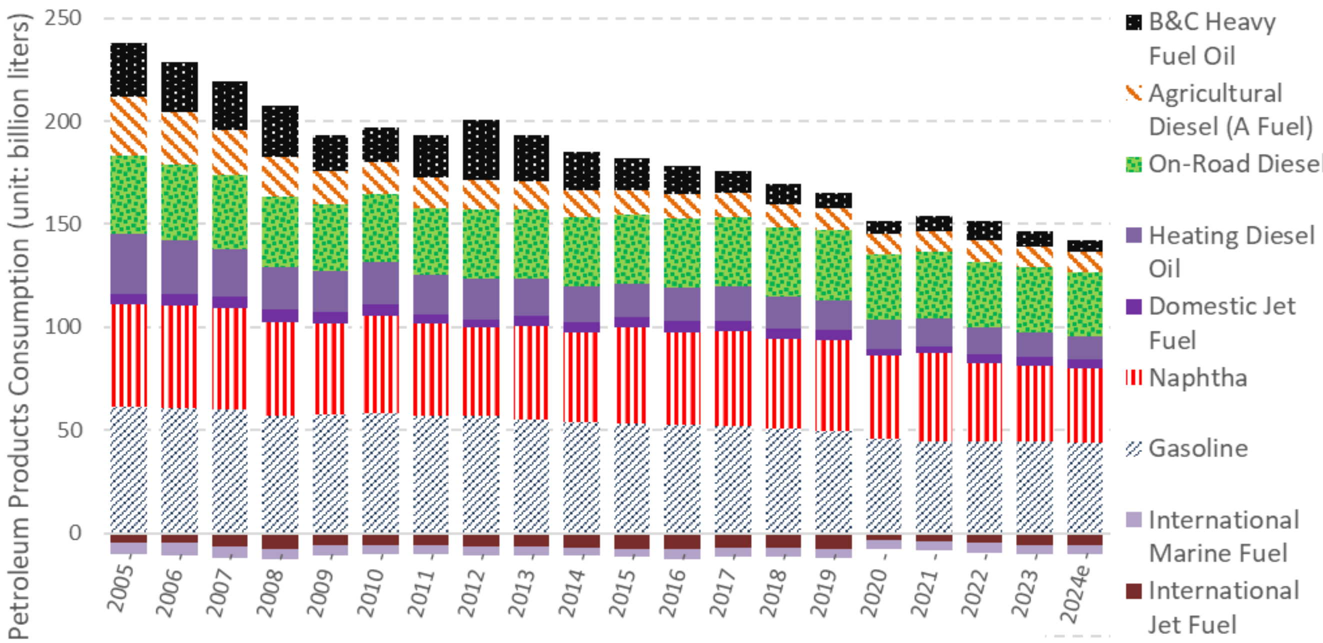
Nakagawa Bussan company from Nagoya, Japan commercially introduced Japan's first E10-grade gasoline[4] in summer 2023.

On November 11, 2024, [METI](#) announced plans to increase bioethanol consumption for on-road vehicles to achieve carbon neutrality by FY2050. Under the [draft proposal](#), by FY2030, Japan will commercially introduce E10 gasoline. This E10 gasoline could incorporate direct ethanol blending in some particular regions or may continue the current inclusion of ETBE. Ultimately, Japanese oil distributors will decide how to proceed. Furthermore, to facilitate the stated FY2040 commercial introduction of E20 gasoline, Japan is planning to develop new gasoline standards and vehicle certification systems for E20. Experts will discuss these proposals with the goal of finalizing a new policy. Some Japanese oil refineries have already planned to introduce higher biofuel blended gasoline in the future. For example, [ENEOS](#) plans to introduce E20 (containing not only biofuels but also eEthanol) by FY2040.

Fuel Pool Size

Petroleum consumption in Japan has been in long-term decline (see Figure 3). Total petroleum consumption in 2023 declined by 3.4 percent from the previous year, and the year-to-date estimate in 2024 shows a similar annual drop for 2024. Japanese domestic polyolefin and polyvinyl chloride demand has been extremely weak since 2022, and the naphtha market demand has also been weak. Also, the heating diesel oil and heavy fuel oil markets have been weak due to high energy costs.

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



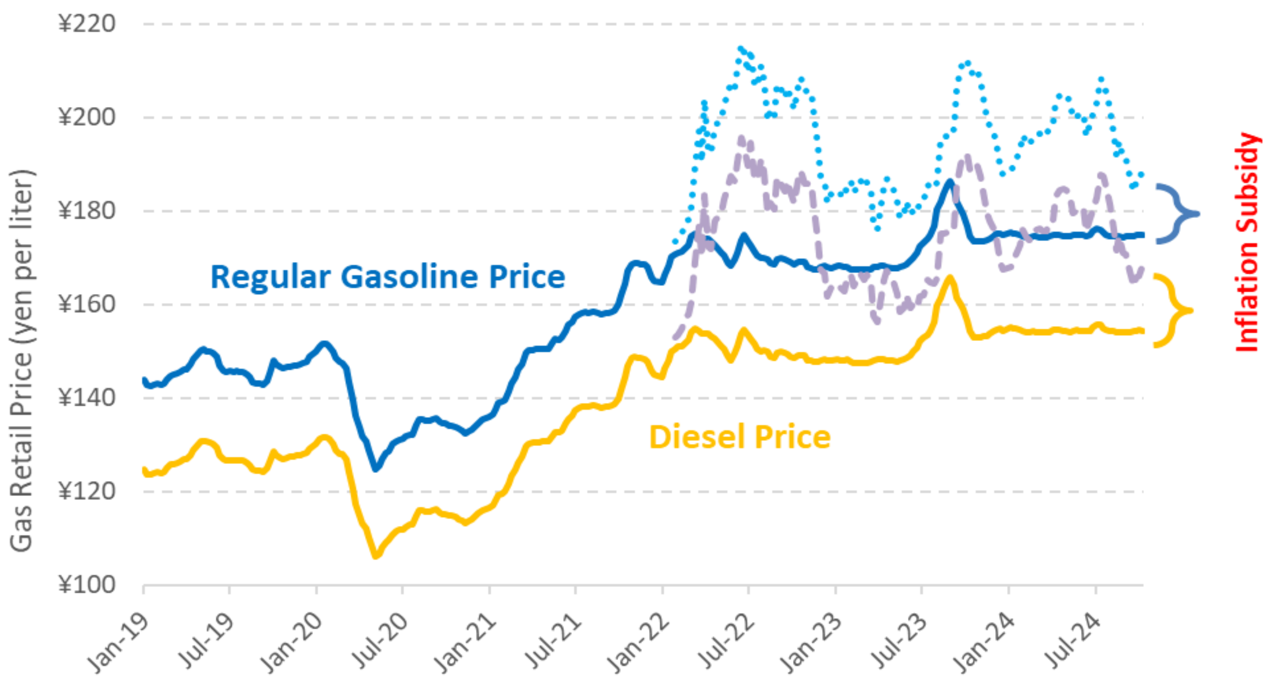
Note: "2024e" represents year-to-date estimate for 2024 (till September 2024 monthly data)
International jet and marine fuel are estimated based on export data.
Source: ANRE

[4] Nakagawa Bussan voluntarily started providing gasoline containing 7 percent of bioethanol (i.e., E7) outside of the Sophisticated Act framework.

Transportation fuel demand dipped sharply during the COVID-19 pandemic. However, the post-COVID period has resulted in the temporary flattening of the long-term decline for both gasoline and diesel pools. The weak Japanese currency has been attracting foreign visitors to Japan. In 2023, 25 million foreign nationals visited Japan, and by September 2024, 27 million foreign nationals will have already visited Japan (YTD estimates 39 million in 2024) this year. Domestic jet fuel consumption also increased 19.9 percent in 2022 and an additional 15.1 percent in 2023. Japan experienced jet fuel shortages at airports caused by strained supply chain capacity, resulting in METI and MLIT launching public-private task force to address this problem.

Since the middle of 2020, gasoline and diesel prices had been rising steadily in Japan due to the weakening Japanese yen and higher global crude oil prices. In response, since January 27, 2022, the GOJ has implemented the Fuel Oil Price Volatility Mitigation Subsidy program aimed at minimizing fuel retail price fluctuations (see Figure 4). The program covers gasoline, on-road diesel, heating oil, and fuel oil. The GOJ initially planned to gradually terminate this temporary program by September 2023. However, gasoline prices spiked around summer 2023 (see Figure 4) and the GOJ then decided to extend this subsidy program. The GOJ initially announced that the program was scheduled to end by December 2024, but the recently elected Prime Minister Ishiba's Cabinet has proposed to extend the program.

Figure 4. Gasoline and On-Road Diesel Retail Price and Subsidy Program

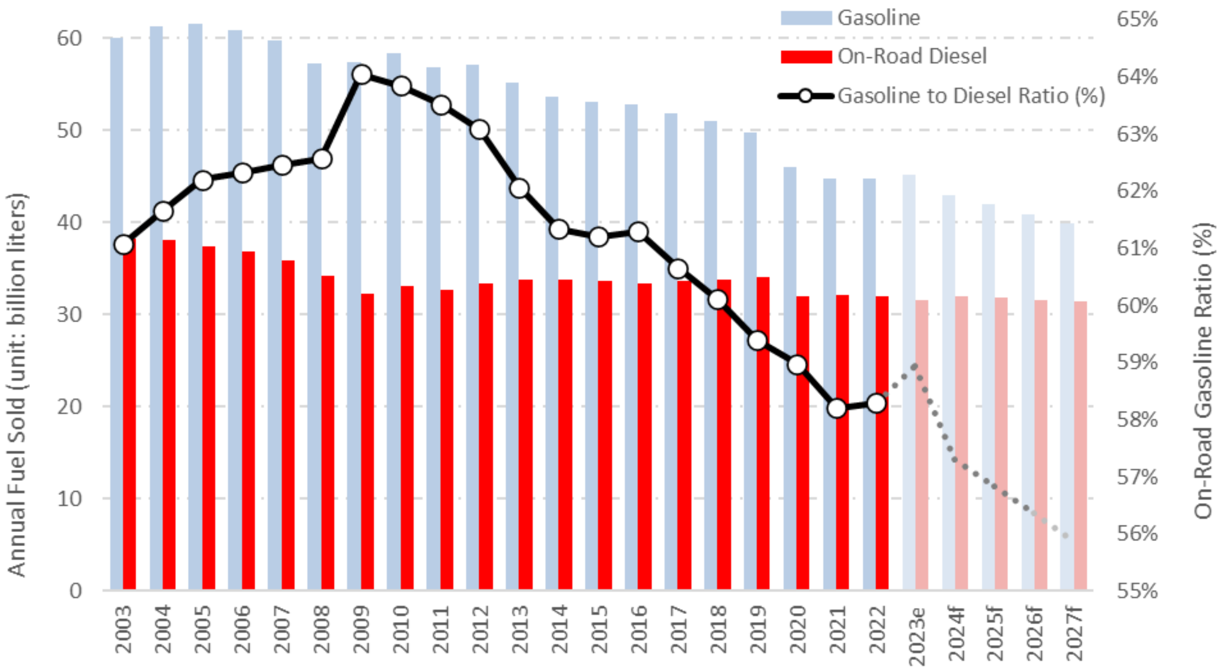


Note: Dotted lines represent the expected retail price by METI without the gas subsidy program based on the Dubai Fateh Crude Oil Price.
Sources: METI

As a result of the subsidy program, the retail price for gasoline in Japan has hovered around 170 yen per liter and about 150 yen per liter for on-road diesel (see Figure 4). Gasoline consumption in Japan was 44.6 billion liters in 2023, marginally declining 0.3 percent from the previous year. Additionally, Japan started regulating the overtime working hours for truck drivers, and following this new regulation, on-road diesel consumption in Japan declined 2.5 percent to 31.2 billion liters in 2023 (see Figure 5).

Gasoline and diesel pools are now set to resume the long-term decline. METI forecasts gasoline consumption in Japan to decrease 2.2 to 2.7 percent a year through 2028 because of the greater fuel efficiency for new vehicles (e.g., hybrid engines). On the other hand, METI forecasts on-road diesel consumption to fall just 0.6 to 1.0 percent per year through 2028 (see Figure 5).

Figure 5. Japan's Past and Expected Consumption of Gasoline and On-Road Diesel



Note: The graph contains year-to-date estimate for 2024 consumption and forecasts for 2024-2027 consumption by METI.
Sources: METI

Sustainable Aviation Fuel as an Emerging Biofuel Opportunity

To address CO_2 emissions from international aviation, in 2016 the International Civil Aviation Organization (ICAO) adopted a global market-based mechanism known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The CORSIA scheme is voluntary for all ICAO members until 2027. The GOJ announced its willingness to voluntarily participate in the pilot phase of CORSIA from 2021.

As everywhere else, the adoption of SAF is the key component of the GOJ's plan to reduce GHG emissions in aviation. On April 22, 2022, MLIT and METI jointly launched a public-private partnership to facilitate the introduction of an internationally competitive supply chain for SAF (JA2022-0041). In the summer of 2022, METI launched SAF production and supply working-group meetings, while MLIT separately initiated working-group meetings for SAF distribution.

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: 1) the stabilization of

CO_2 emissions (i.e., carbon-neutral growth) from international flights at FY2020 levels; 2) the reduction in CO_2 emissions per unit transport from domestic flights by 16 percent by FY2030 compared to FY2013 levels; and 3) the carbon neutrality for both international and domestic flights by FY2050. Japan is aiming to replace 10 percent of the country's conventional jet fuel usage with SAF by 2030. MLIT estimates that by 2030 Japanese airports would like to use 2.5 to 5.6 billion liters of SAF out of a total of 10.9 to 12.3 billion liters of jet fuel consumption to meet the CORSIA goal[5].
With domestic demand for gasoline and other on-road fuels expected to decline by about two percent per year long-term while the jet fuel pool expands and with far fewer options beyond biofuel to decarbonize aviation compared to all other transport modes, Japanese industry rightly sees SAF as the major opportunity to expand Japan's liquid biofuel market. For its part, the GOJ has focused on stimulating domestic SAF production over SAF imports and has identified bioethanol as one of the most promising feedstocks[6] for SAF production in Japan.

On September 30, 2024, METI held the 16th Decarbonized Fuel Policy Working Group meeting under the Resource and Fuel Subcommittee. ANRE outlined several discussion points in the future working group meetings as part of developing stand-alone SAF standards:

- **Supply Target Volume**: Japan aims to achieve a 5 percent or greater reduction in aviation GHG emissions by FY2030 compared to FY2019 levels (the baseline). This target (i.e., 5 percent) is derived from a SAF blend rate of 10 percent combined with a minimum of a 50 percent reduction in life cycle GHG emissions compared to conventional fuel.
- **Definition of SAF**: The qualification and specification of SAF must meet ASTM D7566 and D1655, which is the globally recognized fuel standard.
- **Covered Period**: The first SAF notification will cover the 5-year period from FY2030 to FY2034.
- **Target Operators**: The new notification will require jet fuel producers and importers supplying more than 100 million liters annually to comply with the rules. The allocation of target volumes will be based on the average annual production volume of each company.
- **Flexibility**: Due to uncertainties during the introduction phase, ANRE plans to allow leeway for circumstances beyond the control of business operators.
- **GHG Reduction Goals to Achieve**: To increase the supply of SAF with higher rates of GHG reduction, Japan aims for SAF to achieve a minimum of 50 percent reduction in GHG emissions compared to conventional jet fuel. Additionally, Japan intends to establish obligations to make the best efforts to develop and promote raw materials and new production technologies for SAF.

Airliners that use CORSIA-eligible fuels for international flights may report the emissions reductions from these fuels in their annual CORSIA Emissions Report. As a natural resource deficit country, Japan needs to rely on other countries to procure feedstocks for SAF production. During the meeting, some experts expressed concern that Japan may not be able to secure desirable feedstocks that can reduce GHG emissions more than 50 percent compared to conventional fuel. It is expected that experts will discuss these SAF-related challenges that Japan is facing.

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

[6] Please see Japan Oilseeds and Products Annual for more detail about the availability of used cooking oil.

Financial Supports for Biofuels

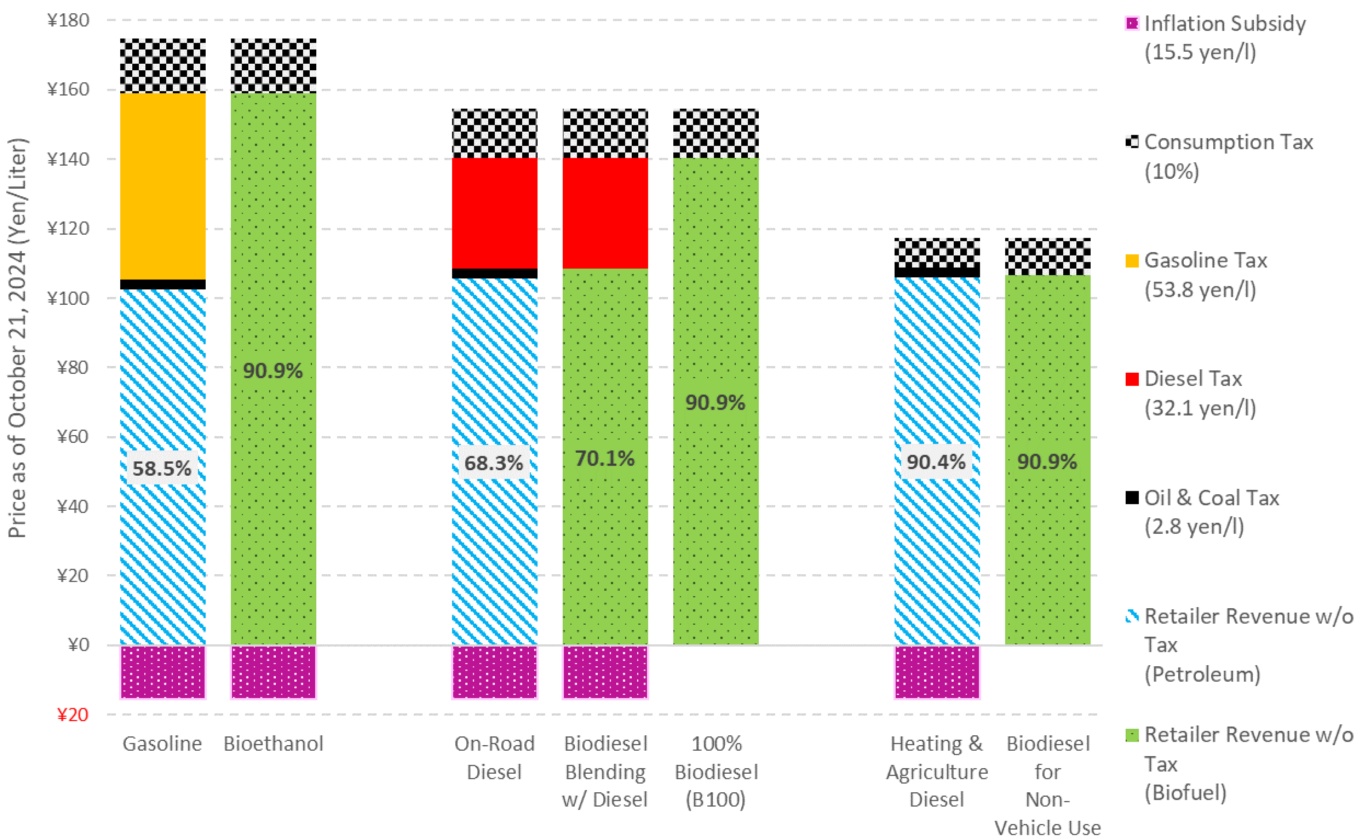
Fossil Fuel Tax Policy

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 (see Figure 6) facilitates price competitiveness of bioethanol relative to gasoline, which notably has 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)[7]. Biodiesel producers have frequently, though unsuccessfully, petitioned METI and the Ministry of Finance to revise the tax structure to expand the biodiesel market. The volumes produced and used remain inconsequential.

Bioethanol blended with gasoline, as well as biodiesel blended with on-road diesel are also eligible for the GOJ's recent subsidy program to reduce the impact of fuel price inflation (see Figure 6).

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



Source: METI

On October 23, 2024, the average retail price of regular gasoline was 174.9 yen/liter (≈$4.32/gallon[8]),

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[7] 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.

[8] $1 USD = 153.35 yen (as of Oct 30, 2024, by BOJ)

154.5 yen/liter (≈$3.81/gallon) for on-road diesel, and 117.3 yen/liter (≈$2.90/gallon) for heating oil. The inflation subsidy for gasoline was 15.5 yen/liter (≈$0.38/gallon[8]) from October 24 to October 30, 2024.

In addition, as already discussed, Japan introduced a carbon pricing mechanism under the GX Promotion Act. Starting from FY2028, crude oil importers will be subject to a "fossil fuel surcharge" based on the amount of CO_2 generated from the fossil fuels they import, respectively.

Financial Supports for the Commercialization of Advanced Biofuel, SAF Projects

In 2020, METI introduced a 2.3 trillion yen (approximately $15 billion[8]) Green Innovation Fund to support research, development, and commercialization of environmentally innovative projects via the New Energy and Industrial Technology Development Organization (NEDO). E-fuels and SAF are key targets for this initiative. For e-fuels, the GOJ aims to achieve a liquid fuel yield of 80 percent of produced hydrocarbon 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 costs of 100 yen per liter.

As part of METI's Green Innovation Fund, on April 19, 2022[9], NEDO awarded 114.5 billion yen (about $755 million) worth of grants for pilot projects to develop e-fuels, SAF, and other renewable fuels. In FY2023, METI separately provided 5.18 billion yen ($34 million[9]) to the bio-jet fuel technology research and development projects of NEDO.

In addition, the GOJ has developed the "Japan Climate Transition Bond Framework" and decided to issue 20 trillion yen worth of GX Economy Transition Bonds over 10 years. From FY2025, METI is planning to invest approximately 340 billion yen ($2.2 billion[8]) for SAF manufacturing and supply chain development over a five-year period.

METI has also proposed a tax reduction plan of 30 yen per liter for SAF production (≈0.75/gallon[8]). METI's proposal allows for a SAF producer to deduct up to 40 percent of corporate taxes for 10 years. The tax reduction amount would be reduced to a 75 percent level in year eight, a 50 percent level in year nine, and a 25 percent level in year ten.

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.

[9] NEDO hasn't opened new applications for SAF and e-fuel projects since then (as of Oct. 2024).

Import Policy: 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[10]" ethanol destined for Japanese distilleries. Under the 2020 U.S.-Japan Trade Agreement (USJTA), by FY2028, 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 (see 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 petroleum oil-based synthetic ethanol (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 the USJTA (HS: 2207.10-199)

2207.10-199	FY2024	FY2025	FY2026	FY2027	FY2028
United States	3.6%	2.7%	1.8%	0.9%	0%

The WTO tariff rate on denatured ethanol (90 percent or stronger; HS: 2207.20 220) remains 27.2 percent. Due to this tariff duty, some Japanese companies that intend to directly blend ethanol with gasoline will import undenatured ethanol, which has much lower tariff rate.

The tariff on biodiesel imports is 3.9 percent for WTO members, including the United States. Japan eliminated the tariff on biodiesel for a number of countries with which it has free trade agreements (e.g., the UK, Switzerland, EU, Comprehensive and Progressive Agreement for Trans-Pacific (CPTPP), and ASEAN). Japan currently does not import biodiesel for on-road use.

Political Leadership on Biofuels and the Future Direction

On May 23, 2022, President Biden and then-Prime Minister Kishida issued the Japan-U.S. Joint Leaders' Statement, which, "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 April 10, 2024, the two leaders again affirmed in the United States-Japan Joint Leaders' Statement that, "we intend to advance widespread adoption of innovative new clean energy technologies, and seek to increase the globally available supply of sustainable aviation fuel or feedstock, including those that are ethanol-based, that show promise in reducing emissions."

[10] The majority of denatured bioethanol coming to Japan is further refined by Japanese distillers, such as J.Alco, and sold as "industrial ethanol" to Japanese consumers. For more information about Japanese industrial ethanol, see JA2021-0072.

Section III. Ethanol

Bioethanol is most commonly produced by fermenting the sugar components found in organic materials such as corn, sugarcane, and rice. Table 2 outlines bioethanol usage for fuel and industrial purposes, along with FAS/Japan's estimates of Japan's average, national blend rate for each calendar year.

Consumption

Fuel Use

All major Japanese oil refineries (PAJ members) blend gasoline with bioethanol-derived ETBE, rather than directly blending gasoline with bioethanol. As the Japanese biofuel standards include an annual 500 million LOE target, which is equivalent to 823.7 million liters of ethanol, Japan consumes approximately 1.95 billion liters of bio-ETBE every fiscal year.

In 2023, Japan imported about 1.8 billion liters of ETBE (93.8 percent) and is estimated to domestically produce 118 million liters of ETBE from Brazilian sugarcane-based ethanol (6.2 percent). FAS/Japan estimates that the ETBE consumed for on-road transportation in 2023 contained 811 million liters of ethanol. This falls slightly short of the annual target volume of 824 million liters, primarily due to delivery lags between the calendar year and the Japanese fiscal year. Japanese consumption of fuel ethanol aligns with (fully satisfies) the GOJ's *de facto* mandates under the Sophisticated Act. While some independent, local gas stations voluntarily sell direct blend E3 or E10 gasoline, their ethanol consumption remains under half a million liters. The average ethanol blend rate in 2023 was 1.8 percent (Table 2).

FAS/Japan forecasts that on-road ethanol consumption will remain around 830 million liters in 2024, with an average ethanol blend rate of approximately 1.9 percent as total gasoline consumption further declines. While total gasoline consumption is expected to gradually decrease, the ethanol target volume remains unchanged, resulting in a marginal but steady increase in the annual on-road ethanol blend rate for the near future.

Industrial (non-fuel & non-beverage) Use

The COVID-19 pandemic significantly increased the industrial bioethanol demand in 2020 to 547 million liters, primarily due to increased use as a disinfectant. Use remained elevated during the pandemic and has since eased but not fully returned to pre-pandemic levels suggesting a somewhat elevated use in medical applications remains. In 2023, industrial bioethanol consumption was approximately 450 million liters compared to the 2019 pre-pandemic level of about 370 million liters. Industry experts indicate that demand has further weakened in 2024 because of price inflation and low consumer spending. Thus, FAS/Tokyo forecasts that the consumption of bioethanol for industrial use will drop to 400 million liters for 2024.

Table 2. Fuel and Industrial Bioethanol Use in Japan (2015-2024)

Bioethanol Used as Fuel and Other Industrial Usages (Million Liters)										
Calendar Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024f**
Beginning Stocks	95	82	89	84	60	78	62	64	92	98
Fuel Beginning Stocks	55	44	46	44	22	23	16	18	55	46
Production	2	1	0	0	0	0	0	0	0	0
Fuel Production	2	1	0	0	0	0	0	0	0	0
Imports	946	1,143	1,194	1,198	1,173	1,381	1,297	1,363	1,275	1,230
Industrial Imports	347	385	412	373	388	538	465	489	464	400
Fuel Imports	599	758	782	825	785	843	832	874	811	830
>of which to make ETBE	60	70	55	87	60	54	66	71	50	45
>imported as ETBE	539	688	727	738	725	789	766	803	761	800
Exports	0	0	0	0	0	0	0	0	0	0
Consumption	961	1,137	1,199	1,222	1,155	1,397	1,295	1,335	1,269	1,230
Industrial Consumption	349	380	415	375	371	547	465	498	449	400
>for food industry	188	190	186	202	209	246	222	228	210	200
Fuel Consumption	612	757	784	847	784	850	830	837	820	831
>as bio-ETBE	612	757	784	847	784	850	830	837	820	831
Ending Stocks	82	89	84	60	78	62	64	92	98	98
Fuel Ending Stocks	44	46	44	22	23	16	18	55	46	45
Refineries Producing Fuel Ethanol (Million Liters)										
Number of Refineries	3	3	1	1	1	1	0	0	0	0
Feedstock Use for Fuel Ethanol (1,000 MT)										
Molasses	8	2	-	-	-	-	-	-	-	-
Rice	1	1	0.5	0.5	0.5	0.5	-	-	-	-
Market Penetration (Million Liters)										
Fuel Ethanol Use	612	757	784	847	784	850	830	837	820	831
Gasoline Pool	53,113	52,849	51,904	50,999	49,785	46,052	44,768	44,781	44,645	43,984
Blend Rate (%)	1.2%	1.4%	1.5%	1.7%	1.6%	1.8%	1.9%	1.9%	1.8%	1.9%

Note: *f* = forecast 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 fossil fuel-based synthetic ethanol volumes are excluded.
Sources: Japan Customs; Japan Alcohol Association; ANRE Total Energy Statistics; ANRE Petroleum Statistics

The common applications for industrial bioethanol in the food manufacturing industry includes food preservation, vinegar production, processing aids (such as condiments, soy sauce, and miso paste), food additives, and flavoring agents. The demand in this sector has been rising as the popularity of processed and ready-to-eat foods is increasing in Japan. As industrial ethanol is heavily used for food applications, Japanese industrial ethanol distributors voluntarily adhere to Japan's food safety regulations. Other industrial chemical applications include use in cosmetics and as a solvent. For more details about Japan's distribution structure for non-fuel ethanol, please refer to JA2021-0072.

Japan annually uses about 250 million liters of imported bioethanol for alcoholic beverage production, though this is outside the scope of this report. Most of this ethanol uses the same distribution channels as industrial bioethanol, but the government tracks them separately for taxation purposes.

Production

When JA Zen-noh (the National Federation of Agricultural Cooperative Associations) halted its fuel bioethanol production made from high-yield rice in 2021, Japan has not since produced any domestic fuel ethanol. The country's annual production of 50-100 million liters of petroleum-derived synthetic ethanol is not included in Table 2, and this production is decreasing. Additionally, J.Alco produces several million liters of industrial ethanol from domestic and imported molasses at its facility in Izumi, Kagoshima.

Trade

Japan's fuel bioethanol consumption is entirely dependent on imports (see Table 2). In 2023, Japan imported about 1.8 billion liters of ETBE, which included 761 million liters of U.S. corn-based ethanol and Brazilian sugarcane-based ethanol. Additionally, Japanese oil refineries produced ETBE using 50 million liters of ethanol imported from Brazil.

A significant portion of ethanol exported to Japan is typically trans-shipped through bonded areas in Ulsan, South Korea. As a result, the trade statistics sometimes show South Korea as the export destination, rather than Japan, leading to a notable discrepancy between U.S. export data and Japan's import figures for ethanol (for further details, see JA2021-0072).

According to industry experts, some food manufacturers specifically request sugarcane-based ethanol. Brazil is the dominant supplier of ethanol for Japan's industrial use, including for the food sector. Additionally, ethanol imports from Pakistan saw a substantial decline during the COVID-19 pandemic but have gradually recovered.

Japan also imports synthetic ethanol, primarily from South Africa and the United Kingdom, and the amounts are excluded in Table 2.

Section IV. Biodiesel/Renewable Diesel

METI and the Japanese oil refineries have not actively promoted on-road biodiesel or renewable diesel use due to limited feedstock availability. Demand is limited to a few urban areas because there is no support for these biofuels from Japan's biofuel transport policy which meets the national goal through the use of bioethanol-based ETBE and in the future an additional goal for SAF.

Some municipalities are engaged in small-scale, localized environmental projects focusing on biodiesel production from used cooking oil (UCO). For example, the City of Kyoto has the largest municipal biodiesel project in Japan, with a daily capacity of 5,000 liters. In FY2023, Kyoto collected 123,000 liters of UCO for biodiesel production. However, as competition intensified, the volume of collected UCO has gradually decreased over the past decade.

In FY2022, Japan consumed 10.6 million liters of biodiesel, according to the latest available energy statistics from ANRE. The COVID-19 pandemic caused the reduction in the amount of UCO generated from restaurant operations. Additionally, rising vegetable oil prices led to UCO being traded at higher prices, with a portion exported to Singapore for sustainable aviation fuel (SAF) production (see Japan Oilseeds and Products Annual).

Since 2011, Japan has been exporting biodiesel to European countries. In 2023, Japan exported 5.9 million liters of biodiesel to Switzerland. Conversely, Japan imports about 1 million liters of biodiesel (HS code 3826.00-000) annually from Belgium, the Philippines, and Malaysia for non-road uses.

Japan generates a limited volume of UCO, most of which is already utilized. According to UCO Japan, in FY2022, Japan generated approximately 0.5 million MT of UCO, with 0.18 million MT directed toward animal feed, 0.11 million MT exported to Singapore, South Korea and European countries mainly for SAF and other biodiesel production, 50,000 MT used in chemical manufacturing (e.g., soap and detergent), and roughly 20,000 MT allocated for biodiesel feedstock. Starting from around 2021, Japanese feed manufacturers have faced a UCO shortage. The feed manufacturers thus needed to import 0.2 million MT of palm oil for compound feed in 2022. UCO Japan estimates that 0.37 million MT of UCO were disposed of in sewage, but 0.19 million MT may be recoverable. For further information about the Japanese UCO and vegetable oil market, please refer to the Japan Oilseeds and Products Annual.

As Japan begins SAF production, a significant amount of biodiesel may be produced as a by-product, potentially increasing biodiesel consumption in the near future.

Section V. Sustainable Aviation Fuel

As of November 2023, Japan is not producing advanced biofuels on a commercial scale. Table 3 outlines commercial SAF projects that have been announced by Japanese oil refineries. Several small-scale pilot projects supported by NEDO and the Ministry of Environment are not included.

Cosmo Oil, JGC Holdings, and Revo International have established a joint venture called Saffaire Sky Energy and began construction in May 2023 on Japan's first SAF production facility at Cosmo's Sakai Refinery in Osaka. The construction has been completed and trial runs are planned to start as early as October 2024. According to Cosmo, the Sakai plant aims to produce 30 million liters of SAF through the hydro-processed esters and fatty acids (HEFA) pathway, utilizing UCO. Full operations are anticipated to begin in FY2025, with plans to produce 4,000 to 5,000 tons of bio-naphtha as by-products.

ENEOS, Japan's largest oil refinery, in collaboration with French TotalEnergies, plans to establish a HEFA SAF production facility at the ENEOS Wakayama Refinery in Arida, Japan. ENEOS aims to use UCO and animal fats to produce 300 to 400 million liters of SAF by 2026 and is also planning to commercially produce non-biogenic e-fuels in Arida by 2040. ENEOS terminated operations at the Arida crude oil refinery plant in October 2023, raising social concerns about job retention in the region.

In 2022, the Idemitsu Kosan company received 29.2 billion yen (about $191 million) for a five-year project to develop and commercialize its SAF supply chain using alcohol-to-jet (ATJ) pathway. According to a press release, Idemitsu plans to annually procure 180 million liters of bioethanol to produce 100 million liters of neat SAF, with pilot production slated to start by 2026 in Chiba Prefecture. While Idemitsu initially intended to launch second and third ATJ SAF plants (JA2022-0041), these plans have not been mentioned recently.

Cosmo Oil is also collaborating with Mitsui & Co. to develop an ATJ SAF manufacturing facility using LanzaJet's technology, with the aim to produce 220 million liters of SAF per year by FY2027. Additionally, Taiyo Sekiyu and Mitsui & Co. have proposed launching an ATJ SAF manufacturing facility in Okinawa, targeting production of also 220 million liters of SAF per year starting in FY2028.

Table 3. Major Japanese Sustainable Aviation Fuel Projects

Oil Company	Main Partners	Location	Operation	Annual Production & Feedstock (mill. liters)		Status
Cosmo	JGC, Revo	Sakai, Osaka	2025	30	UCO	Completed
ENEOS	TotalEnergies	Arida, Wakayama	2026	400	UCO, animal fat	Planned
Cosmo	Mitsui	Sakai?	2027	220	Ethanol	Planned
Fuji Sekiyu	Itochu	Sodegaura, Chiba	2027	180	UCO, oil/fat	Planned
Idemitsu		Chiba	2028	100	Ethanol	Planned
Idemitsu		Tokuyama	2028	250	UCO, oil/fat	Planned
Taiyo Sekiyu	Mitsui	Okinawa	2028	220	Ethanol	Planned

If the above ATJ projects proceed as planned, Japan will require approximately 1 billion liters of CORSIA-eligible bioethanol by the end of 2028, in addition to the demand for on-road bioethanol. To advance these initiatives, the Japanese private sector requires clear policy guidance with minimal uncertainty. This is a primary reason why METI is proactively developing SAF standards under the Sophisticated Act ahead of time (see Section II Policy and Programs).

Before domestic SAF production can launch commercially, Japanese airlines are likely to rely on imported SAF. With support from MLIT, Itochu imported about 5,000 liters of neat SAF from Neste in March 2023 to blend with conventional jet fuel as part of a pilot project. Since SAF does not have a specified HS trade code, Japan imported it under the jet fuel category. Industry experts informed FAS/Japan that the rerouting of ships from the Suez Canal has raised supply chain concerns regarding the securing of SAF imports from Finland for trial runs.

Section VI. Marine Fuel

In July 2023, the International Maritime Organization (IMO) adopted the "2023 IMO Strategy on Reduction of GHG Emissions from Ships," which outlines targets and measures to reduce GHG emissions in international shipping. The strategy aims to cut total GHG emissions by at least 40 percent by 2030 compared to 2008 levels, with a goal of achieving net-zero GHG emissions by around 2050.

The GOJ believes that ammonia has the potential as a long-term marine fuel solution to achieve zero carbon emissions. Numerous ammonia projects are currently underway and supported by NEDO and through GI funds.

The GOJ intends to first realistically introduce drop-in biodiesel, which can be used in existing marine engines and infrastructure without major modifications. However, the significant demand for SAF raises concerns about the availability of feedstock for drop-in marine fuel. Industry experts optimistically believe that domestic SAF production in the future may yield certain volumes of marine biodiesel during the refining process. Another expert noted that Japan's Big Three maritime transport companies[11] prefer to refuel their vessels at international hub ports, such as Singapore, rather than in Japan.

Biomethanol (or green methanol) is another marine fuel that can help reduce maritime GHG emissions. Mitsubishi Gas Chemical (MGC) has begun producing biomethanol at a new facility in its Niigata plant, utilizing methane-rich digester gas sourced from a sewage treatment plant. MGC has obtained certifications from the ISCC System for its biomethanol. In June 2024, MGC announced that it had refueled two vehicle carriers with biomethanol.

Section VII. Notes on Statistical Data

General Terms

ATJ: alcohol-to-jet process to produce SAF
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 using LCA which covers all product life cycle stages from production through to consumption and may or may not include indirect effects. The unit of measure is typically 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) do not use biomass and are instead made from renewable electricity and some renewable chemical such as carbon dioxide, carbon monoxide, and/or hydrogen
EPA: economic partnership agreement

[11] NYK Line, Mitsui O.S.K. Lines, and K Line

ETBE: ethyl tert-butyl ether—used in particular markets as an alternative to ethanol direct blending with gasoline to archive the same environmental goal
EV: electric vehicle
FY: Japanese fiscal year (April-March), for example, FY2021 is April 2021 – March 2022.
GHG: greenhouse gas
LCA: life cycle assessment
LULUCF: land use, land-use change, and forestry
HEFA: hydro-processed esters and fatty acids
HS: harmonized system of tariff schedule codes
INDC: intended nationally determined contribution
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
BOJ: The Bank of Japan
COP: The Conference of the Parties for UNFCCC
EU: European Union
FAS/Tokyo: Tokyo Office of Agricultural Affairs of the Foreign Agricultural Service
GOJ: The Government of Japan
ICAO: The International Civil Aviation Organization
IMO: The International Maritime Organization
JA Zen-noh: National Federation of Agricultural Co-operative Associations
J.Alco: Japan Alcohol Corporation
JBSL: Japan Biofuels Supply LLP
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
UNFCCC: The United Nations Framework Convention on Climate Change

Units
CO_2e: carbon dioxide equivalent, a unit of measure aggregating several greenhouse gases into a single CO_2 equivalent measuring global warming effect. A unit of mass (typically grams or metric tons) per unit of energy delivered (typically joule for transport fuels) are associated to measure climate warming
l: liter, 1l = 0.264 U.S. gallon; 1 U.S. gallons=3.7854 liters
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

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

Energy Content
Gasoline 43.10 GJ/MT
Bioethanol 26.90 GJ/MT
Diesel 42.80 GJ/MT
Biodiesel 37.50 GJ/MT
Jet fuel 44.65 GJ/MT

Domestic Feedstock-to-Biofuel Yield 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 ATJ SAF: 1.8 MT → 1 MT

Attachments:

No Attachments