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Market Situation and Potentials in Japan for Technologies for Solid Biomass Utilization

Report

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Peter Beck

EU-JAPAN CENTRE FOR INDUSTRIAL COOPERATION - Head office in Japan
Shirokane-Takanawa Station bldg 4F
1-27-6 Shirokane, Minato-ku, Tokyo 108-0072, JAPAN
Tel: +81 3 6408 0281 - Fax: +81 3 6408 0283 - TokyoOffice@eu-japan.gr.jp

EU-JAPAN CENTRE FOR INDUSTRIAL COOPERATION - OFFICE in the EU
Rue Marie de Bourgogne, 52/2
B-1000 Brussels, BELGIUM
Tel : +32 2 282 0040 –Fax : +32 2 282 0045 - office@eu-japan.eu

http://www.eu-japan.eu / http://www.EUbusinessinJapan.eu / http://www.een-japan.eu

This report has been prepared by

ECOS Consult GmbH
Peter Beck
Westerbreite 7
49084 Osnabrueck
Germany
Tel.: ++49 (0) 541 911 909 90
E-Mail: info@ecos.eu

www.ecos.eu

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List of Abbreviations

ANRE	Agency for Natural Resources and Energy
BC	British Columbia
BtL	Biomass to Liquid
CHP	Combined Heat and Power
DG RTD	Directorate-General for Research and Innovation of the European Commission
DS	Dry Substance
EPA	Economic Partnership Agreement
FIP	Feed-in Premium
FIT	Feed-in Tariff
FY	Fiscal Year (in Japan government's financial year is from 1 April to 31 March)
GHG	Greenhouse Gas
GW	Gigawatts
IEA	International Energy Agency
ISEP	Institute for Sustainable Energy Policies
JORA	Japan Organic Recycling Association
JPY	Japanese Yen
JST	Japan Science and Technology Agency
kW	Kilowatts
kWh	Kilowatt-hours
MAFF	Ministry of Agriculture, Forestry and Fisheries
METI	Ministry for Economy, Trade and Industry
MEXT	Ministry of Education, Culture, Sports, Science and Technology
MoEJ	Ministry of the Environment, Japan
MoF	Ministry of Finance
MSW	Municipal Solid Waste
MW	Megawatts

MT	Megatons
NGO	Non-Governmental Organisation
NPO	Non-Profit-Organisation
OCCTO	Organization for Cross-regional Coordination of Transmission Operators
PKS	Palm kernel shells
PV	Photovoltaics
REX	Registered Exporters System
SICORP	Strategic International Collaborative Research Program
SPC	Special purpose company
TED	Tenders Electronic Daily
USDA	United States Department of Agriculture

1. Executive Summary

As a country that is 68% forested, Japan's national and local governments have heavily promoted biomass including through the launch of 'Biomass Towns' that act as best practice examples utilising this form of renewable energy for power and heat, as well as fertiliser.

Japan has set the ambitious target to reach net zero emissions by 2050. The current 6th Strategic Energy Plan, released by METI in October 2021, aims to chart the energy policy path to achieving carbon neutrality and, as a next step, to reduce greenhouse gas emissions by 46% by FY 2030 compared to FY 2013.

With the Third Basic Plan for Promoting Biomass Utilization, approved by the cabinet in September 2022 the Japanese government has set the goal for 2030 to utilize approximately 80 % of the yearly biomass output to realize a sustainable society with less environmental burden. However, the current utilization rate of solid biomass is already high: as for example sawmill residues and waste of construction timber with a share of almost 100%.

A variety of governmental and local subsidy programmes, e.g. from the Ministry of Agriculture, Forestry and Fisheries, MAFF, the Ministry of Economy, Trade and Industry, METI, and different prefectures support biomass technologies with high subsidy rates.

The support for the feeding of electricity produced from biomass has remained high, which means a good planning security for the economic operation of biogas plants in Japan. For example, for electricity generated from woody biomass derived from thinning and other sources it amounts to 40 JPY/kWh for small plants (max 2 MW), for electricity from biogas plants it is still 35 JPY/kWh. Japan has also introduced a feed-in-premium (FIP) scheme for renewable power sources from April 2022. The new mechanism allows renewable power producers to sell their electricity in a spot market at a premium to wholesale prices.

Wood pellets, wood chips, palm kernel shells (PKS) and biowastes such as cattle manure or food waste are the main feedstock materials used as energy sources. Of these fuels, imported wood pellets are expected to see the highest increase. Japan has been dramatically increasing its wood pellet imports for its feed-in-tariff (FIT) program. A reason for the steady increase of wood pellet imports is that, after the accident at the Fukushima Daiichi nuclear power plant in 2011 (caused by an earthquake and tsunami) Japan extended its FIT system to a wider range of renewable energies.

The supply of wood pellets in Japan is estimated to import more in the future because of the price gap between domestic and international prices that is approximately three times higher than the imported price from countries such as Vietnam and Canada. Japan imports all of its palm kernel shells (PKS) most of them from Thailand, Malaysia and Indonesia.

For the treatment of biowastes as animal waste and municipal solid waste, biogas plants have an increasing market share in Japan. Currently feedstock and application trends in Japan are shifting from the traditional livestock excreta and sewage sludge, to a composite of sewage sludge and food waste including industrial waste and food scraps. High-rise buildings with "urban biogas systems" that recycle food waste are being implemented. For digestion of organic wastes in Japan, both wet and dry digestion processes are used.

Main applications for the use of solid biomass are:

- Wood pellet production facilities (made from compressed sawdust and other wood waste, and they are used as a fuel source for power plants and industrial boilers).
- Agricultural waste power plants (e.g. digestion and gasification processes)
- Municipal waste-to-energy plants (e.g. digestion and incineration processes)
- Forest biomass power plants (e.g. power stations for generating electricity and heat)
- Biomass furnaces / Biomass boilers (e.g. wood chip boilers for generating heat)

Japan has also been steadily increasing its biomass power generation capacity, with its total operational biomass power generation capacity reaching 6,379MW in 2022 and 243 solid biomass power generation facilities that mainly use unutilized wood (derived from thinning, etc.)

In general, for European companies deciding to do business in Japan, there are four ways to set up operations: A sales agent (this could also be a Japanese partner), a representative office in Japan, establishing a Japanese branch or an incorporation. Especially for SMEs in the beginning, a partnership with a domestic player is a good way for a market entry. Such a partnership can take various forms: arrangements for the collection of feedstock arrangements, technology alliances, joint ventures or value chain alliances. Ideally, these partners belong to the biogas sector such as plant manufacturers (incl. planning service providers) and constructing companies. Many of these companies already utilize technologies and components made by foreign manufacturers for their biogas plants, as for example combined heat and power generators (CHP). These partners can also act as distributors for biogas plants as well as a local agent or distributor to sell in foreign markets. Trading houses are also considered as further potential partners.

For a successful market entry, a membership in associations e.g. joining the Japan Organic Recycling Association (JORA), JARUS (The Japan Association of Rural Solutions for Environmental Conservation and Resource Recycling) is recommended in order to get contacts to multipliers from industry and municipalities in order to access an extensive network, including project developers, technology providers, consultants and engineers. Visits of expert fairs in the biomass sector (such as the regularly organised Biomass Expo fair, the Biomass Pellets Trade & Power Conference or FORESTRISE 2024) may be helpful to get in contact with potential customers and partners.

In the case that electricity generation from biomass is intended beyond feed-in of electricity into the public grid, alternative options should also be considered. Because in some regions of Japan grid operators may limit the power for feed-in, it also should be considered to use electricity and heat locally and only feed-in a part of the generated electricity. This also applies to the utilisation of heat (and possibly also for covering the cooling demand) for coverage of own consumption (not only for the biomass / biogas plant itself but also for surrounding potential consumers such as farms, industry, sewage plants, settlements etc.). Especially for biogas plants, in addition, the sale of fermentation residues as fertiliser (in many cases by saving disposal costs for the residues) can be a solution to improve economic efficiency of the plant.

This report shows the wide variety of biomass utilisation in Japan. The utilisation of almost all types of solid biomass for energy, especially if it is obtained locally wherever possible has clear ecological advantages over other disposal methods for food, such as the form of waste disposal by incineration that is frequently used in Japan. In the long term,

a significant expansion of the Japanese market for biomass technology can be assumed. Besides the generation of heat, power generation technology from biogas or solid biomass has an unspeakable positive added value for national electricity generation and, in the future, when the expansion of wind power and PV in Japan is more advanced, also to provide balancing power.

2. Scope of the Report

This report focuses on the market for solid biomass technologies in Japan and is addressed to mainly small and medium-sized companies in Europe who offer innovative technology in the solid biomass sector. It presents a comprehensive overview of the Japanese market for solid biomass including current trends, drivers, as well as business potentials and challenges for European companies seeking to develop or strengthen their positions in the Japanese market.

Definition of solid biomass:

Solid or compressed pieces of organic matter in the form of pellets that release their stored energy through combustion and burning. Solid biomass or feedstock materials include:

- Wood & wood residues such as trees, shrubs, sawdust, pellets, chips and waste wood.
- Agricultural residues like straw, grasses, seeds, roots, dried plants, nut shells and husks.
- Energy crops from charcoal, peat leaf litter and moss.
- Processed waste such as Bagasse plant waste.
- Animal waste such as dried slurry and manure.
- Municipal solid waste from household rubbish and garbage.

This report does not include liquid biofuels.

Structure of this report:

The political strategies and targets related to biomass utilisation and technologies are described in part 3.

The current size, structure and trends in the Japanese market for is summarized in chapter 4.

Issues related to market access such as distribution channels and regulations are characterized in part 5. This chapter also included some relevant trade fairs and some possible obstacles to market entry.

In part 6, some of the main market players (companies, universities/research institutes, associations) are listed up.

The report concludes with a short analysis of the business opportunities, main challenges, and key success factors in chapter 7.

Thus, the report strives to provide practical information and valuable recommendations for EU-based small and medium-sized enterprises engaging into the market for biomass technologies which helps them to estimate the potential of Japan's biomass market for their specific innovative technology or service, and to capitalize on existing business opportunities.

The report is based on an extensive desk research of relevant publications and media, including publications by Japanese ministries, government bodies and research institutions in Japanese language. Furthermore, information sources such as specialist journals, economic journals, company reports and websites, statistical websites, etc. were integrated to complement the study.

3. Market Framework Conditions

a. Country Profile

Japan has a total land area of 365,000 km² and a population of 126.7 million people, which represents a high population density of 348 persons per km².

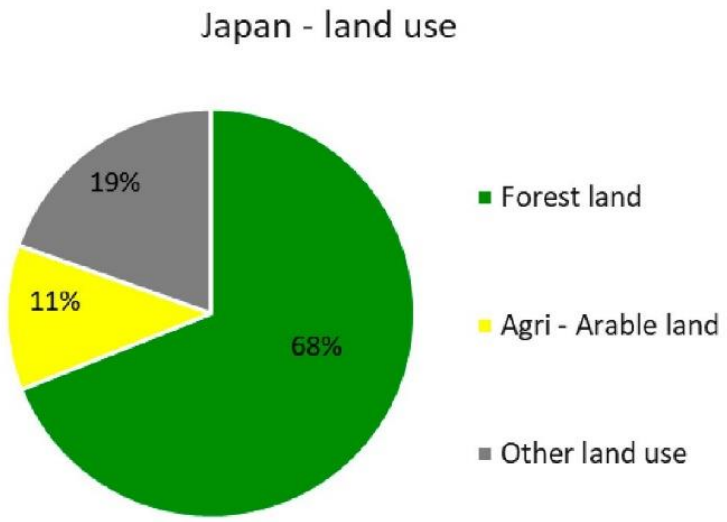


Fig.1: Land use in Japan (2021), (Source: IEA Bioenergy, "Implementation of bioenergy in Japan – 2021 update")

Around two thirds of the land area is forest land and 11% is agricultural land, almost exclusively arable land.

As a country that is 68% forested, Japan's national and local governments have heavily promoted biomass, including through the launch of 'Biomass Towns' that act as best practice examples utilising this form of renewable energy for power and heat, as well as fertiliser.

b. Role of Biomass in the Energy Mix

i. Share of Biomass compared to other renewable energy sources

For 2022, renewables are estimated to account for 22.7% of all electricity generated in Japan (including on-site consumption), a slight increase from 22.3% in the previous year.

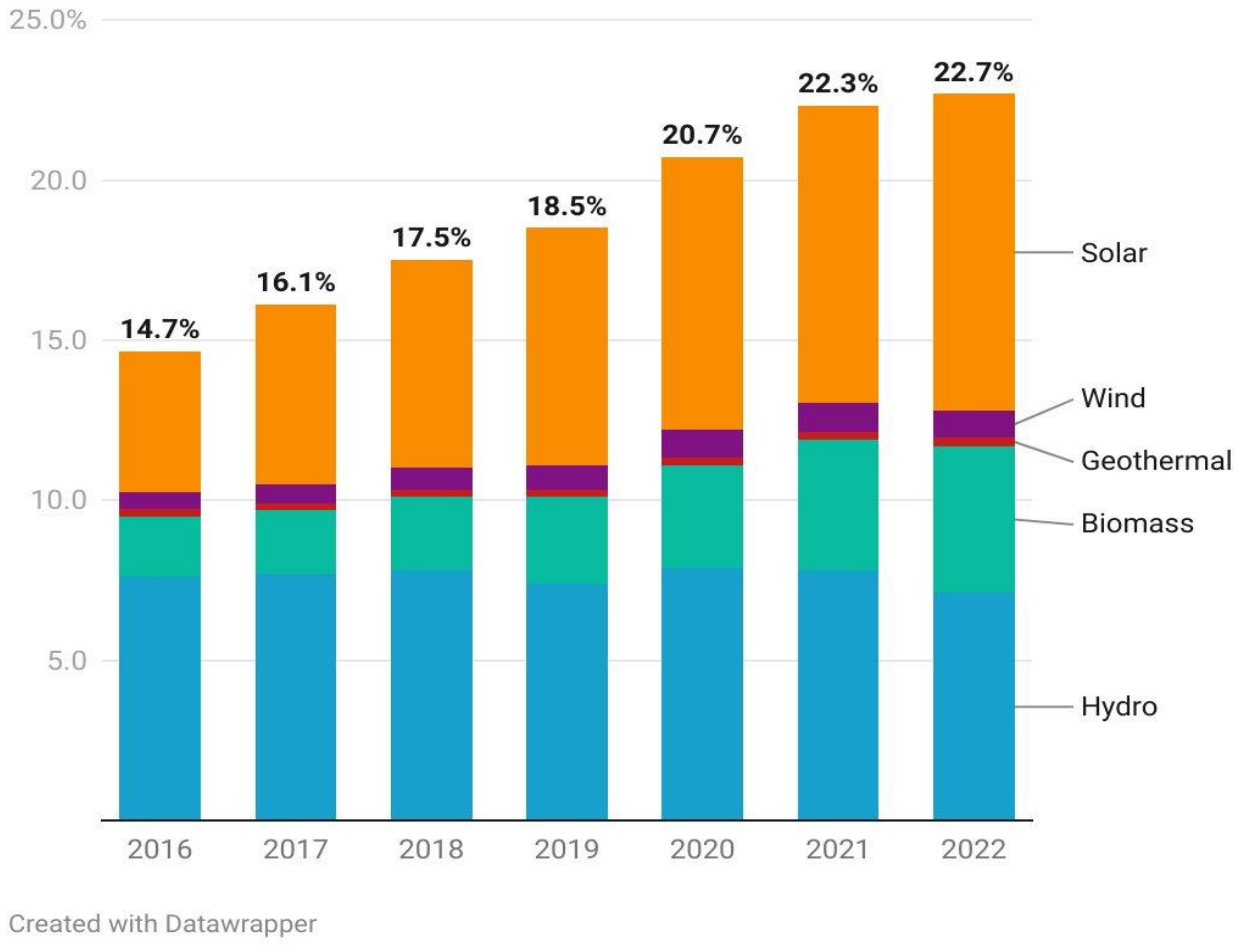


Fig.2: Share of Renewable Energy in Total Electricity Generated in Japan (2022), Source: Institute for Sustainable Energy Policies ISEP (2023)

As for renewables other than solar power, the share of electricity generated from biomass power was 4.6%, up from 4.1% in the previous year.

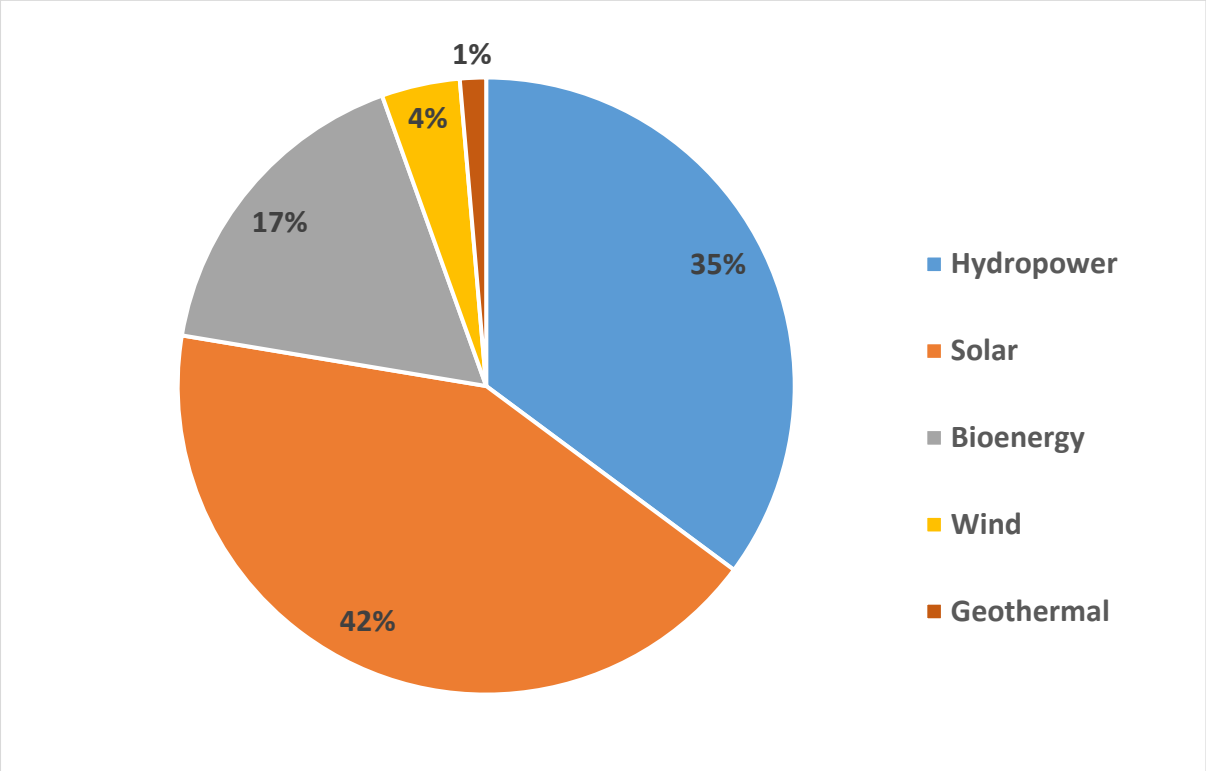


Fig.3: Share of electricity from renewable energy sources in Japan in 2022, (source: Statista (2024))

c. Political Strategy and Subsidies

i. Political strategy and targets

Japan has set the ambitious target to reach net zero emissions by 2050 and to reduce Japan's greenhouse gas emissions by 46 % below 2013 levels by fiscal year 2030 (instead of the previously announced 26%). (Source: Ministry of the Environment (2021), "Annual Report on the Environment in Japan 2021")

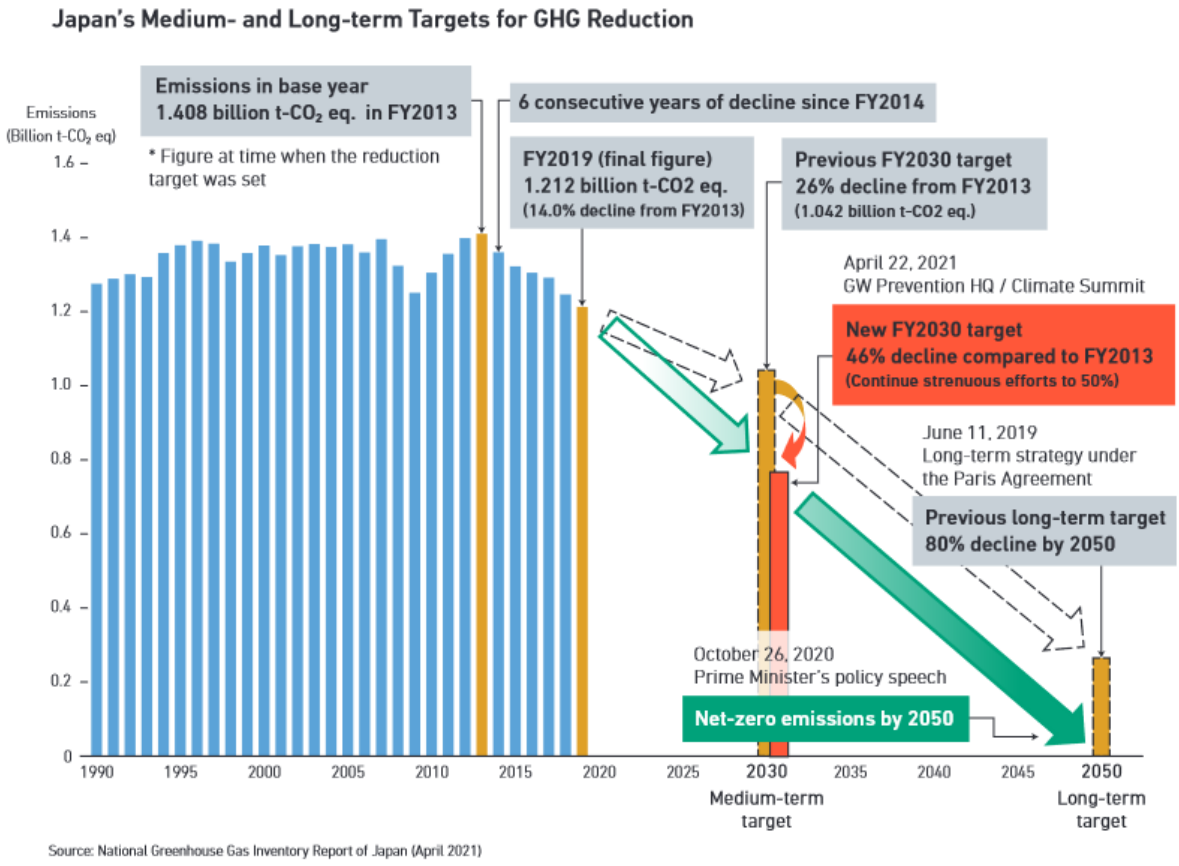


Fig.4: Japan's targets for GHG reduction (2021), (Source: Ministry of the Environment, Japan, "National Greenhouse Gas Inventory Report, 2021")

Japan's energy policy was significantly changed by the 2011 Great East Japan Earthquake and the Fukushima Nuclear Accident.

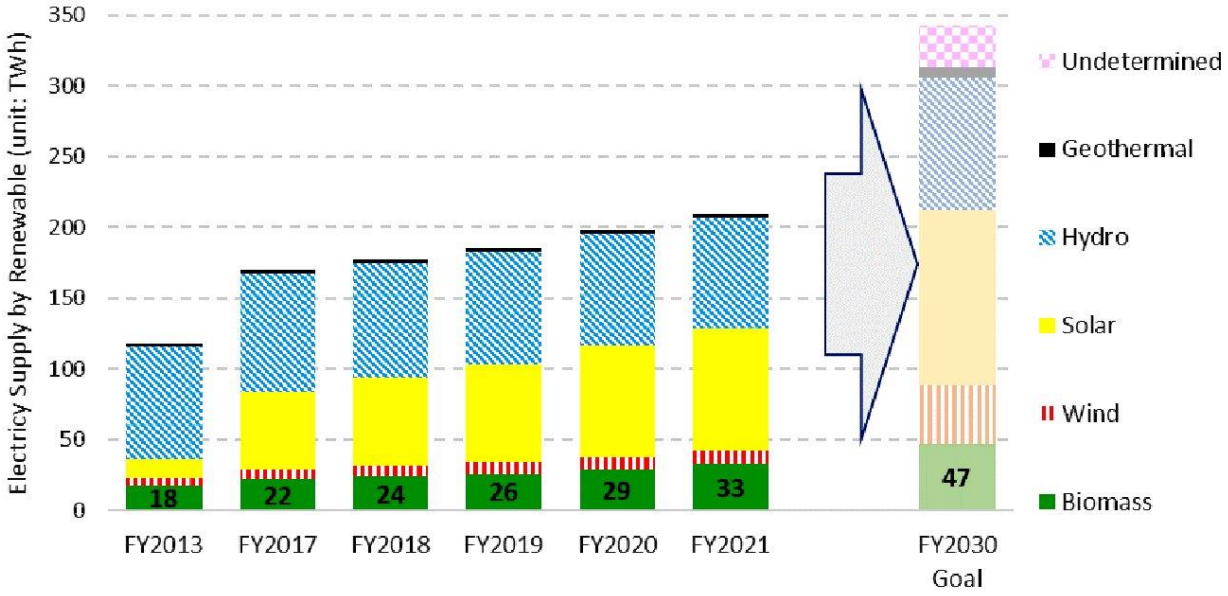


Fig.5: Comparison of FY 2030 Targets for Renewables for Energy Generation-Electricity (source: USDA United States Department of Agriculture, Report "Japan Biomass Annual 2023" (2023))

As part of the Nippon Biomass Strategy, the Ministry of Forestry intends to promote the use of wood biomass as an important energy source in the future.

In October 2021, METI released the **6th Strategic Energy Plan** approved by the cabinet.

The 6th Strategic Energy Plan aims to chart the energy policy path to achieving carbon neutrality by 2050 (announced in October 2020) and to reduce greenhouse gas emissions by 46% by FY 2030 compared to FY 2013, while at the same time continuing the efforts to meet the challenge to achieve the ambitious target of reducing emissions by 50%.

Accordingly, the Japanese government published the outlook for energy demand-supply in FY 2023. It referred to the biomass energy outlook. (Source: Ministry of Economy, Trade and Industry (METI), Japan (2021) "2030 年度におけるエネルギー需給の見通し," written in Japanese, page 41)

The outlook indicated two scenarios for biomass energy expansion: (A) continuation of the current policy effort and (B) the case policy reinforced. (A) estimates if the policy has been implemented in the current pitch, and (B) predicts if further policy improvements will have been implemented i.e. some policy implementations are expected, and these effects are included in the estimation. More specifically, they mention for instance working forward to expand domestic solid biomass utilization by revision of Forest and Forestry Basic Act, allowing biomass utilization to expand continuously.

Current production (1)	FIT certified but not operational (2)	Project operation for newly certified items (3)		Total (=1+2+3)	
		(A)	(B)	(A)	(B)
1,840	2,110	310	390	4,260	4,340

Tab.1: The prospect of biomass energy introduction in (FY)2030 in MWh (selected only solid wood* in biomass estimate)

* Unused thinned wood, general woods (Emitted from wood processing facilities such as sawmills), construction material waste
MAFF announced that the Third Basic Plan for Promoting Biomass Utilization was approved by the cabinet in September 2022. (Source: Ministry of Agriculture, Forestry and Fisheries (MAFF), Japan (2022) "The Third Basic Plan for Promoting Biomass Utilization")

The main basic strategical change was that the 'Prefectural Biomass Utilization Promotion Plan' was set to be formulated by all prefectures in 2030. This accelerates voluntary efforts to utilize biomass utilization all over Japan.

As national goals for 2030, they set to utilize approximately 80 % of the yearly biomass output to realize a sustainable society with less environmental burden. ➞However, the current utilization rate of solid biomass is already high: Sawmill residue (98%), waste of construction timber (96%). These goal rates for 2030 do not change with the current rate. Yet in terms of forest residue, they refer to expand more than 33%, compared to 29% of the current utilization rate.

In April 2022, the Japanese government, at the behest of its Biomass Sustainability Working Group, introduced a mandatory standard for life cycle assessment of greenhouse gas emissions for all new biomass installations (but stack emissions are still excluded). New biomass projects applying for government funding must now demonstrate a 50% reduction in life-cycle emissions compared to average fossil fuel emissions by 2030 and 70% from 2030 onwards.[1]

ii. Legal framework

The **legal framework** of sustainability criteria for biomass fuels, compared for example to the EU, is still not sufficiently developed in Japan. Many parts of the framework of sustainability criteria for biomass fuels are still in discussion. The current discussion focuses e. g. on new standards of environment, society, labour, and governance as well as on third party certifications giving a proof on supply chains of main products (such as bio-substrates, general wood, palm oil etc.) along the entire value chain. The Ministry for Economic, Trade and Industry (METI) has currently established a working group for discussing further assessment standards for sustainability because of the rapid increase of biomass fuel imports in the last few years.

Since April 2023, Japan has implemented a new life cycle greenhouse gas emission standard for biomass power plants supported by its feed-in tariff subsidy for renewable energy. Designed to ensure that forest biomass usage actually reduces carbon emissions compared with fossil fuels, Japan's new standard is similar to those already implemented by fellow forest biomass users like the United Kingdom and European Union.

[1] source: Mongabay Series: Covering the Commons, Planetary Boundaries, 2022

Under Japan's life cycle greenhouse gas emission standard, new biomass plants must be able to reduce their partial life cycle emissions compared with a standardized fossil fuel smokestack emission value by 50% from 2023 onward, and by 70% from 2030. But although existing biomass plants in Japan are required to calculate and disclose their partial life cycle emissions from now on, they aren't obligated to meet the reduction targets[2].

For the installation and operation of biomass plants, different regulations, depending on the treatment process (furnaces, digestion, gasification etc.) are relevant. These are listed in the EU-Japan Centre report "The Market for Biogas Plants in Japan and Opportunities for EU Companies", (created by ECOS). This report is available at https://www.eu-japan.eu/eubusinessinjapan/library/publication/report-market-biogas-plants-japan-and-opportunities-eu-companies

In 2020 NEDO published a brochure on requirements and technical guidelines for planning and installation of biomass energy systems giving, for example, information on system selection (methodology) based on potential raw material (input), checklist for the implementation of a sustainable energy business, major characteristics of methane fermentation business and positive effects on local communities: https://www.nedo.go.jp/content/100927443.pdf

[2] source: "Mongaby Series – News & Inspiration from Nature's Frontline",(2023)

iii. Subsidy Policy for Biomass

Ministry of Agriculture, Forestry and Fisheries, MAFF

MAFF aims to establish a regional ecosystem, utilizing small-scale solid biomass energy in order to use forest resources sustainably. For subsidization, they regulate that the plant should be less than 1000 kW and the energy should not be sold under the FIT/FIP scheme. From FY 2017 to FY 2022, MAFF has supported 51 regions under this provision. Mainly municipalities can apply this subsidy for formulating implementation plans, and Japan Forest Technology Association etc. are in charge of consulting. In FY 2023, 180 million JPY was accumulated as budget and 10 regional sites were accepted.

Also, MAFF offers supporting capital investment to municipalities and private business sectors to facilitate the use of solid biomass. More specifically, the following cases are applicable: to prepare equipment (e.g., mobile chippers), and to construct facilities either where supply solid biomass (e.g., solid fuel production facilities) or where utilize the biomass energy (e.g., boilers). A project should be above 5 million JPY and the subsidy rate should be less than 50%.

Ministry of Economy, Trade and Industry, METI

Since FY 2021, METI has launched a subsidy program to formulate a system regarding biomass energy supply and utilization with the collaboration of MAFF. The program is supposed to continue for 8 years and aims to expand its utilization yearly by 110.000 tons and by (FY) 2032 to reduce biomass fuel material cost by 30% compared to the cost in FY 2021. The subsidy includes the demonstration project of the production and transportation system for solid biomass fuel as well as outsourcing projects relevant to formulating a plan for solid biomass fuel (e.g., chips and pellets). In FY 2023, they have 740 million JPY for the budget and the subsidy rate should be less than two-third per project.

Local Subsidy Programs

Hokkaido prefecture subsidizes the case of introducing renewable energy facilities including solid biogas plants to facilitate local energy production for local consumption. The subsidy rate should be less than 50% (maximum financial support is 50 million JPY). Especially related to the biomass project in FY 2023, they admitted supporting Onsen (hot spring) for boiler renewal, which utilizes solid biomass[3].

Shizuoka Prefecture, where solid biomass plants of more than 10,000 kW are expected to be installed, provides its own subsidy to the municipalities, small- and medium-scale organizations, and NPOs for capital investment. The subsidy rate is less than one-third and the maximum amount of the subsidy ranges from 2 million to 130 million JPY.

Feed-in-Tariff (FIT) for electricity generated by solid biomass

Before the Fukushima disaster in 2011, the FIT system only applied to solar energy. In 2012, Japan adopted an expanded FIT system that covers solar energy as well as most other renewable energy sources, including biomass, wind, geothermal and small hydro. Under the FIT system, power utilities charge their customers a fixed price or tariff for electricity generated from approved renewable energy sources for a predetermined period after the power plants are commissioned. According to the report, the FIT scheme maintained a fixed price regardless of the wholesale electricity price. From fiscal year 2022, Japan introduced a feed-in premium (FIP) programme for renewable energy sources, under which the Ministry of Economy, Trade and Industry (METI) sets a fixed premium that is added to the average

[3] source: Hokkaido Government, 2023

wholesale electricity price of the previous 12 months. From fiscal year 2012 to 2014, FIT program paid equally 32 JPY per kilowatt-hour (kWh) for all plants using domestic "unutilized wood" derived from thinning operations. To expand FIT utilization to smaller plants, particularly in rural communities, ANRE increased the FIT rate to 40 yen per kWh for micro power plants (i.e., generating less than 2 megawatts (MW)), provided they use domestic unutilized wood.

Feed-In-Tariff (FIT) for electricity generated by Wood Biomass:

	Procurement price per kWh etc./base price*1		
	Methane fermentation gas (derived from biomass)*3	Woody biomass derived from thinning and other sources	
		2,000 kW and above*3	Less than 2,000 kW*3
FY 2021 (reference)	39 JPY	32 JPY	40 JPY
FY2022			
FY2023	35 JPY		
Adjustment period/ Delivery period*2	20 years		

Tab. 2: Feed-In-Tariff (FIT) for electricity generated by Methane fermentation gas and woody biomass derived from thinning and other sources Wood Biomass (Source: METI (2023), 買取価格・期間等（2022 年度以降）

	Procurement price per kWh etc./base price*1				
	Solid biomass fuels from general woody biomass and agricultural harvesting		Biomass liquid fuels resulting from the harvesting of agricultural products (category applicable to the tendering system). (derived from biomass)*3	Construction material waste *3	Waste and other biomass*3
	10,000kW or more (Distinguished by the system of entry)	Less than 10,000kW 未*3			
FY 2021 (reference)	Determined by bidding system (4th 18.5 JPY)		Determined by bidding system (4th 18.5 JPY)		
FY2022	Decided through a tender system (5th preliminary undisclosed)		Decided through a tender system (5th preliminary undisclosed)		
FY2023	Decided through a tender system	24 JPY	Decided through a tender system	13 JPY	17 JPY
Adjustment period/ Delivery period*2	20 years				

*1 Procurement price plus tax for FIT schemes , reference price for FIP schemes (excluding bidding system applicable categories) and maximum price for bidding system applicable categories.
*2 Procurement period for FIT schemes and delivery period for FIP schemes.
*3 Regional utilization requirements will be set for FIT certification (excluding modified certification) from FY2022 (except in supply areas such as the Okinawa region and remote islands).

Tab. 3: Feed-In-Tariff (FIT) for electricity generated by Solid biomass fuels, biomass liquid fuels resulting from the harvesting of agricultural products, construction material waste and other biomass (Source: METI (2023), 買取価格・期間等（2022 年度以降）)

d. Obstacles for solid biomass utilisation

There are three main obstacles to solid biomass utilization:

- Firstly, there is a limit to the amount of wood that can be thinned domestically by the Forest and Forestry Basic Act. Therefore, for general wood and biomass liquid fuels, more than 70% of raw materials are imported wood such as palm oil and PKS (Palm Kernel Shell), and there is a marked dependence on foreign countries.
- Secondly, solid biomass power generation has the issue of high generation costs compared to other renewable energy sources such as solar and hydroelectric power generation. Since fuel costs account for 70% in the case of solid biomass, the challenge is clarifying the path to cost reduction.
- Lastly, resources are dispersed over a large area, which tends to result in small-scale decentralized plants that are expensive to collect, transport, and manage.

In addition, if biomass should be utilized for electricity generation, the current limited access to the electricity transmission grid for renewable electricity generation plants is considered as one of the factors hampering the growth of renewable energy in Japan. In order to assess whether there is still free capacity in the power lines, the situation of a power failure must also be taken into account. For this reason, the maximum transmission capacity with two transmission lines is only 50 % (with three or more transmission lines, this can be up to 70 %). Among other reasons, in some cases this situation prevents the connection of renewable energy installations. Several renewable energy suppliers are still waiting to be connected.

Another possible obstacle is that several grid operators only allow electricity feed-in with a limited capacity for new biomass plants. In some regions, for example, only biogas plants with power up to 50 kW can be connected to the public grid.

Planners of Biomass plants for electricity generation are increasingly pointing out that the conversion of bioenergy can be used very well for grid stabilization due to its flexibility in the generation of electricity and its permanent availability. This makes it increasingly difficult for grid operators to refuse or delay the grid connection. In order to significantly increase the supply of energy from renewable sources - as advocated in the government's Basic Energy Plan - both the government and the energy industry are going to maximize the efficient use of the transmission grid. As a first measure to strengthen and stabilize the Japanese transmission grid the independent "Organization for Cross-regional Coordination of Transmission Operators" (OCCTO) was founded in 2015. This is responsible for monitoring and controlling the supply and demand of electricity. Its duties include planning work in order to sustainably promote interregional interconnection and frequency conversion (as for the electricity grid Japan uses 2 different frequencies: 50 Hz in Eastern Japan and 60 Hz in Western Japan). Other solutions include the introduction of smart grids and the recalculation of the grid situation. More detailed information on this issue is given in the EU-Japan Centre report “The Market for Biogas Plants in Japan and Opportunities for EU Companies” (created by ECOS).

4. Market Situation

a. Market Volume

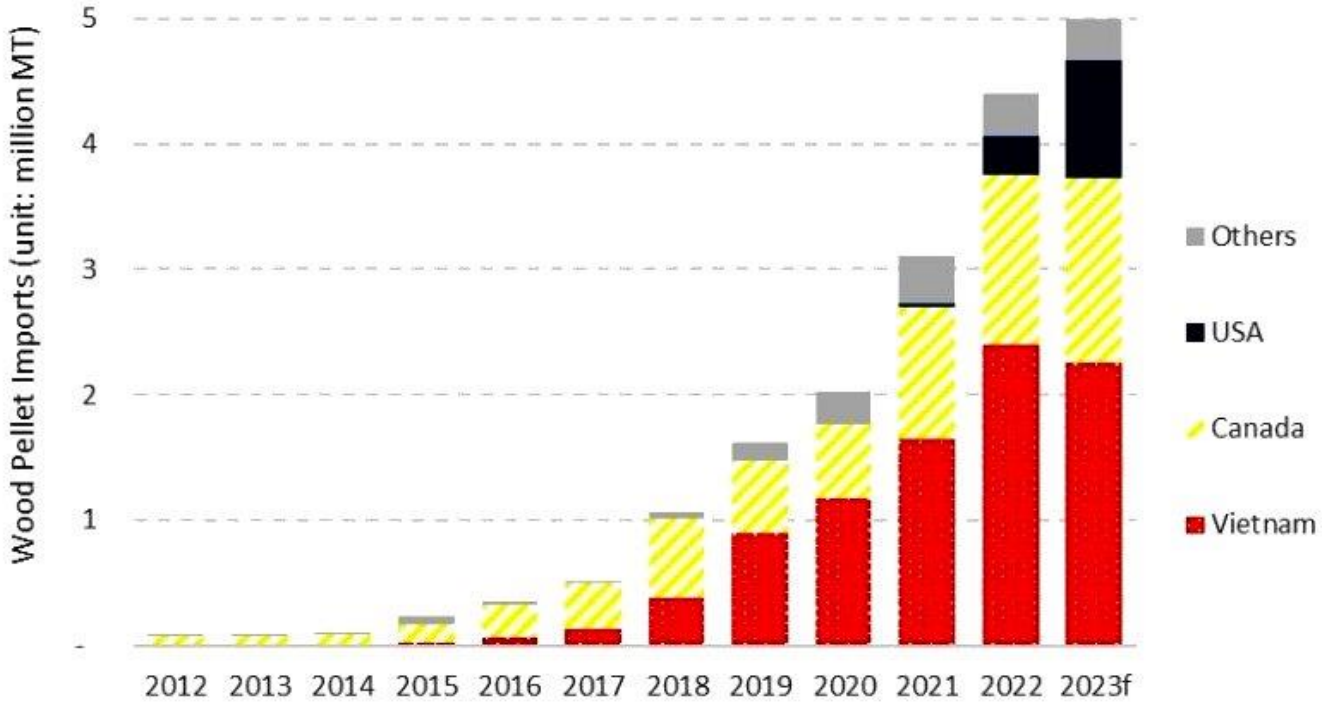
i. Wood chips

Wood chips are sourced largely from Japan's domestic forestry sector. Domestic timber sourced for biomass comes from thinning and forest residues, including treetops and other timber waste; the majority is sourced from tree plantations. Quantities of chips produced from these sources increased from roughly 750,000 metric tons in 2012 (the year the FIT was introduced), to 8.6 million metric tons in 2020, according to government statistics on wood chip for energy usage.

ii. Wood pellets

Of the three fuels, imported wood pellets are expected to see the greatest increase. Japan has been dramatically increasing its wood pellet imports for its feed-in-tariff (FIT) program, with wood pellet imports expected to reach an estimated 4.25 million bone-dry tons this year, according to a report filed with the USDA Foreign Agricultural Service's

The majority is currently sourced from Vietnam, the US and Canada (British Columbia)



Note: The data for 2023 f are based on the first five months of this year.

Fig.6: Growth of Wood Pellet Imports to Japan (Source: Biomass Magazine, "Report: Japan's import of wood pellets to increase in 2023" (2023))

A reason for the steady increase of wood pellet imports is that, after the accident at the Fukushima Dai'ichi nuclear power plant in 2011 (caused by an earthquake and tsunami) Japan extended its FIT system to a wider range of renewable energies.

Since 2017, the import price of wood pellets has been constantly rising from around 20.000 (YEN/MT) in 2017 to 30.000 (YEN/MT) in 2023, increasing by 1.5 times. This was because of the effect that the price of the yen has been weak in the market as well as the Russian-Ukraine war. The impact of the Covid and the rise in transportation fuel costs due to soaring oil prices are subsiding[4].

In particular, the supply of wood pellets in Japan is estimated to import more in the future. This is because of the price gap between domestic and international prices: usually the domestic price in Japan is three times higher than the imported price from Vietnam and Canada etc. This was caused due to the significant decline of people who engage in forest and forestry in Japan: the number of forestry workers in 2020 was 43,710, which has decreased by 35% compared to the number of workers in 2000. Also, the percentage of elderly people engaging in the industry is getting higher with 25% in 2020 compared to 21% in 2010[5]

iii. Palm kernel shells (PKS)

Japan imports all of its palm kernel shells (PKS), a leftover after the oil is processed. Oil palm plantations have been blamed for massive deforestation across Southeast Asia, and especially in Malaysia and Indonesia, for decades. In 2021, Japan sourced 4.3 million metric tons of shells from Malaysia and Indonesia.

Japan imported 19,000t of PKS from Thailand in June, from none a year earlier.

As same as wood pellets, the import price of PKS has been increased from 12.000 (YEN/MT) in 2017 to 22.000 (YEN/MT) in 2023. PKS prices have remained high as supply and demand remain tight due to increased demand in Japan.

[4] source METI (2023) “バイオマス発電事業の現状と要望”
[5] source: MAFF - Ministry of Agriculture, Forestry and Fisheries, Japan, “Annual Report on Forest and Forestry in Japan” (2022)

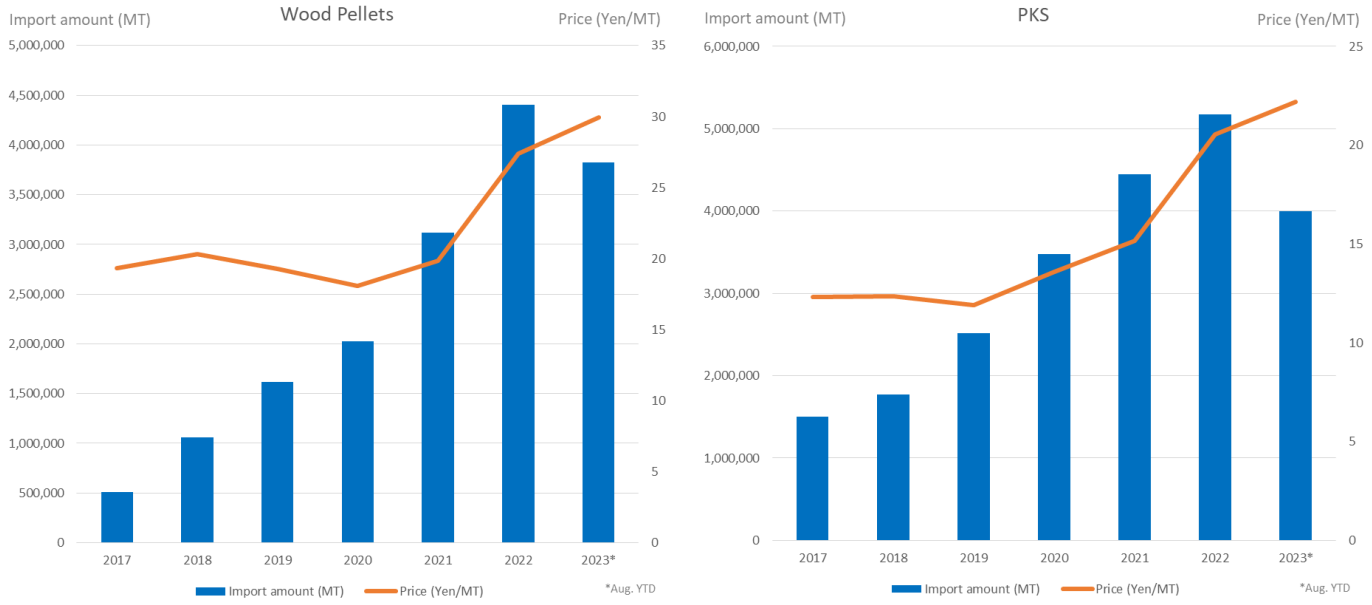


Fig.7: current market trend of wood pellets (left) and PKS (right) (source: METI (2023) バイオマス発電事業の現状と要望)

iv. Biowastes

Processed waste/ Bagasse plant waste.

In the sugar industry, factories produce large amounts of bagasse (residues of sugarcane), which is used principally as boiler fuel. Bagasse produced at factories is converted to carbonized bagasse charcoal through a simple carbonization process (pyrolysis) in a carbonizing furnace. Japan is currently supporting projects Thailand, Indonesia, and Vietnam for producing Raw Materials for Ethanol from Sugarcane Bagasse.

Animal waste and municipal solid waste

In Japan animal waste such as dried slurry and manure and municipal solid waste from household rubbish and garbage are increasingly used in biogas plants.

For digestion of organic wastes in Japan both wet and dry digestion processes are used. While wet systems operate at low solid contents (<10 – 20 % of dry substance (DS)), dry systems operate at high solids (20 –> 40 % DS). The wet fermentation process is more complex and needs a higher amount of investment. On the other hand, the material flow is larger which leads to a higher throughput rate and a better efficiency. Wet digestion plants show improved energy balance and economic performance compared to dry systems. However, dry digestion plants offer several benefits, including greater flexibility in the type of feedstock accepted, shorter retention times and reduced water usage.

As the following figure shows, the installed capacity of bioenergy plants shows an almost steady annual increase of approx. 11-13 % since the year 2014.

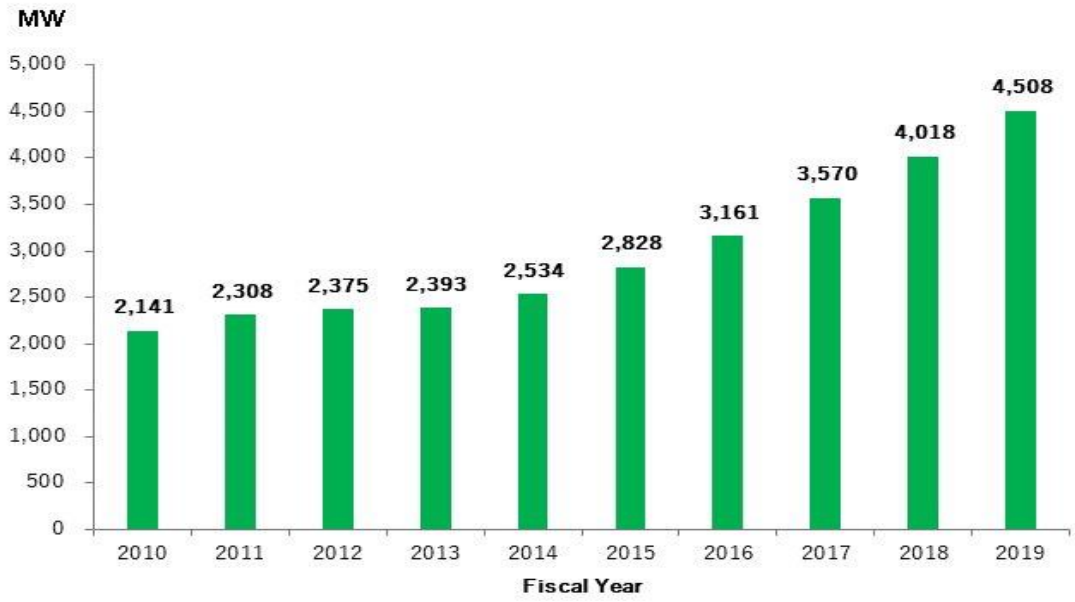


Fig.8: Installed Capacity of Bioenergy (Biogas plants) in Japan (source: Renewable Energy Institute based on METI, ANRE (2020): "Status of the special law on usage of new energy by electric companies in FY2013" and METI, ANRE (2020): "Website for the information disclosure on Feed-in-Tariff")

The market research institute Fuji Keizai determined an annual growth rate of the market for biogas plants in Japan of approx. 10% for the years 2018-2020.[6]

With the aim to introduce more biomass and to ensure a stable procurement and sustainability a growth from 3.5 GW (2017) up to 7.3 GW (2030) installed power for biomass use is expected by METI. The expected increase of Biogas capacity is even higher (from 0.05 GW in 2017 up to 0.16 GW in 2030) (see Figure 9).

[6] source: Deutsche Industrie- und Handelskammer in Japan (2017): "Zielmarktanalyse Japan 2017"

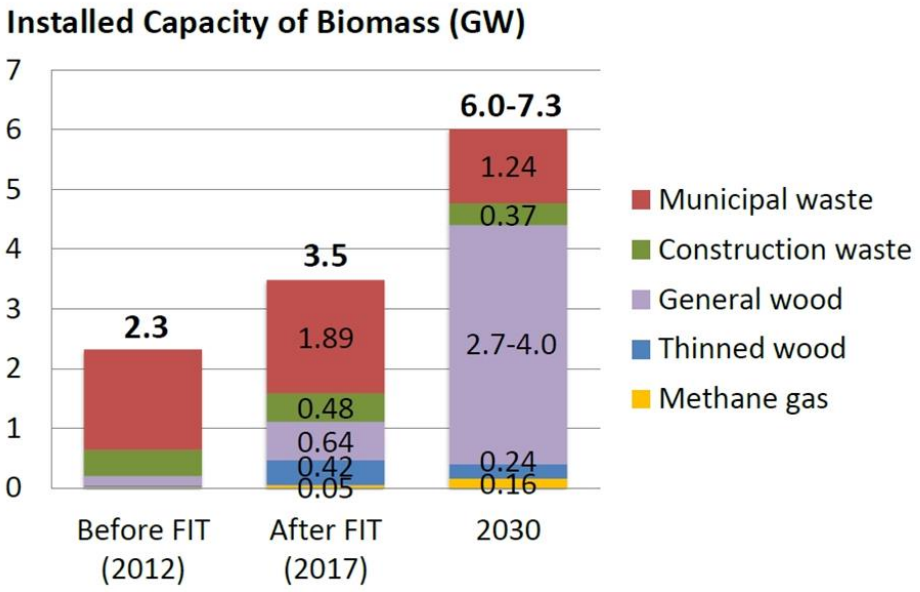


Fig.9: Installed capacity for biomass utilization (source: ANRE, Yamazaki, T. (2018): "Japan's Renewable Energy Policy")

b. Market Developments and Trends

Wood pellets:

Two of the world's largest pellet producers have set their sights on Japan: Drax and Enviva.

Drax, a major U.K. power company and wood pellet producer, has acquired two Canadian pellet producers, Pacific BioEnergy and Pinnacle Renewable Energy, in British Columbia. Pellet companies have received the BC authorities' blessing, according to Roger Smith from the environmental advocacy NGO Mighty Earth. In his view, the BC provincial government is looking to generate revenue from a new "bioeconomy," especially because trees lacking commercial value as timber can still be cut and made into pellets.

Enviva, the world's largest producer of forest biomass for energy, claims it uses woody waste material to make wood pellets. The pellet producer Enviva is now ramping up business with Japan.

Although shipments from Enviva only began in January 2021, the company has set its goal to provide Japan with 3 million metric tons of wood pellets every year, an amount equivalent to Japan's total pellet imports in 2021. Major Japanese trading houses, such as the Sumitomo Corporation and Mitsubishi Corporation, are among the signing 10- to 15-year contracts with Enviva. (source: Mongabay Series: Covering the Commons, Planetary Boundaries, 2022)

Japan has also been steadily increasing its biomass power generation capacity, with its total operational biomass power generation capacity reaching 6,379MW in 2022, up from 5,394MW a year earlier. (source Argus Media group, 2023)

Biogas:

In the **biogas sector** currently feedstock and application trends in Japan are shifting from the traditional livestock excreta and sewage sludge, to a composite of sewage sludge and food waste including industrial waste and food scraps. High-rise buildings with "urban biogas systems" that recycle food waste are being implemented. This is seen as a potential growth market within the sector. ECOS already created a report on behalf of EU-Japan Centre on the market for Biogas Plants in Japan in 2021. The report is available at https://www.eu-japan.eu/eubusinessinjapan/library/publication/report-market-biogas-plants-japan-and-opportunities-eu-companies

Food Waste:

Currently most of the waste from food production is processed into fertiliser and feed.

However Japan still wastes around 5.23 million tons (state 2021, up 10,000 tons from the previous year), of which 2.79 million tons (up 40,000 tons from the previous year) came from business-related food loss generated by food-related businesses and 2.44 million tons (down 30,000 tons from the previous year) from household food loss. (Source: MAFF (2023) "最新の食品ロス量は 523 万トン、事業系では 279 万トンに, ～食品ロス量（令和 3 年度推計値）を公表～")

In order to reduce unused food waste and to recycle it, the Act on the Promotion of the Recycling of Recyclable Food Resources, known as Food Recycling Act, was enacted in 2000 (revised in 2007: According to this act food waste is to be recycled primarily as raw materials for animal feed and fertilizer; The Act was again revised in 2015 with the goal to further reduce the amount of food waste produced and enhance recycling [animal feed, fertilizer, methane]).

Food waste is also part of the Japanese Biomass Industrialization Strategy that includes (among others) measures to promote bio-gasification technologies, the creation of a food-waste collection system, the implementation of recycling through methane gasification, solid fuel conversion and combined utilization with sewage sludge and animal waste, as well as application of FIT scheme.

By means of the methanation of food waste, which is less suitable as feed or fertilizer, the utilization rate was aimed to increase from 27 % in 2009 to 40 % in 2020. (Source: EU-Japan Centre (2015): "Waste Management and Recycling in Japan").

Of 170 registered food waste recycling plants in Japan, 108 are only composting the waste, followed by 55 for animal feed production (Source: World Biogas Association (2019): "Market Report Japan"). According to the Japanese Ministry of the Environment (MoEJ), 42 biogas plants are operating using food waste from households and industry.

Food waste is not generally collected and treated separately in Japan. But in the food industry, restaurants, municipalities, etc., an extensive system of food waste collection and recycling has been established. The Japanese Food Waste recycling law limits the food recycling method to feed, fertilizers, fuel (biogas and carbonization) and oils & fats.

Food waste from the restaurant industry is often not applicable to recycling for the use of fertilizer or animal feed due the difficulty of separation by categories and hygiene management. This kind of waste is better suited for methanation which does not require a strict separation for further use. Food waste is suitable for methanation as it generates an

extremely larger amount of biogas than other biomasses such as manure. By cutting the costs of disposing of food waste It may also lead to new sources of income for restaurants and food industry.

c. Main Applications in Japan

Some of the most common types of solid biomass projects in Japan include:

- Wood pellet production facilities (made from compressed sawdust and other wood waste, and they are used as a fuel source for power plants and industrial boilers).
- Agricultural waste power plants (e.g. digestion and gasification processes)
- Municipal waste-to-energy plants (e.g. digestion and incineration processes)
- Forest biomass power plants (e.g. power stations for generating electricity and heat)
- Biomass furnaces / Biomass boilers (e.g. wood chip boilers for generating heat)

Each of these project types serves a different purpose, but they all play a crucial role in reducing Japan's dependence on non-renewable energy sources and in reducing its carbon footprint.

Main sources for wooden biomass in Japan are thinned wood and logging residue, sawmill byproducts, construction waste, park pruned branches, and orchard pruned branches.

Sixty-seven percent of Japan's land area is forested; in some regions, the proportion of forested area exceeds 80%. Many sawmills use wood from these forests. Furthermore, more than 90% of construction waste and waste wood from sawmills are used to generate energy and paper manufacture in Japan, whereas approximately 30% of pruned branches and logs are used for this purpose (NEDO, 2011). Unutilized pruned branches and logs are left in the mountains or burned in the open. By effectively utilizing this unused woody waste, it may be possible to ensure the production of renewable and sustainable energy (Alao et al., 2022).[7]

i. Wood biomass power stations

Japan has also been steadily increasing its biomass power generation capacity, with its total operational biomass power generation capacity reaching 6,379MW in 2022, up from 5,394MW a year earlier.[8]

- As of March 31, 2022, 433 solid biomass power generation facilities had been approved under the Renewable Energy Feed-in Tariff (FIT) scheme, and 183 of these facilities were in operation.
- Of the 243-solid biomass power generation facilities that mainly use unutilized wood (derived from thinning, etc.) and have been approved under the scheme, 105 are currently in operation: there are 138 FIT/FIP-approved facilities that are not yet operational (as of the end of March 2022), and when all of these facilities are operational, there will be a total of 243 in 40 prefectures.
- Overall, both the number of certifications and the number of installations (number of operations) increased. In particular, the pace of increase in the small-scale unutilized wood category (wood from thinned forests, etc., <2,000 kW) was particularly significant.

[7] source: Science Direct (2023), “Assessment of unutilized woody biomass energy and the cost and greenhouse gas emissions of woody biomass power plants in Hokkaido, Japan”
[8] source: Argus Media Group (2023), “Japan's June biomass imports rise on year”

- Solid biomass power generation facilities, mainly using unutilized wood, are expected to continue to operate throughout Japan. In particular, more than 10,000 kW are expected to be installed in Hokkaido, Yamagata, Fukushima, Gifu, Shizuoka, and Miyazaki.

(source: MAFF (2023), "木質バイオマス発電施設の認定・導入状況や地域別、都道府県別の燃料用チップ利用量の傾向")

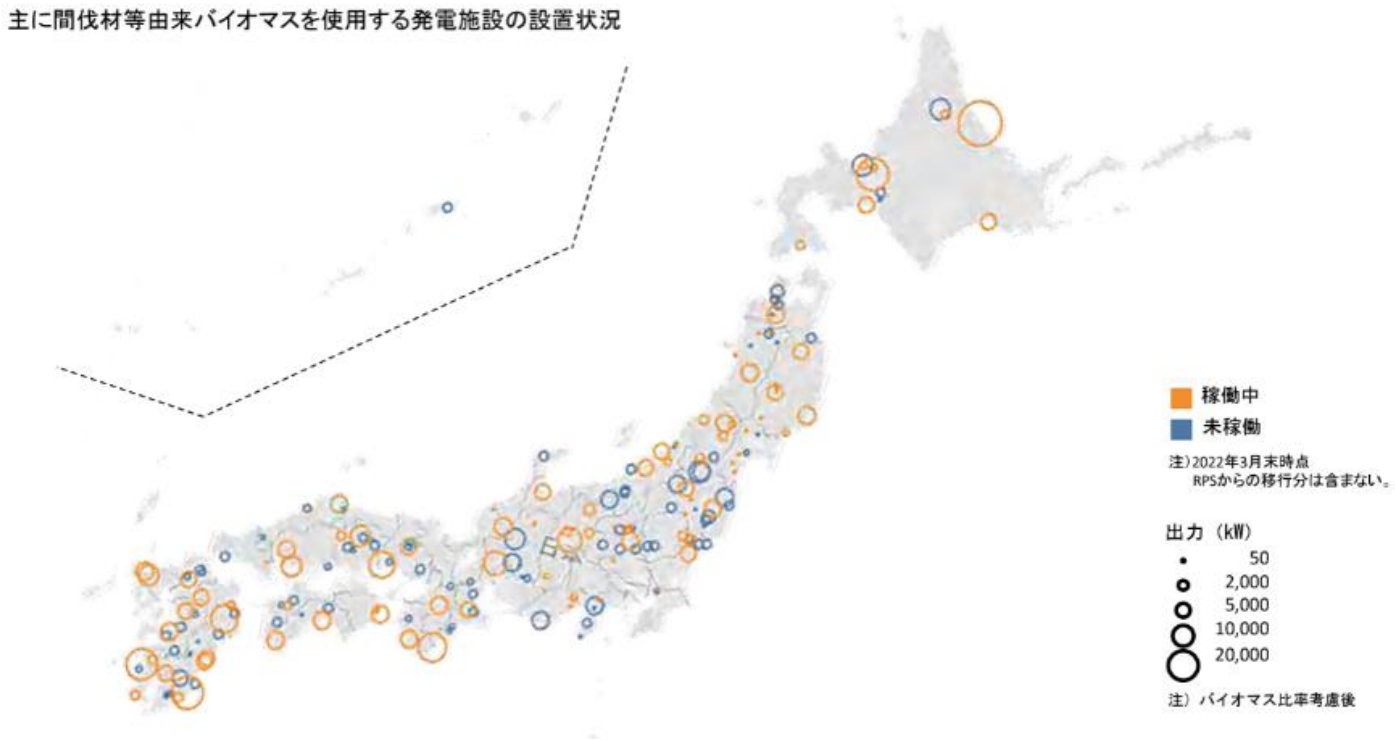


Fig. 10: projected operation of solid biomass power generation facilities (especially unutilized wood category) (source: MAFF (2023), 木質バイオマス発電施設の認定・導入状況や地域別、都道府県別の燃料用チップ利用量の傾向)

The scale of circle indicates how much they can generate electricity (kW). Operating plants are marked with orange, not operating plants with blue circles.

ii. Biomass furnaces / Biomass boilers

With 2,069 units in 2019 (including systems outside the FIT regime) The number of biomass boilers fed with wood raw materials amounted reached its highest peak[9]) during the last 8 Years.

[9] source: Deutsche Industrie- und Handelskammer in Japan (2022), "Zielmarktanalyse 2022 mit Profilen der Marktakteure" based on data from Renewable Energy Institute, 2022

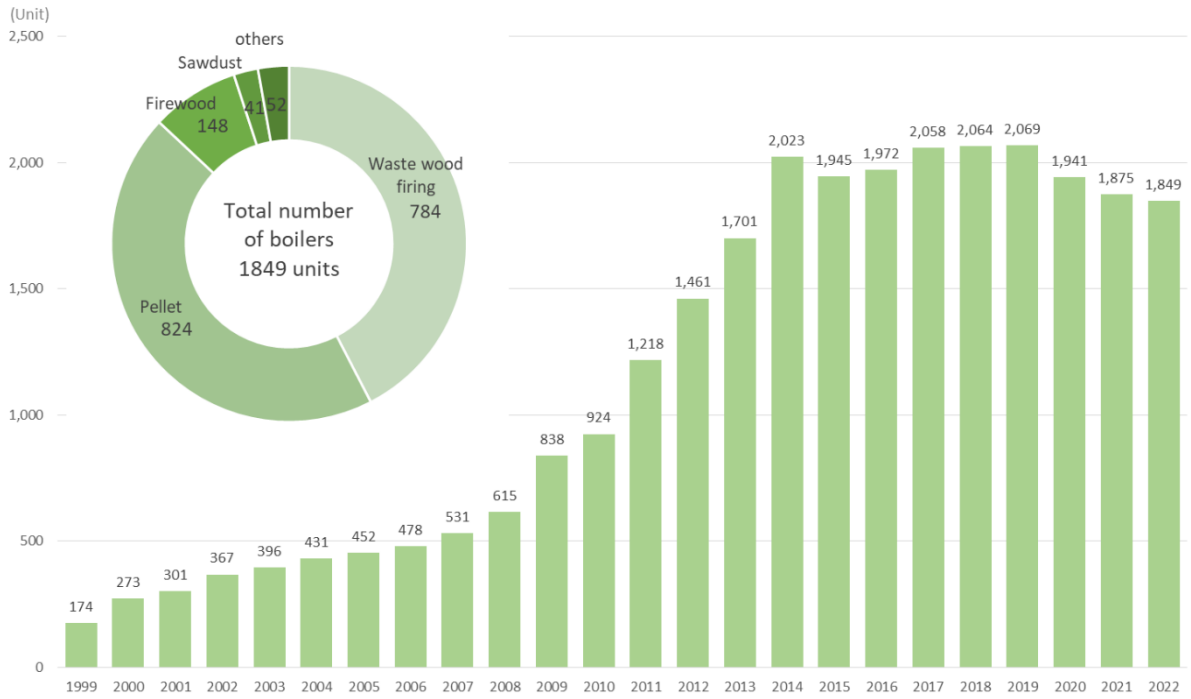


Fig.11: biomass boiler installations in Japan (source: Japan Woody Biomass Association (2018))

It should be noted that wood pellet boilers are hardly used in private households in Japan. Wood chip boilers are mainly used for industrial applications such as the wood processing and furniture industry, but also for additional heating purposes as for example at hot springs (Onsen).

iii. Wood pellet production facilities

Japan currently has 135 domestic pellet plants, down from 137 in 2020. Domestic production is estimated at 150,000 metric tons for 2021, up slightly from 149,000 metric tons in 2020.

But the majority of wood biomass is imported from foreign countries (such as Korea, Vietnam, US and Canada). Japan imported an estimated 3 million metric tons of wood pellets in 2021, up from 2.028 million in 2020, according to a report filed with the USDA Foreign Agricultural Service's Global Agricultural Information Network in late December.

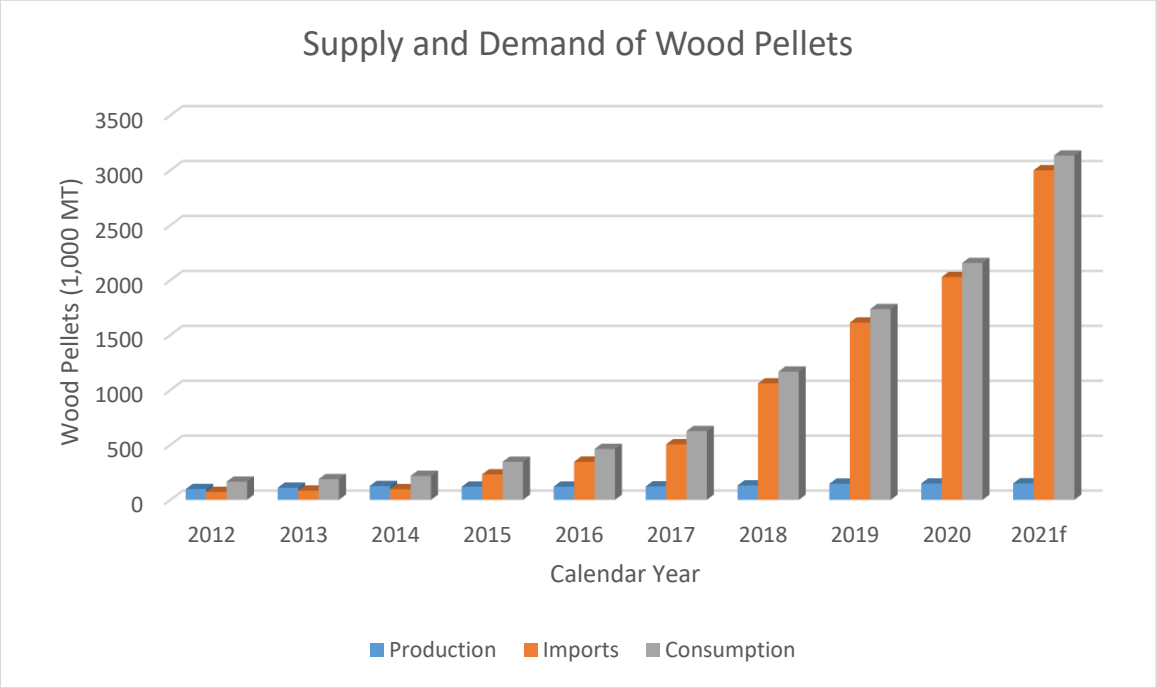


Fig.12: Supply and Demand of Wood Pellets, (Source: Biomass magazine (2022)," Report: Japan imports 3 million metric tons of pellets in 2021")

iv. Biofuel production facilities

At present, BtL (Biomass-to-Liquid) fuels are the subject of various R&D projects on 2nd generation biofuels. The biofuel program is part of Japan's policy to mitigate climate change as well as help to ensure a stable energy supply. As this report is focused on solid biomass only the production of Bio-Ethanol from solid feedstock is mentioned.

Bioethanol (ethyl alcohol) is made by fermenting the carbohydrate components of plant materials, such as corn, sugarcane or rice. While in 2013 approx. 10 Million litres of Bio-Ethanol, produced in totally 5 refineries in Japan from Molasses and residues from rice production were used, today no refinery is operating anymore [10].

[10] source: United States Department of Agriculture – USDA (2022), "Biofuels Annual".

Advanced Biofuels

Second-generation biofuels, also known as advanced biofuels, are fuels that can be manufactured from various types of non-food biomass. Biomass in this context means plant materials and animal waste used especially as a source of fuel.

Second-generation biofuels are made from different feedstocks and therefore may require different technology to extract useful energy from them. Second generation feedstocks include lignocellulosic biomass or woody crops, agricultural residues or waste, as well as dedicated non-food energy crops grown on marginal land unsuitable for food production.

On April 14, 2021, the Japan Science and Technology Agency (JST) and the Directorate-General for Research and Innovation (DG RTD) of the European Commission each announced the results of a call for applications on "Advanced Biofuels and Alternative Renewable Fuels" as a part of JST's Strategic International Collaborative Research Program (SICORP)[11]).

SICORP supports international joint research in research areas prioritized by the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

d. Main Processes in Japan

One of the key factors that sets Japan apart from other countries in terms of biomass projects is the level of technology being used.

From advanced pyrolysis processes to state-of-the-art gasification systems, Japan's biomass projects are some of the most technologically advanced in the world.

The development of bioenergy capacities in Japan has shown a clear upward trend since the introduction of the fixed feed-in tariff (FIT). In January 2022, a total of 780 bioenergy projects are certified for the fixed feed-in tariff under the Japanese FIT system. Of these, 512 projects have already been realized and are in operation. A further 227 projects have been approved for the 20-year FIT term and have yet to be implemented. The 512 projects already implemented can be broken down according to the categorization of the FIT system by feedstock used[12]. It should be noted that there are also many bioenergy plants that are not certified for a FIT for various reasons. The certified plants are broken down as follows:

- Methane fermentation (from biomass): 223 plants
- Wood (from forestry): 96 plants
- Wood and agricultural waste: 68 plants
- Waste from the construction industry: 5 plants

[11] Source: European Commission, 2021, "EU and Japan jointly invest €10,7 million for breakthrough research on advanced biofuels and alternative renewable fuels"; JST 2021, "JST Press Release#1500"

[12] Source: Agency for Natural Resources and Energy -ANRE (2022), "再生可能エネルギー電気の利用の促進に関する特別措置法　情報公表用ウェブサイト"

- Other biomass (includes food waste, used cooking oil, paper and sewage sludge): 120 plants.

Of the total of 223 biogas plants in Japan, 75 are operated on the northern island of Hokkaido alone. This is due to the concentration of dairy and fattening livestock farming on Hokkaido and allows a clear geographical differentiation from other regions. Biogas plants are comparatively small on average (often 250 kW to 400 kW), which is why electricity generation from biogas accounts for only a small proportion overall. However, the number of FIT-certified plants is high, with a total of 223.

90% of Japan's bioenergy production comes from solid biomass. This is also where the greatest potential for growth lies. Biofuels have been used since 2010, but only to a small extent (17 PJ in 2019). Biogas is used to the tune of 9 PJ (source: IEA Bioenergy (2021), "Implementation of bioenergy in Japan – 2021 update" and Deutsche Industrie- und Handelskammer (DIHK) in Japan (2022), "Zielmarktanalyse 2022 mit Profilen der Marktakteure").

One of the most common technologies used in biomass projects in Japan is wood pellet production:

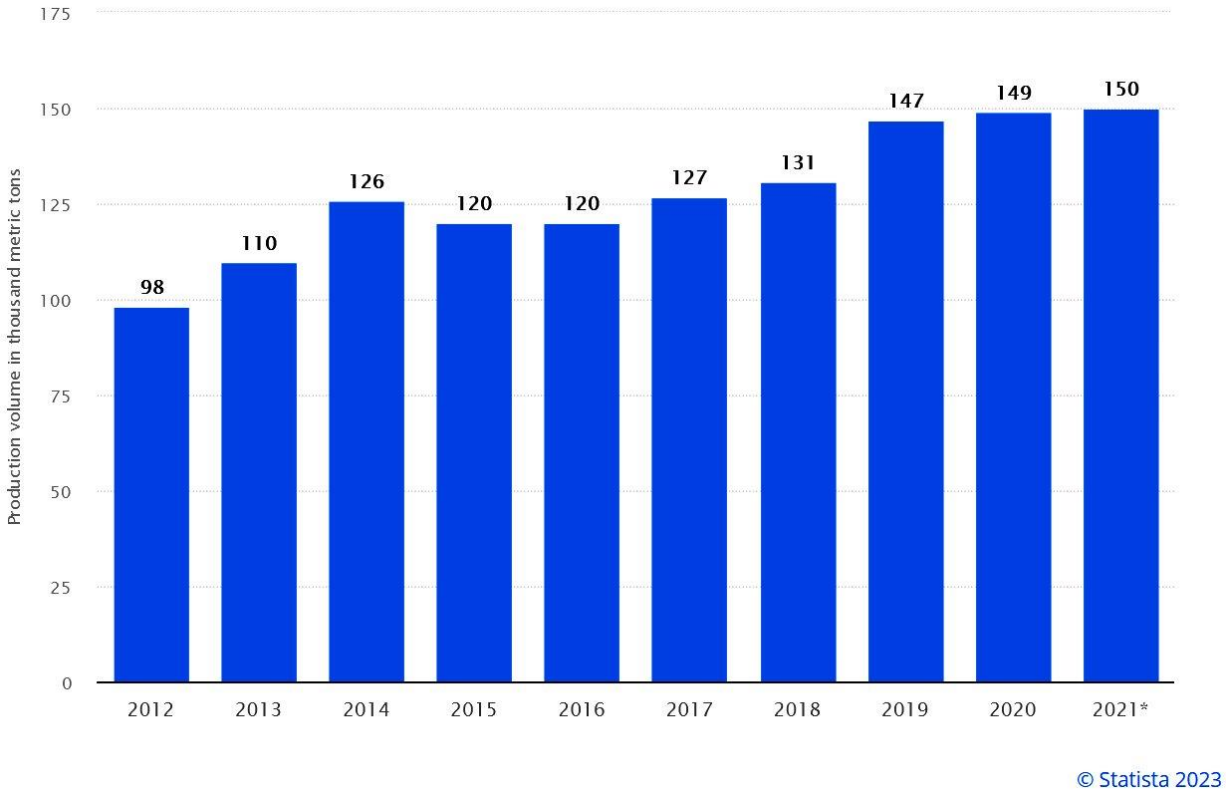


Fig.13: Wood pellet production volume in Japan from 2012 to 2020 with a forecast for 2021 (2023), (source Statista: "Wood pellet production volume in Japan from 2012 to 2020 with a forecast for 2021")

As fig. 13 shows the wood pellet production in Japan shows an almost steady increase of more than 50 % from 2021 to 2021 reaching 150.000 tons in 2021.

5. Market Access

a. Market access conditions

Market entry has been facilitated after the Japan-EU Economic Partnership Agreement (EPA) came into force in February 2019. The EPA removes the vast majority of the € 1 billion of duties paid annually by EU companies exporting to Japan. Once the agreement is fully implemented, Japan will have scrapped customs duties on 97% of goods imported from the EU[13].

When it comes to importing machinery into Japan, the importing company does not require any specific licenses or operating permits. For the European company that wants to export to Japan, it is recommended to register with the respective European Commission customs office as a registered exporter (REX): https://customs.ec.europa.eu/rex-pa-ui/html/manual/rex___create_pre_application.html#

In this way, the declaration of origin for plant components can be drawn up, if it meets the original. In the agreement between the EU and Japan on an economic partnership (EU-Japan EPA), a declaration of the origin of a registered exporter is provided as proof of preference when exporting from the EU (source: European Commission (2019): "EU-Japan trade agreement enters into force"). It is recommended to check the current export regulations and procedures at the German customs office research. (Zoll: "Unternehmen", refer to: https://www.zoll.de/DE/Unternehmen/unternehmen_node.html). More information and a list of custom brokers available depending on the arrival port/airport in Japan can be obtained from the Japan Customs Brokers Association (JCBA): http://www.tsukangyo.or.jp/profile/english.html.

The EU-Japan EPA Helpdesk can also provide further information: https://www.eu-japan.eu/epa-helpdesk

To benefit from Japan-EU Economic Partnership Agreement (EPA) preferential tariff rates, the product to be exported need to be originating in Japan or the EU. More detailed information on the Japan-EU Economic Partnership Agreement is given at the European Commission's website at https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/japan/eu-japan-agreement_en or at the website of the Ministry of Foreign Affairs of Japan at https://www.mofa.go.jp/policy/economy/page6e_000013.html

Public tenders:

As in most other countries, Japan requires a public tender for regional as well as international projects, which are subject to the rules of the World Trade Organisation. This means that even the simplest project must include a construction company or consortium in addition to the owner.

A selection of databases: for public tenders in Japan:

- TED (Tenders Electronic Daily)
- Tender Notice Portals at the EU-Japan Centre: https://www.eu-japan.eu/government-procurement/tender-monitoring-informations/tender-notice-portals

[13] source: European Commission (2019): "EU-Japan trade agreement enters into force"

Foreign exporters will need to establish and maintain a strong business relationship with local partners to succeed in Japan. Companies hoping to enter the Japanese market should visit the country frequently to cultivate contacts and to better anticipate business conditions (see “recommendations” in chapter 7c).

The actual entry restrictions to Japan can be seen on the website of Ministry of Foreign Affairs in Japan: https://www.mofa.go.jp/p_pd/pds/page22e_000910.html.

It has been often said that business cost in Japan is higher than other countries and it could be a market barrier for foreign companies. However, in the last three decades, the Japanese government reduced the national standard corporation tax rate from 40% to 23.2% [14]. The effective tax rate for corporations is approximately 30%, and this is almost the same level as for example Germany.

Further information about the Japanese taxation system is available on the website of the "EU-Japan Tax & Public Procurement Helpdesk" (https://www.eu-japan.eu/japan-tax-public-procurement-helpdesk).

b. Distribution channels

For foreign companies deciding to set up an own business in Japan, there are basically four ways to set up own operations as shown in the table below.

	Sales Agent	Representative office	Japanese branch	Incorporation	
				Kabushikigaisha	Godogaisha
Limitation of activities	-	Sales activities are not allowed	No	No	No
Registration	Not required	Not required	Required*	Required	Required
Party to contract	-	Parent company**	Itself***	Itself	Itself
Tax obligation	-	-	Itself	Itself	Itself (no pass-through)
Disclosure of Financial Information	-	Not required	Not required	Not required	Not required

[14] source: Ministry of Finance in Japan (2020): 法人課税に関する基本的な資料

Limitation of liabilities of share-holders (interest holders)	-	-	No	Yes	Yes

Tab.4: Ways to set up operations in Japan (source: Japan Industry News, "Market Entry and Incorporating in Japan", 2015)

Trading houses are considered as potential distribution partners. Although the traditional trading houses in Japan are still considered primarily as commodity traders, these companies have undergone major restructuring. In recent years they have developed completely new foundations for their business, some of which include the bioenergy sector. A selection of important trading houses and possible partner companies is given under 6 a "Technology Suppliers / Competitors".

It could be also useful to approach local companies in the Japanese market and ask them to include your products (e.g. components for biomass power plants) into their portfolio.

For the local partner, the novelty or uniqueness of a technology is one of the most important criteria. If the technology is already offered by several competing companies in the market, a Japanese trading company will in most cases refrain from cooperating because market entry would then only be feasible at a comparatively high cost. Specialized trading houses also take on the installation/assembly or commission a local company to do so on their own responsibility, while a specialist from Europe usually has to travel to Japan to fine-tune and, if necessary, supervise the assembly.

However, other types of cooperation can also be entered into with Japanese companies, including, for example, cooperation on a technological level or joint ventures. In addition, market entry can also be achieved through contacts with project developers and EPC companies in particular. Membership of one of the industry associations listed in the appendix is also worthwhile. However, an active role in the association requires personnel with sufficient Japanese language skills or a registered local presence. In some cases, it may therefore be worth establishing a local representative office. One of the biggest challenges here is finding staff with experience in the industry and sufficient Japanese language skills.In the heating sector manufacturers of heating systems (e.g. furnace systems, boilers) and installers could also be suitable distribution partners.

Membership in associations (such as Japan Woody Bioenergy Association, Japan Organics Recycling Association or JAPAN FOREST TECHNOLOGY ASSOCIATION (JAFTA) can provide contacts to multipliers from industry and municipalities and access to an extensive network, including project developers, technology providers, consultants and engineers (also see chapter 6 "Major Players").

c. Regulations

Import/Export of machinery to Japan

When it comes to importing machinery to Japan, the importing company wishing to distribute foreign machinery in Japan does not require any special licenses or operating permits. For the European company wishing to export to Japan, it is recommended to register with the relevant customs office of the European Commission as a Registered Exporter (REX).

In this way, the declaration of origin for the recycling plant components can be drawn up if it corresponds to the original. Under the EU-Japan Economic Partnership Agreement (EU-Japan EPA), a declaration of origin from a registered exporter is used as proof of preference when exporting from the EU. It is advisable to check the current export regulations and procedures at the German customs office research. More information and a list of custom brokers available depending on the arrival port/airport in Japan can be obtained from the Japan Customs Brokers Association (JCBA). The EU-Japan EPA Helpdesk can also provide further information.

Technical standard JIS

The Japan Industrial Standard (JIS) is issued by the Japanese Industrial Standards Committee (JISC) which underlies the jurisdiction of METI. JISC works closely with the International Organization for Standardization (ISO) and the International Electronical Commission (IEC). Although JIS is not mandatory and in many cases is very close to ISO, Japanese customers prefer to stick to JIS-certified products because the certification process may include certain special Japanese regulations or specifications that apply only to the Japanese market. Especially for foreign companies, the application process can be difficult due to specific regulations and language barriers. However, there are organizations in Japan that can assist foreign companies with the application process, e.g. the Japan Quality Assurance Organization (JQA).

General regulations for Biomass processing plants

Depending on the area where the facility will be developed, permissions from the local governor and/or other governmental authorities will be necessary under the Agricultural Act, Forest Act, Natural Parks Act, Landscape Act, City Planning Act, etc. (as applicable). In addition, an environmental impact assessment is required for certain large-scale hydro, wind, biomass, and solar projects. Smaller projects may also be subject to an environmental impact assessment under local laws. Recently, more local rules have been enacted due to criticism regarding the disorderly development of solar projects, etc. With respect to offshore wind projects under the Marine Renewable Energy Act, permission for exclusive occupancy and use of designated ocean areas is required. Permission is to be granted to selected developers through an auction process.

In addition Japan has multiple laws that should be considered in the development of renewable energy projects. Those laws include the following:

- The Forest Act, which regulates development work in conservation forest areas and forest areas included in the local forest plan. The Forest Act requires developers to obtain the prior approval of the prefecture governor in order to conduct any development work in such areas.
- The Law on Prevention of Disasters Caused by Collapse of Steep Slopes, which regulates development work in designated steep slope areas.
- The Natural Parks Act, which regulates development work in national park areas. The prior approval of or a filing with the Ministry of Environment or the prefecture governor is required in order to carry out development work in such areas, depending on whether the area is located in a national park.
- The Environmental Impact Assessment Act, which requires certain industrial projects in the renewable energy sector to undergo an environmental impact assessment before development begins.[15]

[15] Source: ICLG - Renewable Energy Laws and Regulations (2023), “Renewable Energy Laws and Regulations Japan 2024”

d. Trade Fairs

- BIOMASS EXPO will take place in Tokyo for three days from 28th February 2024, organized by RX Japan Ltd (co-organized with Japan Woody Bioenergy Association and Japan Organics Recycling Association). International players in a wide range of biomass field (e.g., fuel, manufacturing equipment, measuring/analyzing equipment, heat utilization technologies, electric generating facilities) will participate in the event.
- The 14th annual Biomass Pellets Trade & Power Conference will take place in Tokyo from 13th to 16th May 2024. This event is recognised as Asia's largest gathering of biomass buyers and suppliers and brings together key stakeholders in the biomass supply chain, from producers of wood pellets, wood chips, palm kernel shell, and torrefied biomass to traders, utilities, independent power producers (IPPs), and industrial users across the Asia Pacific region.
- FORESTRISE 2024, will take place in Tokyo from 18th to 20th September 2024J. The fair represents the forest business as a comprehensive industry that encompasses forestry industry and woody biomass industry. Among other groups the fair is targeted to: Forest departments of the government / local governments (prefectural, municipal), Forestry management entities, Forest owners, Raw wood markets, Paper manufacturing companies and trading companies (afforestation division), Academic and research institutions and others.
- „Fukushima Renewable Energy Industrial Fair (REIF Fukushima), October 2024, Big Palette Fukushima: The fair offers companies and/or institutions, who are undertaking businesses in the renewable energy industry and carbon neutrality, to exhibit technology, provide and gather information, hold business meetings and join networking events. This boosts businesses among industry, academia and government as well as raising awareness of citizens of the prefecture whilst expressing Fukushima's strong will to achieve carbon neutrality by 2050 and become a renewable energy frontier both locally and globally.
- „New Environmental Exposition (N-Expo) ",.(Wed), May 22, 2024 – (Fri), May 24, 2024, Tokyo Big Sight, Tokyo: N-Expo (New Environment Exposition) is the largest environmental exhibition in Asia and will enter into its 23rd year in 2014. N-EXPO focuses on New Energy, Resource Recovery/Recycling, Air Pollution, Water Contamination, Soil Contamination and Waste Disposal technologies. The fair is held in May every year.
- „World Smart Energy Week": Smart Energy Week is an exhibition where the latest technologies, information, and people gather to accelerate business in the energy industry. The fair gathers a full range of renewable energy technologies such as hydrogen and fuel cells, solar power, rechargeable batteries, smart grids, wind power, biomass, zero-emission thermal power generation, etc.
  Dates and locations:
  - February 28 (Wed) - March 1 (Fri), 2024, Tokyo Big Sight
  - Oct. 2 (Wed) - 4 (Fri), 2024, Makuhari Messe,
  - Nov. 20 (Wed) - 22 (Fri), 2024, INTEX Osaka, Japan

6. Major players

a. Technology Suppliers / Competitors

At many biomass plants in Japan, the main biomass-specific components utilize technologies and products made by foreign manufacturers, e. g. turbines and CHPs. The increase of installed powerplants after FIT has caused strong dependency on import of biomass fuels.

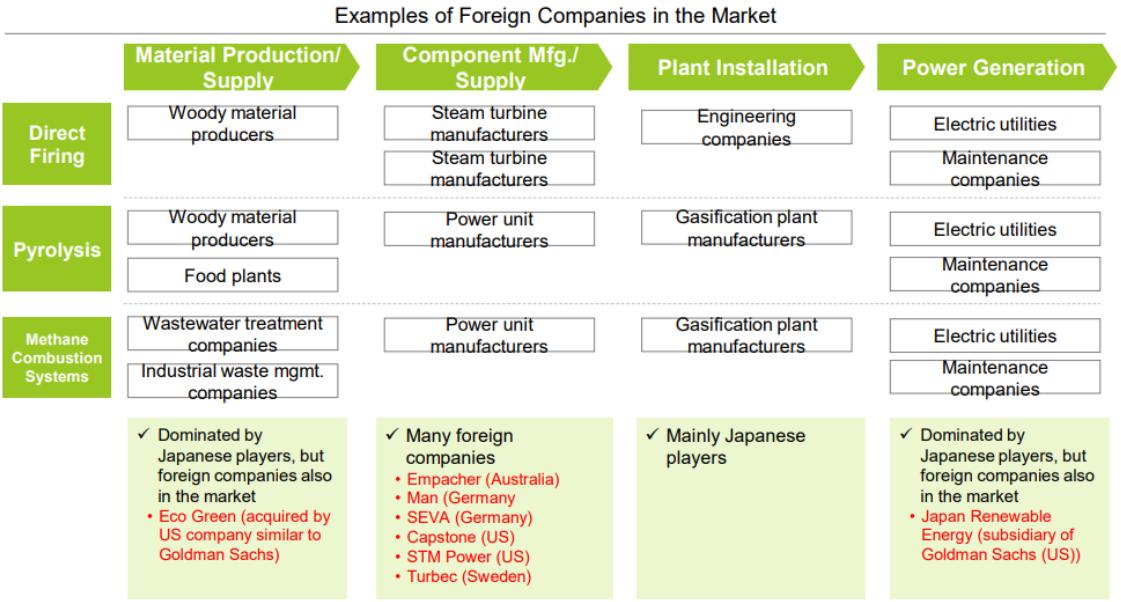


Fig.14: Companies involved in biomass/biogas plant manufacturing and operation (Source: JETRO (2017): "Market Report Renewable Energy")

Examples of major technology suppliers:

The Sumitomo Forestry Co., Ltd described that they expanded five solid biomass plants until June 2021, and started the operation of a new solid biomass plant in Miyagi Prefecture in November 2023. When including this plant, the total electricity generation will be around 251.6MW, which accounts for 5.6% of the solid biomass electricity in Japan (4.5 million kW in March 2023) according to METI. The Idemitsu Kosan Co., Ltd. owns two solid biomass plants, which totally produce 99.000 kW. Also, Kamitsu biomass power generation, manufactured by GE Steam Power, is estimated to generate 50MW.

The Japan Woody Bioenergy Association, established in 2015, promotes the appropriate use of woody biomass as energy. More specifically, they introduced the 19 as membership companies in relation to engineering, construction, design and facilities. Each company is listed below[16]:

[16] source: Japan Woody Biomass Association (2023), Member list

AIR WATER INC. https://www.awi.co.jp/en/index.html
OYAMADA ENGINNIERING CO. Ltd. https://oyamada-eng.co.jp/
KARUIZAWA Fire wood, https://karuizawa-firewood.jp/
菊地建設株式会社 https://kikuchi-cons.co.jp/
JFE Technos Co., Ltd https://www.jfe-technos.co.jp/en/
SymEnergy Inc. https://www.symenergy.co.jp/
KOBELCO ECO-SOLUTIONS Co.,Ltd. https://www.kobelco-eco.co.jp/english/
SINTOKOGIO, LTD https://www.sinto.co.jp/en/
TAISEI CORPORATION https://www.taisei.co.jp/english/
TAGAMI EX CO., LTD. https://www.tagamiex.co.jp/en/
株式会社東部産業 https://www.toubu-s.co.jp/about/
TOYO ENERGY SOLUTION Co., Ltd. https://toyo-energy-solution.co.jp/en/
NAS Construction Co.,LTD. https://nas-con.jp/
JAPAN ENERGY BANK Co.,Ltd. https://j-energybank.co.jp/
Fuji Technical Co,LTD. https://fuji-technical.jp/
DO-SEKKEI https://do-sekkei.co.jp/
Mitsubishi Heavy Industries Power IDS Co., Ltd. https://power.mhi.com/jp/group/ids/
合同会社もりほっと https://mori-hotto.com/
RYUOU INDUSTRIAL Co.,Ltd. http://ryuou.co.jp/

Trading houses (Machinery)

Sun Earth Co., Ltd. https://www.sun-earth.jp/?lang=en
SANYO TRADING CO., LTD. https://sanyo-trading.co.jp/eng/home/
MATSUBO Corporation https://www.matsubo.co.jp/en/
MARUMA TECHNICA CO., LTD. https://www.maruma.co.jp/
RYOKUSAN Co., Ltd. https://www.ryokusan.co.jp/

Trading houses (fuels)

ITOCHU ENEX Co., Ltd. https://www.itcenex.com/en/index.html
Inabata & Co., Ltd. https://www.inabata.co.jp/english/
STX CORPORATION https://www.stx.co.kr/eng
MAEHATA CORPORATION https://www.mkw.co.jp/maehata/english/index.htm

b. Customers

i. Cities and municipalities

Numerous cities and municipalities are now participating in the "Nippon Biomass Strategy" and are presenting their biomass utilisation plans. There are now almost 300 such "biomass towns" in Japan that are promoting the use of biomass as an energy source in line with the Nippon Biomass Strategy. Funding for biomass utilisation plants now exists in several prefectures, with the northern island of Hokkaido playing a leading role. The Japanese Ministry of Ministry of Agriculture, Forestry and Fisheries (MAFF) give an overview in their presentation available at https://www.maff.go.jp/e/policies/env/attach/pdf/biomass-3.pdf.

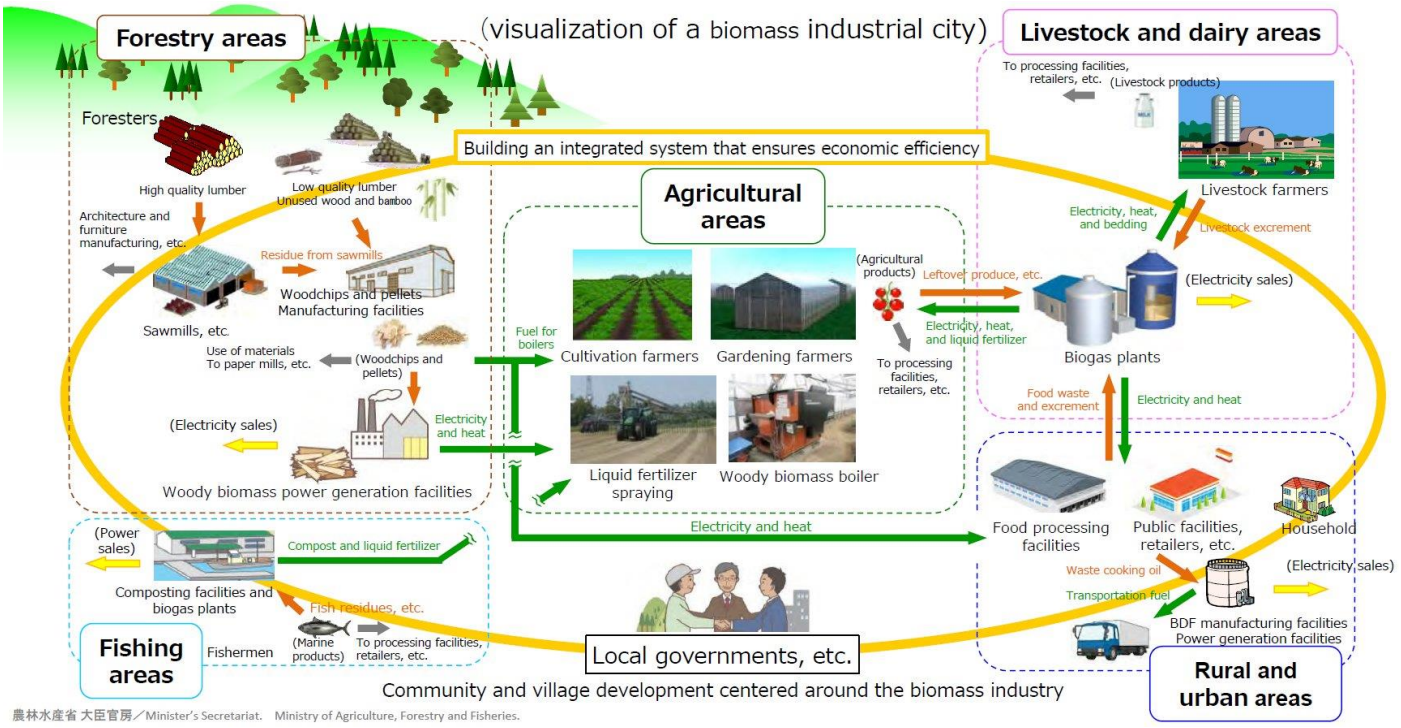


Fig.15: Visualization of a biomass industrial city (source: MAFF Ministry of Agriculture, Forestry and Fisheries (2022) "The Situation Surrounding the Use of Biomass")

One example is **Shimokawa** in northern Hokkaido, where around 90 % of the municipal area is forested. Before the introduction of biomass, the town relied on fossil fuels for heating in winter. Now the municipality operates a renewable forestry system based on the principle of sustainability, which means not felling trees faster than the forest grows and reforesting after felling. The wood is processed into wood chips that are used to heat boilers. Around 40 % of local facilities are heated in this way, including hot springs, day care centres and public housing.

In **Tokyo**, the city administration switched from fossil fuels to biomass energy back in July 2019 to supply 80 % of its electricity needs for its two administrative buildings[17].

ii. Companies

More and more companies are also using local and sustainable raw materials. **Ricoh** is one of the companies in Japan that uses biomass in its operations. At its Eco Business Development Centre in Shizuoka Prefecture, the entire air conditioning and hot water system is powered by wood biomass, which reduces annual kerosine consumption. With the support of the city government, the centre sources its woody biomass from a local forestry company that processes wood from thinning into wood chips.

[17] source: Energy World October 2020, "Japan becoming an international biomass energy hub"

In recent years, biomass plants have increasingly been built near paper mills or timber yards, whose residual products serve as a fuel source. The heat generated can be used for paper production. (source: Energy World October 2020, "Japan becoming an international biomass energy hub").

In 2020, **NTT Anode Energy**, which oversees NTT Group's energy business, announced a capital and business alliance with Forest Energy, a company involved in woody biomass power generation. The company will use thinned wood as fuel to develop energy-efficient small power plants, while NTT will provide electricity storage and DC power supply technologies to promote the spread of locally produced, locally consumed renewable energy throughout Japan.

In order to reduce the food waste and utilize them, also food industries have been paying more attention to biogas plants. Some examples are:

- **Fujidelica Quality**, company for prepared food in Matsuyama prefecture, installed a biomass plant using its own vegetable scraps in its factory.
- **Asahi** announced to produce all cans of "Asahi Superdry" by using electricity from biomass plants from May 2020 (though food residue is not used as fuels).
- **'J Bio Food Recycle'** established by JFE Engineering Corporation with the cooperation of wholly owned subsidiary, JFE Kankyo Corporation, started a joint project with East Japan Railway Company and JR East Environment Access for using industrial and food wastes from public facilities such as station buildings and meat manufacturing plants, with 80 ton per day of food waste treated in biogas plants by fermentation. This project began as a food recycling business by converting to biogas beginning in August 2018.[18]

c. Associations & Research Institutes

Some relevant associations and institutions in Japan are:

Forest Research and Management Organization
To produce electricity and heat from wood biomass in small-scale facilities which is suitable for the local area, they develop technologies to supply low-cost wood biomass, stabilize fuel quality, and evaluate economic efficiency.
https://www.ffpri.affrc.go.jp/ffpri/en/index.html
https://www.ffpri.affrc.go.jp/en/pubs/documents/youran-ffpri-en2023.pdf

Forest Energy Research Co., Ltd 株式会社森のエネルギー研究所:
They are continuing various research and development efforts, including the development of a small combined heat and power plant that uses a wood gasification and combustion system, as well as chip drying equipment and combustors. They are a private company, therefore, consultation is also one of their duties.
*No English name was found, hence, it was elaborated by the author.
https://www.mori-energy.jp/

[18] DNA India (2018), "Japan generates electricity by recycling 80 ton per day of food waste"

Japan Forest Technology Association (JAFTA): This association was established in 1921 as a vocational organization of Japanese professional foresters. They aim to develop and diffuse the technology and science of forestry and to contribute to the cultural advancement of society through forestry-related activities. They conduct research related to planning biomass transformation and study to grasp the resources of under-utilized and unutilized lands. There are works collaborating with government-related organizations.
https://www.jafta.or.jp/index-e.html

JARUS (The Japan Association of Rural Solutions for Environmental Conservation and Resource Recycling): Aligned with the biomass town project by MAFF, they provide support services. There are four services: helping formulation of biomass utilization, support for ordering facilities, verifying the facility performance, and consultation service.
https://www.jarus.or.jp/

JORA (Japan Organics Recycling Association)
The association provides information on biomass promptly, helps develop human resources, has conferences, and promotes Biomass products. Notably, they implement and certify the "Biomass Mark" on the product, made from biomass resources, and as of November 2023, around 2000 products are certified by the association.
https://www.jora.jp/

BPA (Biomass Power Association)
This is a leading association created by the solid biomass power generation industry and was launched in 2016. Their activities widely range such as information sharing, creating an environment to sustain business management, and making policy recommendations to the government.
http://www.bpa.or.jp/

7. Market Potentials and Recommendations

a. Potentials

90% of Japan's bioenergy production comes from solid biomass. This is also where the greatest potential for growth lies. For European companies, there are also opportunities as suppliers of components and entire systems. These can be brought into the country via a local partner. Specialized trading companies or companies for planning, assembly and procurement - EPC (Engineering, Procurement, and Construction) companies - are particularly suitable for this. In particular, a certain novelty of the technology and sufficient differentiation from competitors already active in the market are crucial.

CHP plants:

There are also increased opportunities in the area of combined heat and power generation. Compact combined heat and power plants (CHP plants) are particularly interesting for the direct supply of electricity and heat for agricultural businesses, industry and waste recycling. Power purchase agreements (PPAs) will also become increasingly important

in the future. This is likely to open up further opportunities in the future, e.g. for the use of CHP units for food processing companies. A special technology with hardly any Japanese competition is wood gasification in conjunction with CHP units. However, it should be noted that the infrastructure for district heating in Japan is underdeveloped, so the heating concept must have a local heat consumer when planning. As this will not change significantly, the chances of integrating bioenergy into district heating generation are very limited.

Biogas plants:

Compared to Germany, Japan has a smaller number of domestic companies that provide components for or entire biogas plants. Japan is therefore dependent on technology from abroad. German companies are already strongly represented in this area. As the market for biogas plants is also growing due to the high FIT there is still great potential for growth here. Smaller plants with an output of 50 kW to less than 1 MW are particularly in demand[19].

Components for retrofitting and upgrading for increased energy efficiency:

Components for retrofitting and upgrading to increase the energy efficiency of existing systems are also in demand. This also includes the reduction of CO2 emissions. One example is the increase in substrate quality for biogas plants, but components for increased energy efficiency or reduced CO2 emissions are also in demand for other areas of the bioenergy sector.

In addition to the technologies mentioned above, the still immature Japanese market for bioenergy is open to other products with a certain novelty or uniqueness.

b. Challenges and main obstacles for market entry

Despite the many benefits of biomass projects, there are also a number of challenges that need to be overcome in order to make these projects successful.

Some of the biggest challenges for biomass projects in Japan are:

- **Lack of financing:** biomass projects can be expensive to start and operate, and raising finance can be a major challenge. Especially for Japan higher investment and construction costs should be considered.
- **Technical difficulties:** The technology used in biomass projects is complex and there are many potential obstacles that need to be overcome to make these projects a success. Technology must be adapted to new market. Components such as furnace systems, boilers or gasifiers for example must fulfil safety regulations for earthquakes. This means that, compared to European standards, it must first be clarified whether special reinforcements should be considered.
- **High quality standards**, different regulations must be followed. Detailed information on specific topics such as standards, regulations and approval procedures, as well as websites of SMEs and authorities, is often only available in Japanese.

[19] source: Deutsche Industrie- und Handelskammer in Japan (2022), “Zielmarktanalyse 2022 mit Profilen der Marktakteure”

- **Resistance from local communities:** In some cases, local communities may be opposed to biomass projects due to concerns about environmental impacts and potential health risks or odour nuisance.
- **Competition with local players:** The Japanese market is relatively mature, with established local players. European companies may face the competition from Japanese companies that already have well-established networks, references, customer relationships, and market knowledge. Building a competitive advantage and differentiating themselves from local competitors can be a significant challenge. As a rule, Japanese tend to favour national products and manufacturers. On top of that, Japanese are of course loyal to their existing business partners. Partnering with local Japanese distributors, agents, or joint ventures can provide European companies with market entry support, access to local networks, and distribution channels. Collaborative ventures can help European companies establish a presence in the Japanese market and tap into the opportunities it offers.
- **Win a contract for public projects:** Although tendering for public projects is common, it is difficult for a foreign company to win a contract. Obstacles include the lack of transparency in the tendering process, specific conditions that are difficult for foreign companies to meet, vague evaluation criteria, difficult access to relevant information and the requirement for prior domestic project references. The best strategy for a European company is therefore to work with a Japanese company, familiarize itself with the tendering process, and gather domestic references.
- **High customer orientation and a good corporate image** are prerequisites for successful business in Japan.
  - Japanese customers are uncompromising when it comes to quality - even cosmetic faults and irrelevant to the function of the product. Japanese companies are quick to question the entire production and logistics process.
  - An additional delivery check ex works or on arrival in Japan to ensure "Japanese quality" is recommendable. Also, in the plastic recycling market in Japan, the quality standards are very high, and the requirements for the quality of recycled plastics are strict.
  - In a country where "the customer is God", a high level of service and perfect quality is considered normal. In this view, a deal is not considered closed after delivery, as Japanese customers usually expect free service and after-sales support.
- **Often long decision-making processes:** Since decisions in Japanese companies are often the result of extensive consultations with many people from different departments throughout the organization, the decision-making process is particularly lengthy, and several meetings are needed to reach an agreement.
- **Language:** A main obstacle and challenge to doing business in Japan still is language. A trained, experienced Japanese interpreter is recommended for discussions and negotiations with potential business partners or customers.

Special remarks for plants generating electricity from solid biomass (such as power stations or CHP's):

- In general, the current limited access to the electricity transmission grid for renewable electricity generation plants is considered as one of the factors hampering the growth of renewable energy in Japan. In several regions of Japan, large utilities that also own the transmission grid regularly refuse to buy electricity from solar, wind, and biomass plants because of a lack of free capacity in the grid.
  In Japan, grid connection is approved according to a "first come, first served" principle, regardless of the type

of electricity source (renewable energy or large fossil fuel power plants). Accordingly, the transmission capacity of the electricity grid will be ensured in the order applications are submitted. Even if the planned and built power generation is not in operation, the capacity is included in the calculation. In order to assess whether there is still free capacity in the power lines, the situation of a power failure must also be taken into account. For this reason, the maximum transmission capacity with two transmission lines is only 50 % (with three or more transmission lines, this can be up to 70 %). Among other reasons, in some cases this situation prevents the connection of renewable energy installations. Several renewable energy suppliers are still waiting to be connected.

Another possible obstacle is that several grid operators only allow electricity feed-in with a limited capacity for new biogas plants. In some regions, for example, only biogas plants up to a power of 50 kW can be connected to the public grid.

- In order to significantly increase the supply of energy from renewable sources - as advocated in the government's Basic Energy Plan - both the government and the energy industry now started to maximize the efficient use of the transmission grid. As a first measure to strengthen and stabilize the Japanese transmission grid in the future, the independent "Organization for Cross-regional Coordination of Transmission Operators" (OCCTO) was founded in 2015. This is responsible for monitoring and controlling the supply and demand of electricity. Its duties include planning work in order to sustainably promote interregional interconnection and frequency conversion (as for the electricity grid Japan uses 2 different frequencies: 50 Hz in Eastern Japan and 60 Hz in Western Japan). Other solutions include the introduction of smart grids and the recalculation of the grid situation.

Especially for biogas technologies there are additional challenges:

- Waste producers are often far away which implies a necessary establishment of a transport network which sometimes involves considerable effort and additional costs. However, it may be an advantage that the establishment of such a transport network can also have an influence on the delivered substrate by encouraging improved waste separation on site and sensitising the parties where the food is produced to the issue of biogas and renewable energies. If one forms a network or concludes partnerships beforehand, the transport network can also be used for other tasks, thus minimising costs.
- In some cases, access to feedstock sources (e.g., food waste or livestock manure) must be developed as a first step. In this case, communication with the local community, waste producers, network operators, authorities and other persons is necessary for the operation of a biogas plant. Therefore, access to local decision makers and some lobbying might be necessary, which can hardly be sone without a local partner.
- Plant operators have to be trained, not only regarding technical aspects of the biogas plant but also the selection of usable substrates. The composition and quality of substrates may change during the operation period and, if the plant operator is not experienced or if the operator is not properly trained, biogas production may decrease.
- Technology must be adapted to new market as for example different voltages, and partly also different net frequencies have to be considered. The grid connection must be clarified with the electricity supplier before

the application for FIT is submitted to METI. It should also be noted that in Japan there are still some regions such as Hokkaido and Kyushu with capacity bottlenecks in the power grid. Here possible additional costs are incurred if the network operator decides in a specific individual case that the network must be expanded.

- components such as digestion tanks must fulfil safety regulations for earthquakes. This means that, compared to European standards, it must first be clarified whether special reinforcements especially for digestion tanks or materials (such as stainless steel which is for example more flexible than concrete) should be considered.

Despite these challenges, the Japanese government remains committed to expanding the use of biomass energy, and numerous projects are already underway to help overcome these challenges and bring biomass energy to the forefront of the country's renewable energy efforts.

Japan is a world leader in the use of biomass energy, and its projects set the standard for innovation and sustainability.

With continued investment and commitment, biomass energy will play an important role in Japan's future energy landscape.

c. Recommendations

When European manufacturers of biomass technologies enter the Japanese market, it is essential that they tailor their approach to the specific needs and requirements of the Japanese market. To be successful in the Japanese market, European companies should pay close attention to the following factors:

- **Collaboration** is a key element of Japan's biomass industry. Companies actively collaborate with government agencies, research institutions, and other stakeholders to share knowledge, expertise, and best practices. These collaborative efforts promote continuous improvement, technological innovation, and the development of efficient processes. The collective expertise of various stakeholders helps Japanese companies stay at the forefront of industry advancements. The collaboration pattern is various. Some are cooperating with universities and companies, or governments and associations.
- **Time and human resources** are required: Entering the Japanese market requires significant financial, time and human resource investments. A thoughtful long-term approach is necessary to achieve success and make a positive impact in this demanding market.
- Utilize **supporting organizations** such as embassies, chambers of commerce, JETRO and the EU Japan Centre for Industrial Cooperation to access valuable market information and market entry assistance.
- Customers are expecting **high quality and an intensive after-sales-service**, which should best be carried out by a specialized Japanese service company. Existing customers need to be visited regularly, not only for business purposes but also to be visible and to maintain the relationship. It is important to continue to be seen as demonstrating a serious willingness to operate in the Japanese market and to deepen the relationship with Japanese partners. Ensure that both **products and associated services, such as sales, after-sales support and maintenance, are of an exceptionally high standard**, as the Japanese market demands top quality.
- **Select reliable partners**: Carefully select reliable partners to work with, as they can have a significant impact on the success of market entry.
- Build strong **customer relationships**: Focus on building and maintaining excellent customer relationships. Regular visits, including courtesy visits, are essential to build trust and visibility.

- Build **local networks**: Work on building local networks and personal relationships as these play a vital role in business development and success.
- Attending important **trade fairs**: Participating in prominent trade shows is essential for gaining exposure and networking.
- **Detail and image**: Japanese consumers value attention to detail, so invest in areas such as professional interpretation services to ensure clear communication and a positive image.
- **Highlight EU origin**: Capitalize on the excellent reputation of European environmental technologies and proudly display EU origin, especially for companies from Germany, the Netherlands, and the Nordic countries.
- **Interpreters:** Never skimp on a highly qualified interpreter, as this person represents the company and needs to understand and convey more than just words.

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