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RENEWABLE ENERGY INSTITUTE

Position Paper

Sustainability of Wood Bioenergy

Implementation of System for Ensuring GHG Reduction

September 2020

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Disclaimer

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Renewable Energy Institute

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Introduction

The FiT scheme introduced in 2012 has driven bioenergy growth in Japan in recent years. As a result, fuel consumption has increased sharply, and ensuring sustainability has become a pressing issue.

In Japan, in the FiT scheme and in the broader electricity business in general, there were originally no regulations forcing electricity producers to verify sustainability of fuel. As a result, in April 2019, Ministry of Economy, Trade and Industry, the Agency for Natural Resources and Energy ("METI/ANRE") created the Biomass Sustainability Working Group ("Sustainability WG"), and it has discussed the establishment of sustainability standards and a certification system that could be used to verify compliance with the standards.

The scope of the Sustainability WG, however, was limited to agricultural biomass and did not include woody biomass, so in terms of actual implementation of sustainability initiatives, the situation remains ambiguous. In addition, beginning in fiscal 2020, evaluation methods of greenhouse gas ("GHG") emissions reduction benefits of bioenergy are scheduled for deliberation, but these discussions need to be comprehensive and include wood bioenergy. Especially, the transition of energy system for decarbonization by 2050 is critical now and the necessary actions must be taken appropriately to maximize bioenergy contribution to reduce GHG emissions.

In this position paper, we first summarize the current state of wood bioenergy utilization and issues going forward, both globally and in Japan. We then clarify a basic approach to systemic mechanisms for ensuring sustainability that are generally premised on utilization under Japan's FiT scheme.

Next, we take a broad look at carbon flows involved in bioenergy use, and then, organize points of discussion on verifying GHG emissions reduction benefits and approaches to setting GHG emissions reduction targets with a long-term view. Finally, we give a summary statement on the importance of sustainable forest management, which constitutes the basis for ensuring the sustainability of wood bioenergy.

Systems for ensuring bioenergy sustainability have already been built in Europe, so we've also referenced information on systems in the EU, the UK and the Netherlands.

It is our hope that this paper will be read by a broad audience and be of assistance in the development of sustainable bioenergy throughout the world.

Chapter 1: Systems for Ensuring the Sustainability of Woody Bioenergy

I. Current state of wood bioenergy development and issues going forward

1. Global status

Bioenergy is the most utilized form of renewable energy. Bioenergy supplied worldwide in 2017 totaled 55.6 EJ, accounting for around 10% of the world's primary energy supply[1]. A particularly important form of bioenergy is wood bioenergy, which is estimated at 23 EJ, around half of the total[2]. However, this figure includes traditional biomass, which is not necessarily efficient and includes firewood and charcoal used in developing countries, so converting its use to more efficient manners is an important challenge.

In Western countries, and in Japan as well, modern bioenergy is utilized, and efficiency has been pursued while striving to ensure sustainability[3]. Specifically, development in these regions has centered on wastes and residues in accordance with the principle of cascading use. For example, in Sweden, almost 40% of total primary energy supply is bioenergy, primarily woody biomass, and nearly all of it comes from residual, byproducts and wastes from the forestry and wood industries[4].

In addition, modern bioenergy has been used in tandem with efforts to raise the efficiency of its transport and handling. The main example of this is the biomass pelletization. As recognition of its utilization increased, global production volume has steadily risen, reaching 55.0 million tons in 2018[5]. A good portion of this is pellets made from residual agricultural products in countries such as China, and production of wood pellets specifically was 37.0 million tons in 2018 (Figure 1-1). Pellets have high energy density, making them well suited to long distance transport, so trade volumes are also increasing.

On the other hand, with their increased use at large-scale power plants worldwide as an alternative to coal, there has been increasing doubt and criticism regarding their sustainability and GHG reduction benefits in particular[6]. As background, imports of wood pellets have been increasing in European countries that do not have extensive forest resources like the UK, the Netherlands, and Denmark. Pellet production has certainly been increasing recently, as described above, but 37.0 million tons of woody biomass pellets is equivalent to 0.66 EJ, which is just 1.1% of total bioenergy supply[7]. In addition, clear cutting of forest stand only for energy use is rare, and, actually, most harvesting and thinning is done for construction materials and for public functions to maintain water resource and biodiversity[8].

1 World Bioenergy Association (2019) Global Bioenergy Statistics

2 Lauri et al. (2017) Impact of the 2℃ target on global woody biomass use. Forest Policy and Economics. Vol. 83, pp.121-130

3 There is no international consensus on the definition of modern bioenergy, but there is agreement on the general trajectory. GBEP (2020) Global Bioenergy Partnership Sustainability Indicators for Bioenergy: Implementation Guide

4 IRENA (2019) Bioenergy from boreal forests; Swedish approach to sustainable wood use

5 Bioenergy Europe Statistical Report 2019

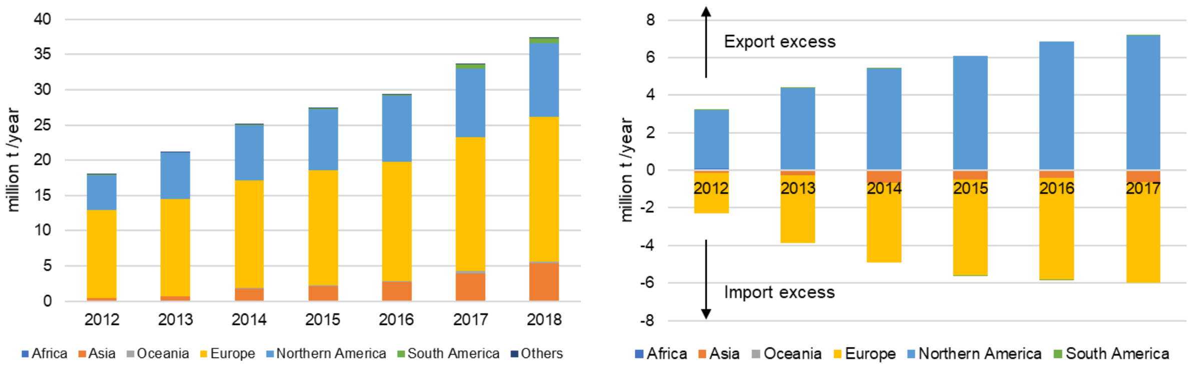
6 EASAC (2019), "Forest bioenergy, carbon capture and storage, and carbon dioxide removal: an update"; Mighty Earth (2019), "Sumitomo Corporation's dirty energy trade," etc.

7 Lower calorific value of pellets calculated at 18 GJ/ton.

8 IEA Bioenergy (2019) The use of forest biomass for climate change mitigation: response to statements of EASAC

To achieve a decarbonized society by 2050, overall use of modern bioenergy, including for applications other than power generation, such as heat and transport, is anticipated to increase to around 125 EJ[9]. Of this, wood bioenergy is estimated to have the potential for supply of 27 to 43 EJ by 2030[10]. This can be assumed to include increased pellet production and trade and other new usage formats. Accordingly, in order to effectively leverage the potential of wood bioenergy and contribute to global decarbonization, policy measures need to be taken to comprehensively ensure sustainability.

Figure 1-1 Global Pellet Production (left) and Net Trade Volume (right)



Source） Renewable Energy Institute based on FAO Stat

2. Status in Japan

(1) Majority of use in Japan from domestic waste sources

Wood bioenergy also plays an important role in Japan, accounting for almost 90% of total bioenergy supply. As with the rest of the world, almost all the fuel comes from wastes or residues, and domestic sources account for the majority of share.

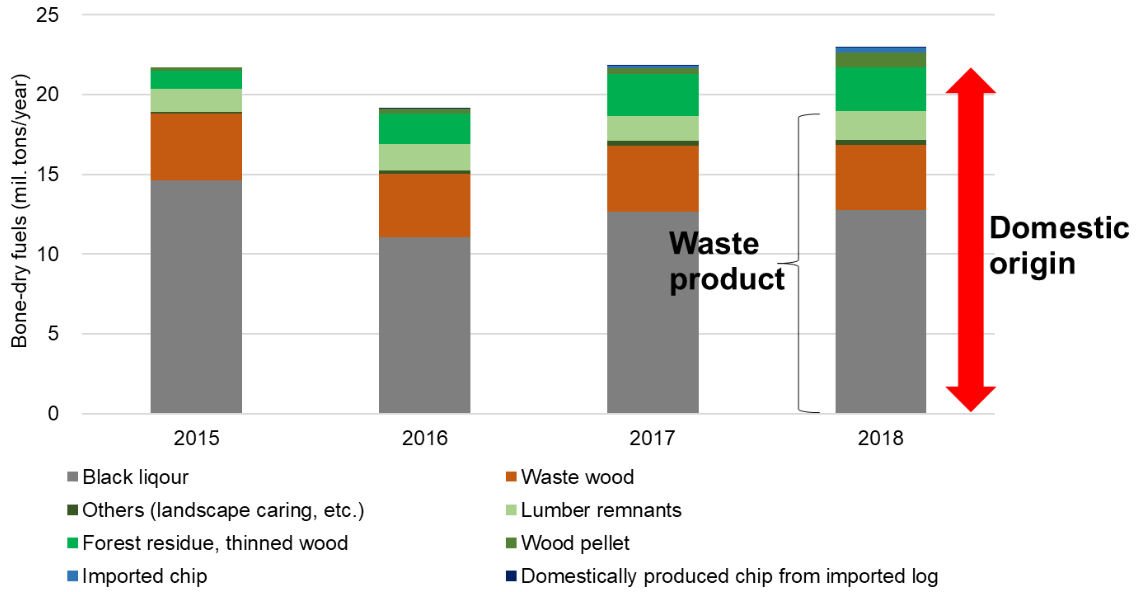
Figure 1-2 shows trends in woody biomass consumption from 2015. Black liquor is included because it is an important biomass consumed at pulp and paper mills, though it is not compiled as a part of Forestry Agency statistics.

Of the total, biomass from waste products (black liquor, construction waste, lumber remnants, landscape caring wood) accounted for 17.9 million tons, 78% of total fuel use. Additionally, when including forest residue and thinned wood, biomass from domestic sources amounts to around 21.0 million tons, which is 90% of the total. On the other hand, while imported biomass (woody pellets and imported chips) has increased, at present, it still only accounts for around 10% of the total.

9 IRENA (2019) Global Energy Transformation, The Remap Transition Pathway

10 IRENA (2014) Global Bioenergy Supply and Demand Projections, A Working Paper for Remap 2030

Figure 1-2 Woody Biomass Use in Japan



Note: Use of black liquor declined in 2016, but according to statistics compiled by the Japan Paper Association and other sources, there was no major change in paper and pulp production volume, so it can be surmised that the decline was due to changes in classificatory scheme used by the Comprehensive Energy Statistics.

Source: Renewable Energy Institute based on Forestry Agency, "Woody Bioenergy Usage Trend Survey," and METI/ANRE, "Comprehensive Energy Statistics"

(2) Increase in pellet imports and diversification of suppliers

At the same time, even in Japan, with high electricity purchase prices guaranteed by the FiT scheme, imports of wood pellets from overseas have been increasing. Although PKS (Palm Kernel Shell) imports had been leading the way until recently, wood pellet imports increased sharply, and in 2019, they were both around 1.60 million tons. Moreover, until 2017, they consisted almost entirely of pellets made in Canada, but since then, pellets from Vietnam have increased rapidly, and pellets from the US are expected to increase going forward (Figure 1-3Figure 1-3).

In British Columbia, which accounts for a majority of Canada's pellet exports to Japan, nearly 100% of forests have been certified, and nearly all the wood used to make the pellets was said to be from lumber remnants and dying or dead trees, so there were no major problems with sustainability[11].

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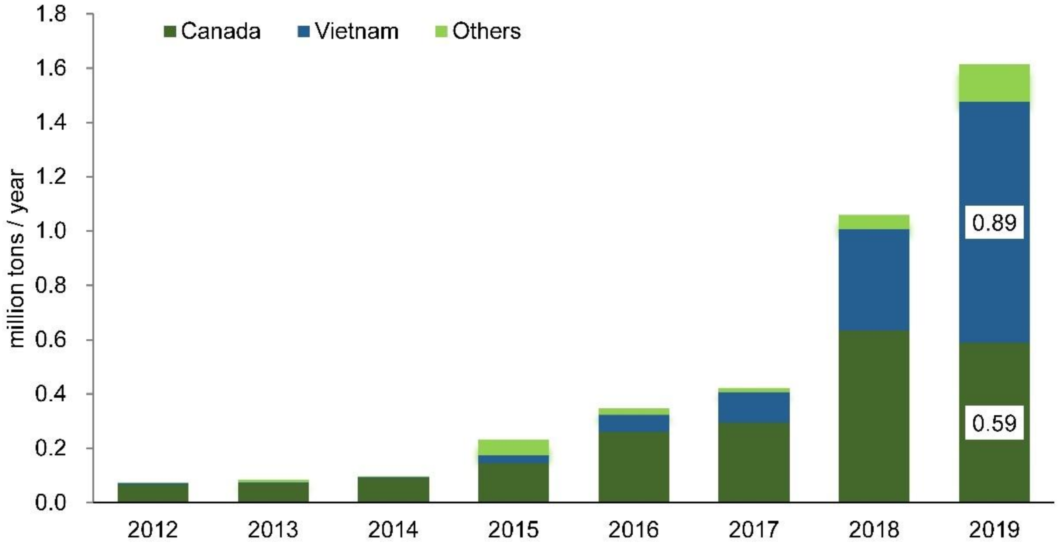
11 Wood Pellet Association of Canada (2013) British Columbia Wood Pellets, Sustainability fact Sheet

On the other hand, Vietnamese pellets with rapid increase of imports in recent years should be handled with caution. Vietnam has a world-class hub of wood processing companies for products like furniture. For this reason, wood products of various kinds are brought to the country from around the world to be used as raw materials, and it has been pointed out that this includes some wood harvested illegally[12]. When Vietnam was already producing and exporting wood pellets, there were reports in South Korea, its main export destination, of FSC certification being misrepresented[13].

Figure 1-3 Japanese Imports of Wood Pellets



Source) Renewable Energy Institute based on Trade Statistics

In addition, major growth is expected going forward in pellets produced in the US[14]. In general, a relatively low percentage of US forests are certified, and the percentage is particularly low in the southern part of the country, where many pellet factories are located; the figure was just 17% as of 2010[15]. The region is also known as a biodiversity hotspot, where environmentally conscious practices are suggested[16].

In line with the diversification of the production regions, new challenges are emerging in ensuring sustainability and FiT as well as its relevant systems need to be re-examined.

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12 ScoutAsia Research. "Vietnam Under Pressure to Clear Out Illegal Wood." Financial Times. Jun. 25, 2019.

13 International Trade Administration (2016) 2016 Top Markets Report Renewable Fuels. Sector Snapshot. USA Department of Commerce.

14 USDA Foreign Agricultural Service (2019) Biofuels Annual, Japan

15 Southern Regional Extension Forestry (2010) An Introduction to Forest Certification in the South

16 Critical Ecosystem Partnership Fund. "North American Coastal Plain". https://www.cepf.net/our-work/biodiversity-hotspots/north-american-coastalplain

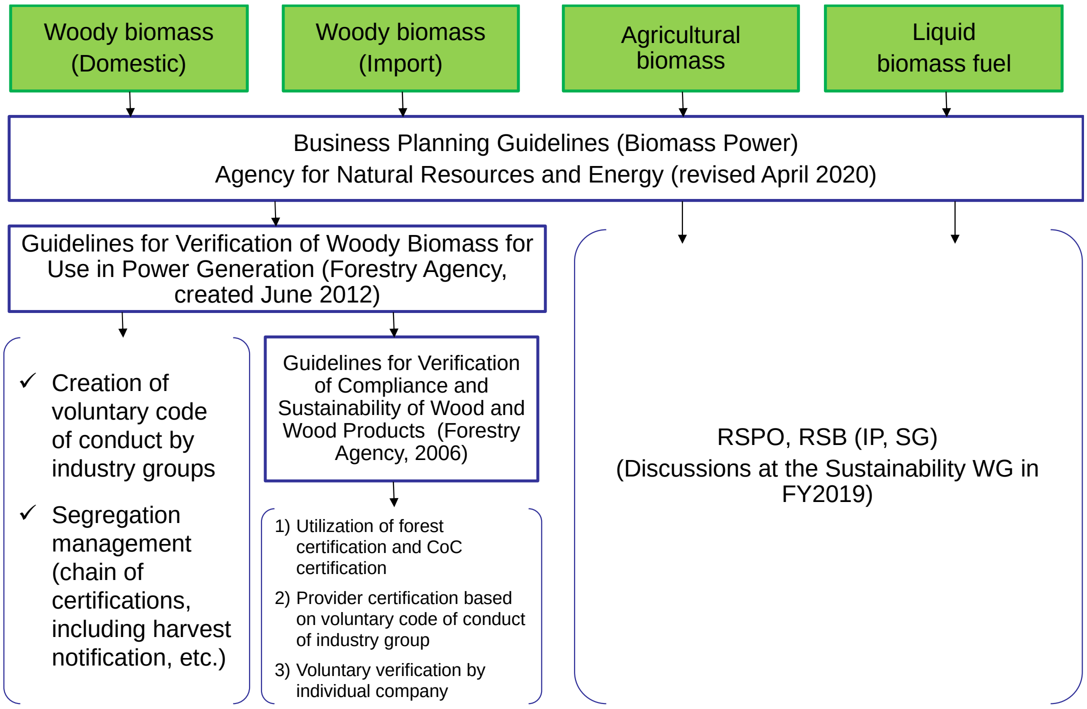
II. Systems for Ensuring Sustainability

1. Current state of ensuring wood bioenergy sustainability and related problems

(1) Different mechanisms for ensuring sustainability for each fuel

First of all, we summarize the current state of framework for ensuring the sustainability of wood bioenergy under Japan's FiT scheme. With regard to fuel procurement, all biomass electricity producers must refer to the Business Planning Guidelines (Biomass Power), which is updated every year by METI/ANRE. However, to find out the details, it is necessary to refer to different standards and guidelines for each type of fuel (Figure 1-4).

Figure 1-4 Framework for Verifying Sustainability of FiT-Certified Bioenergy (as of April 2020)



Source) Renewable Energy Institute

The Sustainability WG, established in 2019, has held discussions only on agricultural biomass and liquid biomass fuel. As a result, sustainability standards required under Japan's FiT scheme have been organized from perspectives that cover the environment, society and labor, and governance (Figure 1-5). As of the end of fiscal 2019, verifying sustainability using two third-party certification schemes, the Roundtable on Sustainable Palm Oil (RSPO) and the Roundtable on Sustainable Biomaterials (RSB), was accepted but other schemes that had been considered were judged as non-conforming at present and in need of improvements.

Figure 1-5 Sustainability Standards Required under Japan's FiT Scheme

Area	Assurance scope
Environment	Consideration of land use changes
	GHG emission reductions
	Biodiversity protection
Society and labor	Appropriate titles related to agricultural and other land: Land use rights secured by biomass producer
	No child labor or forced labor
	Occupational health and safety
	Right of workers to organize and enter into collective bargaining
Governance	Legal compliance (overseas)
	Information disclosure
	Certification renewal/cancellation
Supply chain assurances	
Assurance of independence of certification	

Source) Biomass Sustainability Working Group, Interim Summary (November 2019)

(2) Problems with Goho compliance guidelines from FiT standpoint

Woody biomass overall accords with the Guidelines for Verification of Woody Biomass for Use in Power Generation, which were formulated by the Forestry Agency in 2012 to accommodate the FiT scheme[17]. Further, regarding imported woody biomass, segregation management and certificate provision are required based on the Guidelines for Verification of Compliance and Sustainability of Wood and Wood Products ("Goho Compliance Guidelines[18]"), which was issued by the Forestry Agency in February 2006. However, the Goho Compliance Guidelines were created in 2006 for verifying public procurement based on the Green Procurement Act, so they include some outdated information and do not take into account use for power generation with FiT subsidies. For this reason, compared to agricultural biomass, which has been the subject of structured discussions by the Sustainability WG, there are some vague and inadequate areas like those described below.

First, for public procurement, only legality is stipulated as a requirement; sustainability is just recommended to be considered in procurement[19]. As sustainability is generally thought to be a broader concept of legality, the Sustainability WG has created broad-ranging standards for the environment, society and labor, governance and other areas (Figure 1-5). Accordingly, more discussion is needed on whether the Goho Compliance Guidelines are adequate for ensuring the sustainability of woody biomass under the FiT scheme.

17 On the problem of unused wood, refer to Renewable Energy Institute (2019), "Recommendations for Reform of the FiT Scheme for Regional Woody Bioenergy Power Generation."

18 "Goho" means legality in Japanese.

19 Guidelines for Verification of Compliance and Sustainability of Wood and Wood Products Q&A Question 11-2

Secondly, the Goho Compliance Guidelines recognize three verification methods; 1) use of forest management and chain of custody (CoC) certifications, 2) provider certification based on voluntary action guidelines from an industry group, and 3) voluntary certification by individual companies (Figure 1-4). These are all forms of so-called self-certification, and, therefore, inconsistent with how agricultural biomass is handled under the FiT scheme, which is based on third-party certification.

Thirdly, the certification schemes given as examples in the Goho Compliance Guidelines need to be reviewed for whether they can actually be utilized for verifying sustainability under the FiT scheme. Regarding the certification systems that can be utilized, the Goho Compliance Guidelines state that when standards of the scheme have been established for "compliance with forest-related laws and regulations" and for "systemic frameworks for sustainable forest management," and the certificate issuers have been judged as capable of providing a reasonable explanation, the scheme can be treated as having satisfied legal compliance and sustainability requirements. Which is to say, whether or not a scheme can be utilized depends on an assessment of the scheme users[20]. By contrast, the mechanism for agricultural biomass under FiT involves the Sustainability WG deliberating on acceptable certification schemes and independent experts performing assessments.

Based on the above three points, verification methods for woody biomass sustainability should be discussed by the Sustainability WG organized by METI/ANRE. Or, alternatively, the Forestry Agency should lead discussions with external experts to make amendments of its two guidelines to adequate levels of sustainability required by the FiT scheme.

(3) Clean Wood Act not being utilized

Actually, Japan already has a law that requires electricity providers to verify wood product sources. It is the Act on Promoting the Distribution and Use of Legally Harvested Wood and Wood Products, known commonly as the Clean Wood Act, which went into force in May 2017.

The law requires due diligence[21] by business entities that first bring wood into Japan (type 1 wood-related business entities). Biomass electricity producers are positioned as type 2 wood-related business entities, and they are required to manage risk by checking the compliance verification records of type 1 wood-related business entities. Business entity registration under the Clean Wood Act is voluntary, but the FiT Act mandates compliance with domestic laws, so one might assume that all business entities involved in FiT-certified business entities conduct registration as a matter of course. However, at present, among wood bioenergy electricity producers, very few have done this (Figure 1-6).

Accordingly, for all bioenergy electricity producers, registration as a type 2 wood-related business entity under the Clean Wood Act needs to be made truly mandatory as a part of implementation of FiT. Moreover, promoting audits by the registration body and disclosing the results would be effective in enhancing initiatives in ensuring sustainability.

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20 Guidelines for Verification of Compliance and Sustainability of Wood and Wood Products Q&A Question 21-1, Question 21-2

21 Due of care and efforts required of companies, etc. and carried out as a matter of course

Figure 1-6 Number of Biomass Electricity Producers Registering Under the Clean Wood Act

Registration body	Registered biomass electricity producers
Japan Plywood Inspection Corporation	1 company
Japan Gas Appliances Inspection Association	5 companies
Japan Forest Technology Association	None
Japan Testing Center for Construction Materials	None
Hokkaido Lumber Inspection Corporation	None

Note: Japan Housing and Wood Technology Center, another registration body, does not register woody biomass electricity producers.

Source) Renewable Energy Institute based on information published on registration body websites (accessed June 10, 2020)

2. Direction of sustainability verification for wood bioenergy

(1) Clarification of responsibilities of electricity producers

The following offers a general direction for wood bioenergy sustainability verification based on analyzing current conditions. What is first necessary is for electricity producers to accurately understand the limits of certification schemes and recognize their responsibility on ultimate risk management and handling under the FiT scheme accordingly.

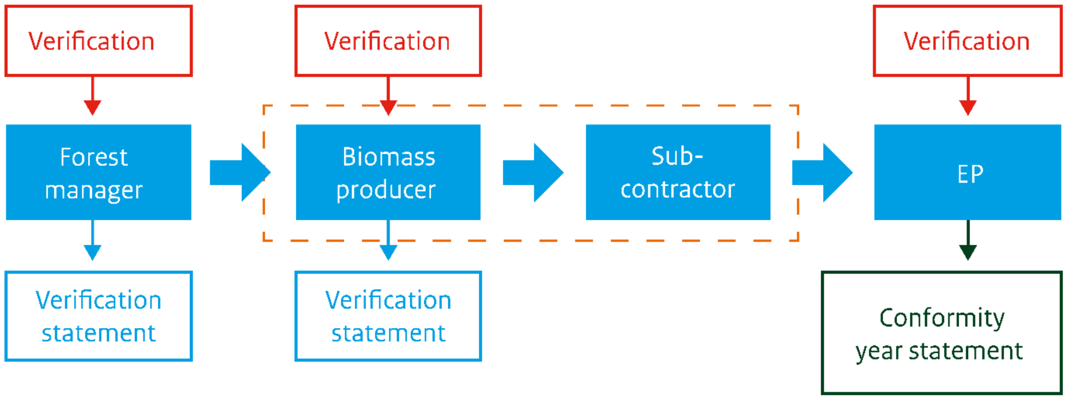
It is obvious considering that their business is conducted at sales prices equivalent to market prices plus a surplus approved by the FiT. In the UK and the Netherlands, which have similar subsidy programs, electricity producers are made to submit detailed reports that have been audited by a third party. For example, in the Netherlands, forest management companies and biomass producers (including subcontractors) must register the biomass category, country of origin, GHG emissions, certification schemes used and other information for each fuel consignment and have this information audited (Figure 1-7). Energy producers (EP) compile the audit results and submit them as the Conformity Year Statement. This statement includes annual average GHG reduction rates and proof of the fact that a third party has conducted certification or verification of all fuel consignments (a certification scheme can also be used).

By contrast, the annual reports that must be submitted under Japan's FiT system include only general information such as, the fuel name, annual usage volume, collection/harvest region, purchase unit price, and there is no information on confirmation of the fuel's sustainability[22]. In addition, as mentioned later, under the current FiT scheme, electricity producers do not have to be included in the chain of certification (they do not have to acquire chain of custody (CoC) or supply chain (SC) certification[23]), so confirmation of the sustainability of fuels used by electricity producers is potentially inadequate.

22 https://www.enecho.meti.go.jp/category/saving_and_new/saiene/kaitori/dl/fit_2017/report/report_bio.xlsx

23 RSPO uses the term "supply chain (SC)" certification, and FSC uses "chain of custody (CoC)" certification.

Figure 1-7 Relationship Between Electricity producers and Supply Chain Companies (Netherlands SDE+)



Note: In the case of woody biomass from forest products (categories 1 & 2), EP means Energy Producers

Source: Netherland Enterprise Agency (2020) Verification Protocol for Sustainable Solid Biomass for Energy Applications

(2) Accurate understanding of existing forest certification systems

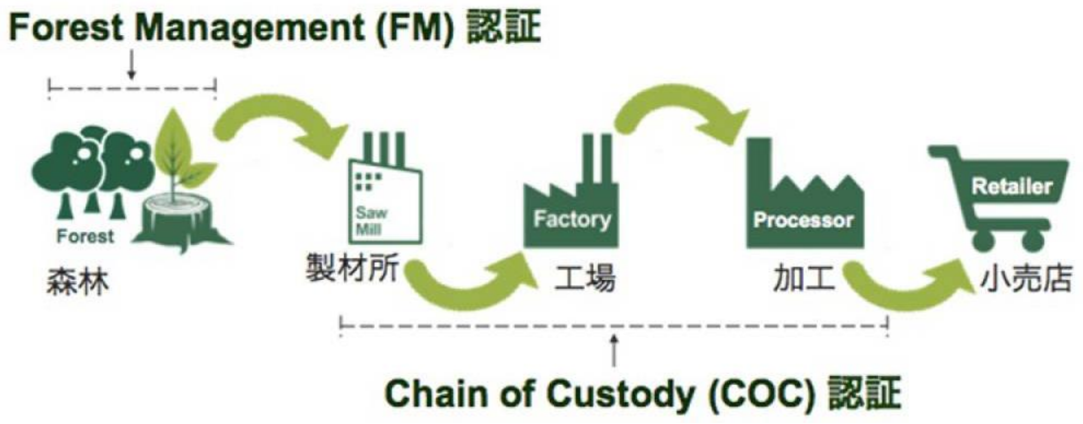
To show that the sustainability requirements of the FiT are verified, as utilized for agricultural biomass, third-party certification programs like FSC that are recognized its effectiveness around the world could be applied for woody biomass to improve efficiency of policy implementation.

However, existing forest certification schemes like FSC are premised on material use, so unless their characteristics and limits in this regard are understood, they cannot be appropriately used as a tool for FiT sustainability verification in the purpose of energy use; and, certification schemes developed by non-state actors like the FSC should not be used opportunistically without taking full account of their characteristics. In actuality, FSC's system is utilized without a full understanding of it, and some have noted the potential risk for inappropriate transactions to be established[24]. In the following, using FSC as an example, we summarize potential problems with using existing forest certification as a means of verifying bioenergy sustainability.

First of all, forest certification schemes include forest management (FM) certification, which verifies the level of forest management, and chain of custody (CoC) certification, which verifies that FSC-certified raw materials are being appropriately managed along the entire supply chain (Figure 1-8). When CoC certification is acquired, the fact that the product is FSC certified may be displayed on documents and attached as a label when the product is sold.

[24] FSC Japan press release, "Precautions when Using FSC Forest Certification for the Biomass Feed-in-Tariff System (June 9, 2020)" https://jp.fsc.org/jp-jp/news/id/677

Figure 1-8 Forest Management and Chain of Custody Certification of FSC



Note: Flow of feedstocks without FM certification, such as controlled wood, is not shown in this chart

Source) FSC Japan

It should be noted, however, that CoC certificate holders are still allowed to handle non-certified materials. For this reason, the fact that the supplier holds CoC certificatation is not adequate proof of sustainability; it is absolutely necessary for the purchaser to make appropriate confirmation[25]. The certification holder appropriately labels the product in accordance with FSC rules and the purchaser confirms this, and through this process, the chain of custody is assured. This is the intent of CoC certification.

However, under the current FiT scheme, electricity producers are not required to obtain CoC certification. So the chain is broken just before reaching at the electricity producer.

Even with the CoC certified fuel trader, sales of non-certified materials are not prohibited and electricity producers without certification are outside the scope of audits. Therefore, through FSC auditing mechanisms, it is impossible to verify the status of certification of purchased materials and fuels. The government, as administrator of the FiT scheme, is responsible for verifying; however, the scheme was developed with risks. The fact is that the mandated annual report requires no information on fuel sustainability, as mentioned before, and relies on good faith on the electricity producers.

[25] Guidelines for Verification of Compliance and Sustainability of Wood and Wood Products Q&A Question 21-7, “The supplier’s acquisition of CoC certification is conditioned on the material being forest-certified, but this alone is not adequate. The purchaser must check the information on the shipping invoice for each shipment, or check the labels displayed on the product.”

■ Controlled Wood

It is important to understand controlled wood of FSC. In fact, 100% FSC wood (FM wood) only accounts for a portion of the certified wood products. The majority is FSC mix products that can include controlled wood recognized by FSC and/or recycled materials.

Controlled wood is not wood produced from certified forests, so strictly speaking, it is not certified wood. However, controlled wood is recognized for use as a raw material in mix products only when it is confirmed to not fall under any of the following five categories that are unacceptable sources for FSC[26].

1. Illegally harvested wood
2. Wood harvested in violation of traditional and human rights
3. Wood from forests in which high conservation values are threatened by management activities
4. Wood from forests being converted to plantations and non-forest use
5. Wood from forests in which genetically modified trees are planted

It should be noted that because of the existence of the controlled wood system, it is not possible to calculate the quantity of wood products produced from an FM forest based on its area alone.

(3) Utilization of bioenergy specific certification schemes

As discussed thus far, there are many points that need to be considered when using existing forest certifications like FSC for verifying the sustainability of wood bioenergy, so in countries like the UK and the Netherlands, energy producers are included in this chain and required to conduct appropriate verification and report to the government.

Moreover, bioenergy certification schemes have been developed so that these processes are conducted in a consistent, unified manner. Key examples are the Sustainable Biomass Program (SBP) and Green Gold Label (GGL) (Figure 1-9). These schemes do not force a choice between them and existing forest certification like FSC; rather, they are designed to compensate for the shortcomings of existing certification schemes for bioenergy verification, and so can be used in combination.

With the UK's sustainability standards, it was assumed that the two forest certification schemes recognized under its Timber Procurement Policy, FSC and PEFC[27], would primarily be utilized. However, FSC and PEFC do not have standards for GHG reductions, and because of the existence of the controlled wood and the inability to identify raw materials, they do not meet some standards of the UK. SBP, on the other hand, has been rated as meeting all requirements[28], and its share of the European market, including the UK, is currently over 60%[29].

26 FSC (2019) Strategy for FSC Mix products and controlled wood
27 Programme for the Endorsement of Forest Certification
28 Ofgem (2018) Renewables Obligation: Sustainability Criteria
29 Sustainable Biomass Program (2020) Activity and Operational Update

When considering this in the context of Japan based on the above example of the UK and other countries, utilizing a bioenergy certification system would provide the following advantages.

- All business entities on the supply chain (fuel producers, traders, electricity producers) would have to acquire the necessary certification
- The sources of all raw materials would have to be verified, which would make it possible to eliminate unverified materials and fuel mixtures
- Attribute information such as the fuel type, area of origin, and GHG reductions are retained in the data for each fuel transaction, so this information could be utilized for government verification and raising the trust of consumers

In Japan's FiT scheme, existing forest certifications like FSC have been cited, but given their limitations, promoting acquisition of a certification like SBP or GGL developed for bioenergy would be effective in raising reliability and transparency[30].

Figure 1-9 Bioenergy Certification System Logos (SBP, GGL)

Sources) SBP and GGL

[30] erex Co., Ltd., a biomass electricity provider, has acquired GGL certification, although their main fuel is PKS not woody biomass, the first electricity provider in Japan to have done so. https://www.erex.co.jp/en/news/pressrelease/139/

Chapter 2: Promoting Use of Bioenergy as a Climate Change Measure

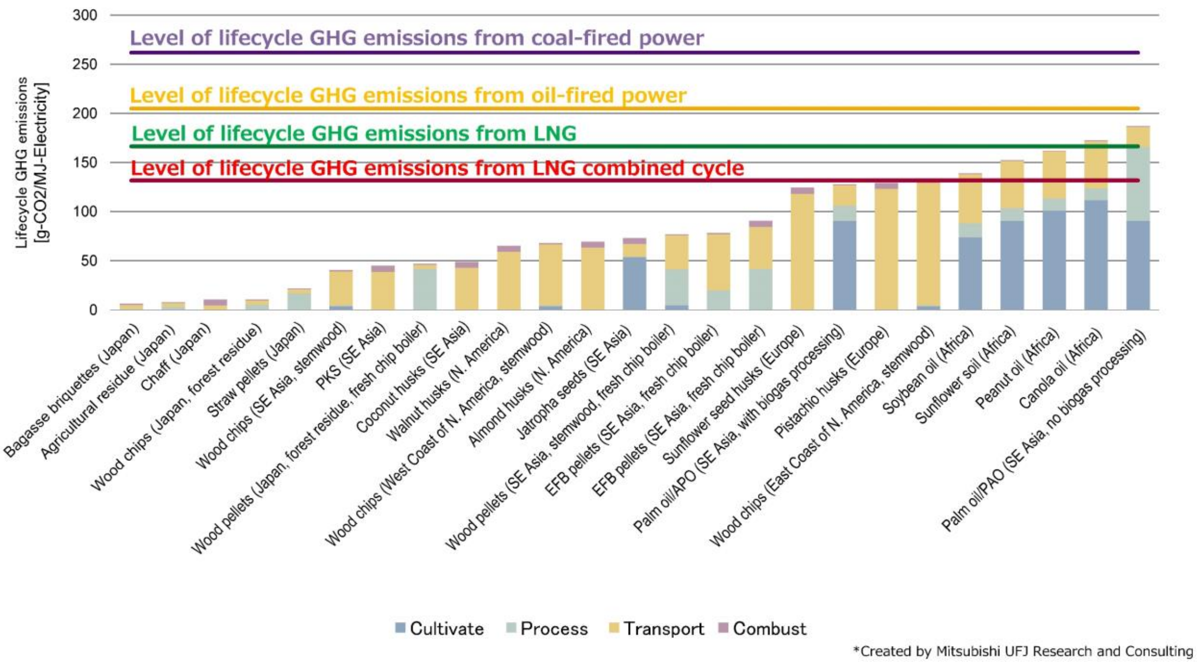
I. Framework for tracking GHG reductions through bioenergy use

1. Commencing verification of GHG reduction benefits under the FiT scheme

One of the most important benefits of bioenergy and other renewable energy sources is their contribution to addressing climate change by reducing GHG emissions from fossil fuels. In the case of bioenergy, another key point is to combine bioenergy with carbon storage and sequestration of ecosystems for meeting long-term emission target[31].

This is why verification of GHG emissions reduction benefits is included in the EU RED (Renewable Energy Directive) and is among the sustainability items for liquid biofuels in Japan. By contrast, Japan's FiT scheme has thus far not recognized GHG reduction benefits. This problem was first taken up by the Sustainability WG in April 2019, and the draft results of calculations of lifecycle GHG emissions were released[32] (Figure 2-1).

Figure 2-1 Lifecycle GHG Emissions Estimates for Bioenergy Fuels



Source) Agency for Natural Resources and Energy, "Environmental Impacts (Primarily Impacts on Global Environment)" (April 2019)

31 IPCC Fifth Assessment Report (2013)

32 Agency for Natural Resources and Energy (2019), "Environmental Impacts (Primarily Impacts on Global Environment)," Biomass Sustainability Working Group (1st session), Document 2

As a result, the estimates made clear that for all fuels GHG emissions were lower than coal- or oil-fired power, but GHG emissions from some fuels were higher compared to LNG. In light of these results, the problem is on the agenda for continued discussion by the Sustainability WG in fiscal 2020, and it will be important to establish appropriate evaluation methods, including for fuels like wood bioenergy already recognized under FiT, and to recommend forms of use with high GHG reduction benefits.

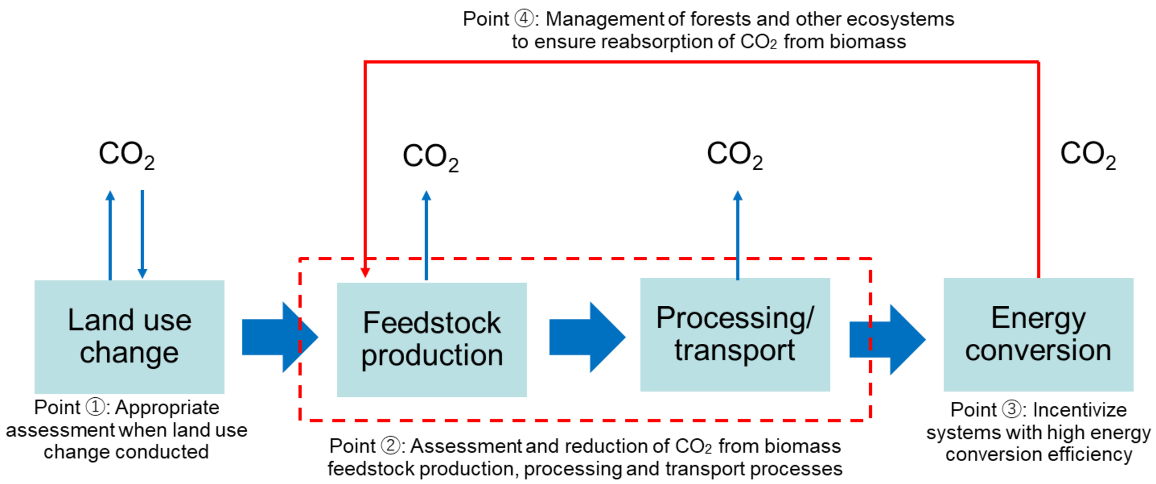
2. Overall flow of GHG for assessment

Lifecycle assessments (LCA) are used to evaluate GHG emissions reduction benefits for bioenergy. LCA evaluate the product's lifecycle, from production and use to disposal, clarify corresponding resource consumption and discharge volumes, and assess the impact on the environment.

LCA is used in part of the EU's RED sustainability standards, so the methodology is already developed[33]. In Japan as well, it is used as standards for liquid biofuels, so guidelines have been established by METI/ANRE[34] and Ministry of the Environment[35].

Based on these earlier studies, Figure 2-2 summarizes carbon flows in bioenergy use as well as points of discussion in Japan.

Figure 2-2 Overall Carbon Flows in Bioenergy Use



Source) Renewable Energy Institute

First, when the fuel used is a primary product and not a byproduct or waste product, negative impacts need to be eliminated by appropriately considering any land use change, for deforestation for example, so this must be included within the scope of the LCA (Point 1). Also, the environmental impacts of the supply chain, from feedstock production to processing and transport, need to be assessed and linked to reductions (Point 2). Moreover, these environmental impacts are ultimately calculated per unit of

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33 JRC-IES (2010) General Guide for Life Cycle Assessment - Detailed Guidance

34 Agency for Natural Resources and Energy (2018), "Decision Standards for Oil Refiners Related to Use of Non-Fossil Fuels for Five Years Beginning Fiscal 2018"

35 Ministry of the Environment (2009), "LCA Guidelines on Greenhouse Gas Reduction Benefits of Biofuels Ver. 1.0"

electricity or heat produced (e.g., per kWh or GJ), so energy conversion efficiency is also important (Point 3).

Carbon dioxide from biomass emitted during energy conversion, such as by combustion, is reabsorbed by forests and other ecosystems where the next generation of feedstock is produced. For this reason, the EU's RED and Japan's guidelines put emissions at zero (carbon neutral)[36]. For this assumption to continue to hold true, forests and other ecosystems must be maintained and managed over the long term, which is something that requires sufficient consideration (Point 4).

This paper goes through the first to third discussion points, which are handled within the normal LCA process, and then lays out a basic approach to the fourth point, which is extremely important for ensuring GHG reduction benefits from bioenergy use.

II. Development of systems for managing GHG reduction benefits

1. Points related to LCA-based management for GHG reduction

(1) Appropriate assessment of land use changes (Point 1)

The first key point is to ensure that use of bioenergy does not deplete the carbon storage capacity of forests and other ecosystems. For example, when bioenergy use directly involves land use conversion such as deforestation (development of a forest with high carbon storage capacity, in particular), a large amount of carbon is emitted, and this needs to be appropriately assessed. In extreme cases, the amount of GHG emitted could be at least 100 times greater than the GHG reduction benefits from replacing fossil fuel use[37].

This point is taken into account in sustainability standards as well; the EU's RED II states that "harvesting maintains or improves the long-term production capacity of the forest" (Article 29, 6(a)), and in the Netherlands, Principle 3 states that "production of raw biomass does not result in the destruction of carbon sinks".

Reduced carbon storage due to land use change therefore has a major impact on carbon reduction benefits from bioenergy use, so it is typical to include this in the LCA method as well[38]. In the EU, default values cannot be used and must be calculated independently when there are land use changes. Guidelines for calculations were compiled in 2010 immediately after RED was formulated in 2009. It calls for GHG emissions to be calculated based on representative values arranged by climatic zone and ecosystem and allocated over 20 years[39].

Based on the EU's methodology and considering geographic conditions in Japan, we have calculated estimated GHG emissions when a tropical rainforest in Southeast Asia is redeveloped to create a

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36 While CO_2 emissions are nil, emissions of non-CO_2 greenhouse gases (CH_4 & N_2O) need to be reported due to their significantly higher global warming potential.

37 IEA Bioenergy (2011) Using a Life Cycle Assessment Approach to Estimate the Net Greenhouse Gas Emissions of Bioenergy

38 JRC-IES (2010) ibid

39 Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC

plantation of fast-growing trees (eucalyptus and poplar) and the trees are all harvested within 20 years to produce wood chips; the findings are summarized below (Figure 2-3). The EU guidelines require that changes in the soil's carbon storage capacity be calculated as well, but this is not included in our estimates.

Natural tropical rainforests boast high carbon and biomass storage capacity, but when converted to a plantation of fast-growing trees, that storage is reduced by around 16-20%. When this change in carbon storage is allocated over 20 years and divided by wood chip energy produced each year, around 124-210 g CO_2-eq are emitted to produce 1 MJ of energy. The emissions factor for coal has been reported at 98.94g CO_2-eq, covering from production to combustion[40], which means carbon dioxide emissions are higher than this.

Figure 2-3 CO_2 Emissions of Wood Chips Produced by Conversion of Tropic Rainforest to Fast-Growing Poplar Plantation

Ecosystem/climatic zone	Carbon storage capacity (t CO_2-eq/ha)		Change in carbon storage capacity (tCO_2-eq/ha/yr)	CO_2 emissions per fuel calorie (gCO_2-eq/MJ)	
	Before conversion	After conversion		Eucalyptus	Poplar
Tropical rainforest, Asia (continent)	678.3	139.3	27.0	124.6	161.2
Tropical rainforest, Asia (islands)	843.3	139.3	35.2	162.8	210.5

Note: Carbon storage capacity uses EU guidelines (Commission Decision of 10 June 2010), and eucalyptus and poplar harvest per unit of area uses BioGrace II default figures, which are, respectively, 216,245 MJ/ha/yr and 167,200 MJ/ha/yr.

Source) Renewable Energy Institute

In Japan as well, for liquid biofuel (bioethanol), land use change effect is already included in LCA calculations based on the METI/ANRE's sustainability standards and also mentioned in the Ministry of the Environment's guidelines. These put the baseline date at April 1, 2012 and require changes in carbon storage from land use changes to be allocated over a 20-year project period. As the case of palm oil, the Sustainability WG reported GHG emissions increase of five folds with tropical forest conversion and 139 folds if the forest soil is peat[41].

Regarding indirect land use change (iLUC), quantitative evaluation of impact is exceedingly difficult, so this is generally not included in standard LCA[42]. In Japan as well, it is necessary to first clarify the risks.

40 Youn and Yamada (1999), "Lifecycle Inventory Analysis related to Fossil Fuel Energy in Japan," Energy Economics Vol. 25 (8), pp. 22-48

41 Agency for Natural Resources and Energy (2019), ibid.

42 IEA Bioenergy (2011) ibid

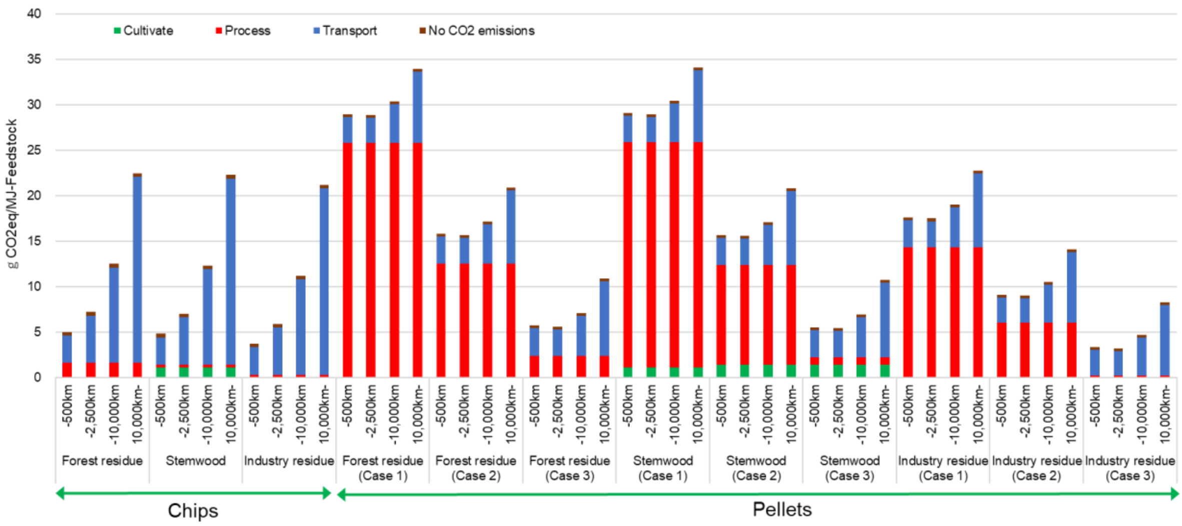
(2) Supply chain GHG assessment and reduction (Point 2)

Energy is used in biomass supply chain, from feedstock production to processing and transport. Additionally, waste products and wastewater are given off, so these environmental impacts need to be appropriately assessed. However, these environmental impacts differ greatly depending on pathway assumptions for the biomass fuel, including production region, production method, transport distance and its efficiency.

Because of such factors, in the EU, 16 routes for solid biomass were comprehensively surveyed, and two workshops were held with stakeholders, and this helped in setting default values in the revised RED (hereinafter, "RED II")[43].

Based on the EU's calculations shown in Figure 2-4, it is possible to see specifically which aspects impact GHG amounts emitted through the supply chain for bioenergy use and also consider which biomass fuels should be selected.

Figure 2-4 GHG Emissions from Representative Channels for Wood Bioenergy Use



Note: Emissions from land use changes are not taken into account (set at zero).

Source) Renewable Energy Institute based on JRC (2017)

1) Cultivation

Forest residue other than stemwood, and industry residue, are treated as byproducts, and emissions from the cultivation process are not considered. For this reason, even though emissions from the cultivation of stemwood are not large enough, there is still an incentive to use forest and industry residue.

43 Joint Research Center (2015) Solid and gaseous bioenergy pathways: input values and GHG emissions and Joint Research Center (2017) Solid and gaseous bioenergy pathways: input values and GHG emissions, ver.2

2) Processing

Generally, in the processing of pellets, it involves finer pulverization than wood chips, drying and forming processes, which requires a greater consumption of energy. In the EU, with regard to pellet production, three types of heat sources have been indicated for the drying process, natural gas boilers (Case 1), wood chip boilers (Case 2), and CHP systems using woody bioenergy[44] (Case 3). GHG emissions in Case 1 are particularly high, around two times that of Case 2. Emissions are lowest in Case 3 with waste heat utilization. This shows the importance of promoting energy efficient systems and the use of renewable energy.

3) Transport

In EU calculations, classification is done by procurement source for each fuel type and expected origin of products are represented by the transport distances. Specifically, the range for Europe is 1-500 kilometers, for Russia, it is 500-2,500 kilometers, for Brazil, 2,500-10,000 kilometers, and western Canada, over 10,000 kilometers. While the graph is difficult to decipher, this is why there are cases in which transport of 1-500 kilometers (production in Europe) has worse transport efficiency than transport of 500-2,500 kilometers (transport from Russia).

The impact of the transport process on GHG emissions differs with the fuel format. The rate of increase in GHG emissions for wood chips, which have low energy density, becomes larger as the transport distance increases. By contrast, with pellets, even with a longer transport distance, there is not much increase in GHG emissions from the transport process. It can be seen that GHG emissions from transport spanning continents, like in the case of Brazil and Canada, are not as large as emissions from the processing process, except in Case 3.

By assessing GHG emissions over various routes in this way, selection of raw materials and fuel formats with low GHG emissions can be promoted. Additionally, further GHG reductions need to be recommended through means such as promoting supply chain efficiency[45] and decreasing energy consumption, and selecting or switching to renewable energy sources for electricity or fuel.

(3) Improving energy use efficiency (Point 3)

Regarding the units used in LCA assessments (functional units), calculations are made per unit of electricity or heat produced at the final stage, so the higher the energy use efficiency (the generating efficiency, etc.), the greater the GHG emissions reduction benefits. GHG assessments under sustainability standards for liquid biofuel in the transportation sector use comparisons per fuel calorie because it would not be meaningful for comparisons to take into account the fuel economy of individual vehicles. On the other hand, in the case of solid biomass like wood, the energy efficiency of the power plant that uses the fuel has a major impact on calculations of GHG emissions per functional unit.

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[44] A CHP system using the Organic Rankine Cycle (ORC) is assumed.

[45] A good example is investment that was made to switch from trucks to rail in order to transport pellets from a production plant in the southern U.S. Bioenergy International, "New US$15m rail link helps Drax reduce supply chain emissions and biomass costs," May 28, 2020

For this reason, sustainability standards in the UK and the Netherlands already have mechanisms for appropriately assessing CHP (combined heat and power), and this has been incorporated into RED II as well[46]. As seen in Figure 2-5, the formula for CHP takes into account energy quality of heat (exergy) and adds items for assessing heat use, so to this extent GHG emissions are calculated at low levels. In Japan, deployment of CHP has not become as widespread as expected, so ensuring that assessments are appropriate is important from the standpoint of promoting the systems as well.

Figure 2-5 Calculation Method of GHG Emissions by Bioenergy Power Generation

For a non-CHP station;

$$\textit{GHG emission}\ (gCO_2\textit{-eq/MJ electricity}) = \frac{\textit{Emissions from production of biomass}}{\textit{Electricity efficiency of power plant}}$$

For a CHP station;

$$\textit{GHG emission}\ (gCO_2\textit{-eq/MJ electricity}) = \frac{\textit{Emissions from production of biomass}}{\textit{Electricity efficiency of power plant}} \times \frac{\textit{Electricity efficiency of power plant}}{\textit{Electricity efficiency of power plant} + C_h \times \textit{Thermal efficiency of power plant}}$$

Note: If the temperature of the useful heat at delivery point is less than 423 Kelvin (K), the C_h is 0.3456. If it is greater than or equal to 423 K then subtract 273 from the temperature and divide the answer by the temperature. C_h is Carnot efficiency, which means ratio of exergy in useful heat

Source) Ofgem (2018) Renewable Obligation: Sustainability Criteria

2. Setting appropriate GHG reduction targets

(1) Current GHG reduction targets

After performing appropriate assessments like the above, what GHG reduction standards should be set and how should they evolve in future?

We first looked at current reduction standards in Japan and the EU and found that with regard to liquid biofuel, where standards have been established ahead of other categories, they started at around 50% of fossil fuels and have been steadily strengthened while being revised over the course of around five years Figure 2-6.

46 EU Renewable Energy Directive Annex V. Rules for calculating the greenhouse gas impact of biofuels, bioliquids and their fossil fuel comparators, C. Methodology

Regarding solid biomass, the EU has required a reduction of around 70% from the start. The baseline used is GHG emissions from electricity generated with fossil fuels of 183gCO_2-eq/MJ-electricity[47], so a 70% reduction is 54.9 gCO_2-eq/MJ-electricity or less, which is generally the same level as the targets in the UK and the Netherlands Figure 2-7.

In the EU's discussions, as of 2010, GHG emissions from electricity generated with fossil fuels, which is used as the baseline, was set at 198 gCO_2-eq/MJ electricity[48]. However, with subsequent revisions to the composition of power sources that use fossil fuels, as the 2014, the figure was set at 186 gCO_2-eq//MJ-electricity[49], and in 2017, at 183 gCO_2-eq//MJ-electricity, so the standard has steadily gotten stricter.

The discussions that soon begins in Japan on GHG reduction standards will proceed on the basis of these current standards. With regard to fossil fuels as the comparator, mining, transport, refining and other processes need to be taken into account in order to make the comparisons fair[50].

Figure 2-6
GHG Reductions Standards in the EU and Japan (Reduction Compared to Fossil Fuels)

System	Category	GHG Reduction Standard	Scope
EU-RED2	Liquid biofuel, biogas (transport use)	50%	Plants in operation prior to October 2015
		60%	Plants in operation from October 2015
		70%	Plants in operation from January 2021
	Solid biomass (electricity/heat production)	70%	Plants in operation from January 2021 (20 MW or more)
		80%	Plants in operation from January 2026 (20 MW or more)
Japan - Sophisticated Energy Supply Act	Liquid biofuel	50%	FY2011-FY2017
		55%	FY2018-FY2022

Source) Renewable Energy Institute

Figure 2-7 GHG Standards in the UK and the Netherlands (gCO_2-eq/MJ-electricity)

Country	Target	Threshold	Scope
UK	66.7	79.2	2013 - April 1, 2020
	55.6	75.0	April 1, 2020 - March 31, 2025
	50.0	72.2	April 1, 2025 - 2030
Netherlands	56.0	74.0	

Source) Renewable Energy Institute

47 1 gCO_2-eq/MJ-electricity is equivalent to 3.6 CO_2-eq/kWh-electricity.

48 European Commission (2010) Report from the Commission to the Council and the European Parliament on Sustainability Requirements for the Use of Solid and Gaseous Biomass Sources in Electricity, Heating and Cooling

49 Commission Staff Working Document (2014) State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU

50 Calculation example from Youn and Yamada (1999)

(2) Setting targets with long-term view

Discussions on reduction targets needs to be set with a long-term view. Biomass power plants commencing operations in the near future will continue to operate until around 2040, taking the FiT support period into account. Furthermore, ideally, as a low carbon power source, operations should continue even after FiT support ends. Therefore, current reduction rates compared to fossil fuels should not be the only focus: long-term trends out to 2040 and 2050 with expectation of renewable energy growth from current levels and progress of low-carbon power source mix must be considered.

For example, the Sustainable Development Scenario (SDS) in the IEA's WEO-2019 requires achievement of 27.1 gCO_2-eq/MJ-Electricity on a worldwide basis by 2040 (Figure 2-8). By contrast, Japan's SDS in WEO-2019 is put at 52.1 gCO_2-eq/MJ-Electricity for 2030 and 16.3 gCO_2-eq/MJ-Electricity for 2040[51].

In the UK in 2018, the reduction target for 2025 and thereafter was lowered significantly to 8.1 gCO_2-eq/MJ-Electricity[52]. The figure is equivalent to a 95.9% reduction compared to fossil fuels, and given that the reduction rate to this point was 75%, it can be said to represent a significantly more challenging regulation. At the same time, one can also say it's a valid long-term requirement for the UK because the country is aiming to achieve around 14 gCO_2-eq/MJ-Electricity for all power sources by 2050.

In light of these considerations, it would be effective for Japan to require adequate reductions at present while also simultaneously discussing the future and for the country to clarify in advance that it will strengthen standards in stages going forward. This would be done while making reference to Japan's liquid biofuel policy and European initiatives.

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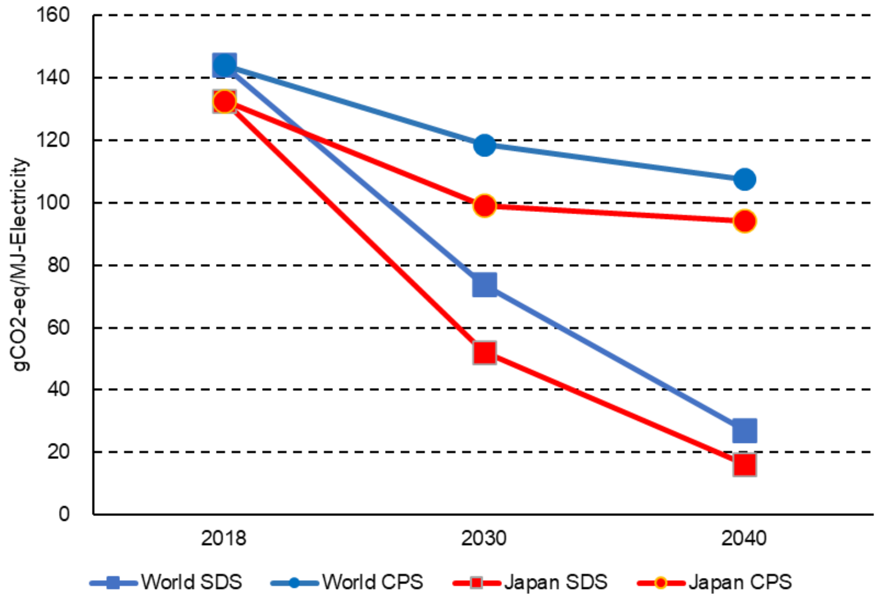
51 In the Federation of Electric Power Companies of Japan's Action Plan for the Electricity Business for Achieving a Low-Carbon Society, the figure is set for 2030 on the usage end at 102.8 g-CO_2/MJ-Electricity (370g-CO_2/kWh).

52 BEIS, UK (2018) Contracts for difference scheme for renewable electricity generation, Government response to consultation on proposed amendments to the scheme - Part B & Follow-up consultation on implementation, contract changes, and a revised CHPQA standard

Figure 2-8 Electricity Sector Emissions Factor Projections (WEO-2019, SDS)



Source) Renewable Energy Institute based on IEA (2019) World Energy Outlook 2019

(3) Management by electricity producers

In terms of operations, in this context as well, management at the electricity producer level is fundamental. And, in fact, in the EU generally and in the UK and the Netherlands, there is integrated verification of sustainability, and management is conducted at the electricity producer level for GHG reductions as well. Specifically, management is conducted for each power plant so that GHG emissions from each consignment of fuel used is within the upper threshold shown in Figure 2-7 and the annual average is lower than the target.

It is also important that information be disclosed publicly to raise trust. Figure 2-9 shows a portion of the information disclosed in the UK. The type and quantity of fuel used and GHG emissions for each fuel are disclosed monthly for each power plant. As direct transactions of electricity becoming a reality, these are expected to increase transparency by linking values of renewable energy, such GHG reduction rates with the amount of electricity purchased.

Figure 2-9 Information on Bioenergy Fuel Sustainability Disclosed in the UK

Biomass Sustainability Report 2018-19 data set. Information reported to Ofgem on a monthly basis.

Note: This does not include information relating to solid and gas stations less than 1MW. This is included in the tab 'Profiling Data 2018-19'.

Generating Station Name	Period of use	Fuel type	Fuel name	Fuel State	Quantity	Unit of measurement	Land criteria reported	Greenhouse gas criteria reported	Unit
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	757	Tonne	Yes	24.85	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	317	Tonne	Yes	24.85	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	22	Tonne	Yes	21.89	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	52	Tonne	Yes	21.89	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	3,880	Tonne	Yes	24.77	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	4,386	Tonne	Yes	24.77	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	6,147	Tonne	Yes	22.45	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	5,398	Tonne	Yes	24.07	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	2,608	Tonne	Yes	27.72	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	3,633	Tonne	Yes	27.76	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	8,691	Tonne	Yes	20.07	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	8,725	Tonne	Yes	20.5	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	2,169	Tonne	Yes	30.7	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	2,019	Tonne	Yes	30.92	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	1	Tonne	Yes	30.73	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	3	Tonne	Yes	30.73	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	113,884	Tonne	Yes	45.66	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	114,534	Tonne	Yes	45.67	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Oat Pellets (CCP)	Solid	28	Tonne	Exempt	15.04	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	105	Tonne	Yes	34.11	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	150	Tonne	Yes	33.93	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	0	Tonne	Yes	35.45	gGHG/MJ electricity
Drax Power Station (RB) - A,C,E	Apr-18	Biomass	Wood Pellets	Solid	0	Tonne	Yes	35.45	gGHG/MJ electricity

Source) Biomass Sustainability Report 2018-19 data set, partial excerpt. Some data has been rearranged due to space considerations.

In Japan as well, it is desirable for GHG emissions reduction to be managed at each electricity producers giving due consideration of their ultimate responsibility for ensuring the sustainability on fuel use. Even in Japan's case, electricity producers perform GHG calculations based on the Act on Promotion of Global Warming Countermeasures and make FiT annual reports. In addition, final figures depend on the efficiency of the power plants, which can be expected to increase energy use efficiency through more efficient plant operations.

For this reason, developing and promoting the use of a GHG calculation tool (LCA tool) is an important part of ensuring that electricity producers are able to perform assessments themselves. In the EU, default values are indicated for various fuel routes, as we saw above, but independent calculations by electricity producers are also allowed. This is why BioGrace[53], an Excel-based GHG calculation tool, has been developed and released. Bioenergy specific certification schemes for bioenergy have GHG reduction standards, and their own calculation tools are available for use, but using BioGrace is also an acceptable option. However, the coefficients in BioGrace reflect conditions in Europe, so there may be some inconsistencies with the situation in Japan. It would be preferable for an authorized tool to be developed by a public agency in Japan as well.

53 BioGrace I is for liquid biofuels, and BioGrace II is for solid biofuels and biogas.

3. Establishing the carbon neutrality of woody bioenergy

(1) Maintaining and increasing forest carbon storage

As indicated in the previous section, in GHG emissions management using LCAs, carbon dioxide from bioenergy emitted in energy conversion is set at zero. This is because the carbon dioxide emitted is reabsorbed by forests and other ecosystems and used to produce the next generation of raw materials (which means it is carbon neutral). However, in order for this assumption to hold, forests and other ecosystems with adequate carbon dioxide absorption capacity need to be perpetually maintained and managed (Point 4 in Figure 2-2).

As we have seen, modern bioenergy use has developed in accordance with the principle of cascading use and has centered on residual and waste products. In addition, extreme cases in which forests are cut down for energy use are limited, and, normally, forests are harvested in a way integrated with use of the materials, but the importance of sustained management of forest ecosystems, the basis for carbon neutrality, is something that needs to be constantly confirmed.

However, in reality, as detailed in the latest FAO report, while the speed of deforestation has slowed compared to the 1990's, the situation is certainly not adequate[54]. This is why all sustainability standards in the EU, the UK and the Netherlands, and bioenergy certification schemes include requirements for ensuring reabsorption by forests (Figure 2-10).

Japan's sustainability standards also do include consideration of land use changes (Figure 1-5), but this requirement is related to limiting the conversion of primary forest to agricultural farm or plantation development, and there are no requirements on subsequent reabsorption of carbon dioxide by forest ecosystems. This is linked to the fact that the Sustainability WG's discussions were premised on agricultural bioenergy and did not take into account wood bioenergy produced directly from forests. Going forward, in the working group's discussions this fiscal year, woody bioenergy should also be on the agenda, so it will no doubt be necessary to make revisions.

54 FAO (2020) Global Forest Resources Assessment 2020 Key findings

Figure 2-10 Sustainability Standard/Bioenergy Certification Scheme Requirements for Ensuring Reabsorption by Forests

Country ／ Certification	Requirement items to ensure reabsorption by forest
EU	Article 29 : 7. Biofuels, bioliquids and biomass fuels produced from forest biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 shall meet the following land-use, land-use change and forestry (LULUCF) criteria (a) the country or regional economic integration organization of origin of the forest biomass: (i) is a Party to the Paris Agreement; (ii) has submitted a nationally determined contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC), covering emissions and removals from agriculture, forestry and land use which ensures that changes in carbon stock associated with biomass harvest are accounted towards the country's commitment to reduce or limit greenhouse gas emissions as specified in the NDC; or (iii) has national or sub-national laws in place, in accordance with Article 5 of the Paris Agreement, applicable in the area of harvest, to conserve and enhance carbon stocks and sinks, and providing evidence that reported LULUCF-sector emissions do not exceed removals;
UK	Wood Fuel Advice Note version2 P10：The productivity of the area is maintained, in particular by: ・ adopting plans to avoid significant negative impacts on productivity ・ adopting procedures for the extraction of wood that minimise the impact on other uses of the area ・ providing for all of the contractors and workers who are working in the area to be adequately trained in relation to the maintenance of productivity ・ maintaining an adequate inventory of the trees in the area (including data on the growth of the trees and on the extraction of wood) so as to ensure that wood is extracted from the area at a rate which does not exceed its long-term capacity to produce wood Compliance with the productivity requirements should be monitored, the results of that monitoring should be reviewed and planning updated accordingly The area is managed in a way that ensures the health and vitality of ecosystems is maintained, in particular by ・ adopting plans to maintain or increase the health and vitality of ecosystems ・ adopting plans to deal with natural events such as fires, pests and diseases ・ taking adequate measures to protect the area from unauthorised activities such as illegal logging, mining and encroachment
Netherlands	Principle 3: Production of raw biomass does not result in the destruction of carbon sinks. Principle 9: The production capacity for wood products and relevant non-timber forest products is maintained in order to safeguard the future of the forests.
SBP	Criterion 2.9: Regional carbon stocks are maintained or increased over the medium to long term.
GGL	Principle 4: The production capacity of wood products and other relevant non-timber forest products shall be maintained in order to safeguard the future of the forests. Principle 7: Production of raw biomass shall not lead to the destruction of carbon sinks.

Source) Renewable Energy Institute

(2) Bioenergy contribution to development of the bioeconomy

The carbon storage and absorption capacities of terrestrial ecosystems like forests will play an extremely important role in achieving carbon neutrality and climate stabilization[55]. At the same time, as is summarized in the IPCC's Fourth Assessment Report in 2007, which states that " in the long-term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, will generate the largest sustained mitigation benefit", how to strike a balance between carbon storage of forest and material and energy use of wood biomass will be the key issue.

Regarding how the energy is used as well, in light of the current situation in Japan, this paper has generally been premised on energy used for electricity generated under the FiT scheme, but the contributions of bioenergy to heat use and in the transportation sector through conversion to liquid fuel also need to be pursued. In addition to this, bio-materials from woody biomass can be used as alternatives to carbon-intensive materials like iron, cement and plastic. Use of bioenergy therefore is coming to be considered part of the bioeconomy[56], which includes material use, and in this overall bioeconomy, resource efficiency needs to be raised, GHG emissions reduction maximized and sustainability ensured. Within this larger framework, Japan's bioenergy players are also expected to be active contributors.

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55 IPCC (2019) Climate Change and Land, Summary for Policymakers

56 The concept of the bioeconomy is introduced in REI's Proposal for Energy Strategy Toward a Decarbonized Society - Achieving a Carbon-Neutral Japan by 2050.

Position Paper

Sustainability of Wood Bioenergy

Implementation of System for Ensuring GHG Reduction

September 2020

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