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JAPAN RENEWABLE ENERGY FOUNDATION

Proposal for Woody Biomass Power Generation under the Feed-in Tariff Program

April 23, 2012

Japan Renewable Energy Foundation [1]

Points about the Proposal

In a FIT program, purchasing woody biomass-derived electricity at fixed prices is an effective means of promoting efficient utilization of forest resources. At the same time, however, the existing lumber utilization system could crumble, potentially leading to interference with sustainable use of forest resources, if excessively high tariffs are established.

In determining tariffs and categories to be purchased, our policy should be firmly based on the sustainable use of forest resources such as: taking into account life cycle assessment (LCA) in terms of global warming measures; including efficient use of heat; and continuing application of cascading use. To be specific, we present the following proposals.

- Determine tariffs based on cascading use of biomass in order to avoid competition between material and energetic biomass use,
- Determine tariffs prioritizing cogeneration,
- Determine higher tariffs for small and medium-sized facilities, and
- Determine tariffs for each fuel type.

Proposed tariffs for unused woody biomass power generation

Category	1,000 kW to 20,000 kW (excluding 1,000 kW)			1,000 kW or less	
	Initial 2 years	Subsidies provided	3rd or later years	Initial 2 years	Subsidies provided
Tariff	20 to 25 yen	About 17 yen	20 yen or less	30 to 35 yen	About 25 yen

1. Details of the proposal

[11] This proposal was compiled with cooperation of the following people: Mr. Keiji Kajiyama of Fuji Research Institute, Chair Miyuki Tomari of NPO Biomass Industry and Society Network, Dr. Hironao Matsubara of NPO Institute for Sustainable Energy Policies (ISEP), Professor Emeritus Minoru Kumazaki of Tsukuba University, and Mr. Aikawa Takanobu of Mitsubishi UFJ Research and Consulting.

(1) Determining tariffs based on cascading use of biomass

- To avoid competition between material and energetic biomass use, we should exclusively use byproducts when using woody biomass as fuel. To be precise, tariffs should be determined in such a way that portions of wood that can be used for lumber, plywood, or paper products are used as lumber while the portions that are inevitably produced in the lumber production process as less valuable material are used as fuel.
- Through full use of byproducts, we would be able to reduce costs incurred in the processes from tree trimming to lumber production, thereby reducing tariffs,
- Specifically, we propose that tariffs should be set to or below the level of prices of raw wood for paper wood chips (about 4,000 yen/ton with a wet basis moisture content of 50%) to avoid a tightening supply-demand balance for biomass as production materials.

＜Use of wood byproducts＞

"Use of wood byproducts" means the use for energy of part of wood discarded and remaining after the whole wood is cut down, transported, and made into products. Or, it also means the use for energy of low-quality wood cut down and transported using the same processing system as installed for producing lumber and plywood products. In the former case, costs are incurred in connection with collection, chipping, and transport of wood for energy, but no expense arises in relation to wood cutting, transport, or wood processing. In the latter case, fixed expenses for transport, installation, and cleaning of machines do not arise. Thus wood that was once left unused can be used efficiently.

To use wood for energy, we need machines to collect and chip trees. With a conventional system, we are able to transport only wood sections of thinned trees from the mountain. Thus, under the conventional system, we have to use wood portions for lumber, plywood, and paper products for energy. This means that more costs are incurred and, in addition, we cannot utilize waste wood. Waste wood generated in the lumber and plywood production process at a factory is also a wood byproduct.

(2) Determining tariffs prioritizing cogeneration

- If woody biomass is used in mono-generation, we obtain an energy use efficiency of only about 20%. On the other hand, if we use wood biomass in cogeneration and produce heat and electricity simultaneously, we can expect total energy efficiency of 65 to 85%. Thus, the same amount of wood produces more energy to replace fossil fuel, helping Japan to reduce its

dependence on imports or decrease the outflow of Japan's wealth.

- In the German FIT program, prioritizing cogeneration for efficiency use of biomass resources and contributing to regional economy, lower tariffs are granted for mono-generation (11.0 euro cent≒12.1 yen per kWh in the case of a 5,000kW[2] facility) while higher tariffs are provided for cogeneration, in order to encourage effective utilization of heat (11.0 euro cent +4.0 euro cent =15 euro cent≒16.5 yen per kWh).

[2] Exchange rate is: 1€＝110 yen

Additional tariffs applied to biomass cogeneration facilities under the German FIT program

Facility size	Tariffs (kWh)	Additional tariffs for cogeneration
Up to 150 kW	14.3 euro cent	+6.0 euro cent
Up to 500 kW	12.3 euro cent	
Up to 5,000 kW	11.0 euro cent	+5.0 euro cent (500 to 750 kW) +4.0 euro cent (750 to 5,000 kW)
to 20,000 kW	6.0 euro cent	No additional tariffs

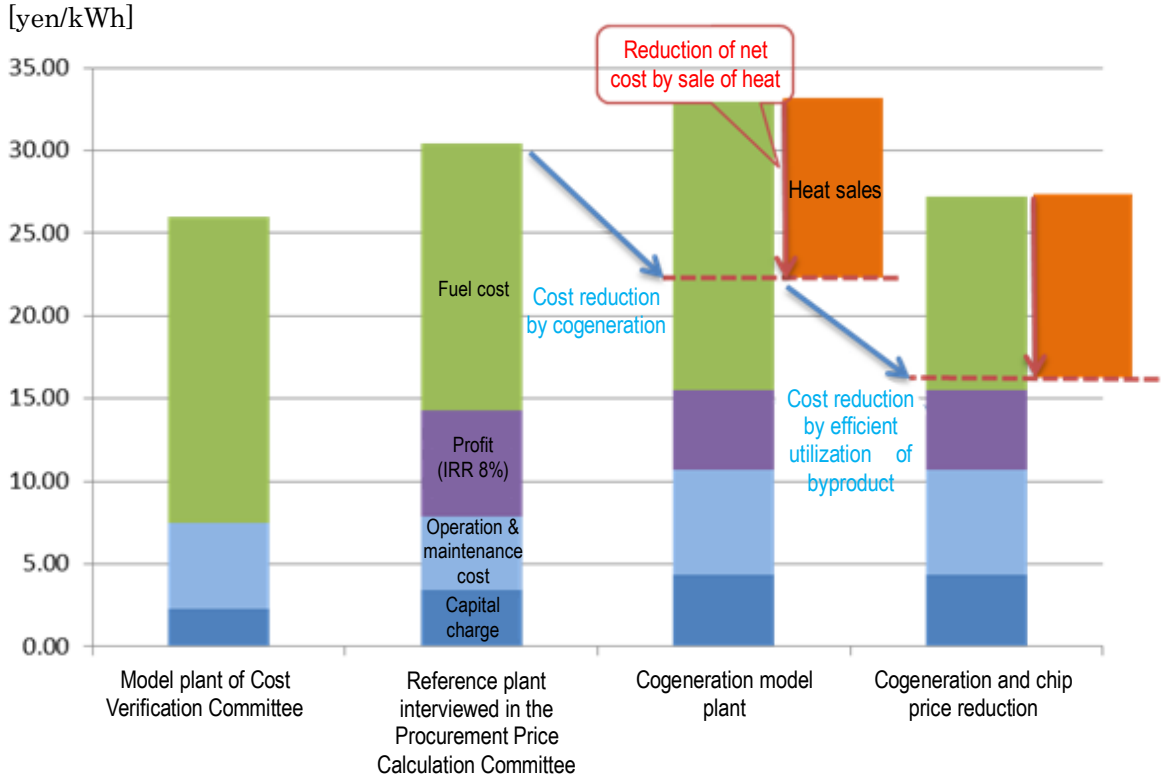
Source: German FIT law (EEG Section 27, Annex2)

- Higher total energy efficiency after introduction of heat generation would effectively reduce CO_2 (by 60 to 70%). Because small and medium-sized cogeneration facilities are installed at heat-consuming sites and regions, they are capable of supplying both heat and electricity for themselves in an emergency.
- Specifically, to guarantee an IRR of 8% in a case in which 1,000-20,000 kW facilities use unused woody biomass, tariffs should be 20 to 25 yen /kW for initial 2 years (about 17 yen if a 50% subsidy is provided for initial investment).
- After the initial two years, the efficient utilization of byproducts would be realized. As prices of raw wood and wood chips decrease, it would be desirable to reduce tariffs in the 3rd or later years to 20 yen/kWh or lower levels.
- By contrast, in a case in which 1,000-kW or smaller facilities use unused woody biomass, initial tariffs should be 30 to 35 yen /kWh, when calculated in the same manner (about 25 yen if a 50% subsidy is provided for initial investment).

Proposed tariffs for power generation using unused woody biomass

Category	1,000 kW to 20,000 kW (excluding 1,000 kW)			1,000 kW or less	
	Initial 2 years	Subsidies provided	3rd or later years	Initial 2 years	Subsidies provided
Tariff	20 to 25 yen	about 17 yen	20 yen or less	30 to 35 yen	about 25 yen

Estimation of cost reduction by cogeneration



(For details of calculation, refer to the last page)

(3) Determine higher tariffs for small and medium-sized facilities

- Large-scale power generation facilities could face with following problems:
  - Except for power generations locating in a lumber mill[3], fuel must be procured from a wide diversity of sources and supplies, making it difficult for large facilities to maintain stable fuel procurement, and
  - Most projects will be undertaken by major enterprises, which would fail to encourage small projects involving small distributed power generation units typical of biomass energy[4].

[3] Power generation facilities in Japan locating in lumber mills that utilize lumber waste and other byproducts are already operating 5,000kW or larger power generation systems.
[4] Proposal by the Iwate Woody Biomass Study Group ("Policy Recommendations on Creation of a New Community and Promotion of Woody Biomass, July 2011) divides the uses of Iwate woody biomass into three categories: (a) use by individual household, (b) use by small and medium-sized facilities, and (c) use by large facilities or power equipment. The group's recommendations focus on (a) and (b), not on (c) because the group considers that policy (c) would be practical only for regions meeting special requirements.

- As shown in reference cases provided below, generation of 5,000 kW using unused biomass would require an extensive deforestation. The central government is set to radically reform Japan's forestry under the Forests and Forestry Restoration Plan[5]. There may be some time; however, before the supply system is firmly in place. Any hasty increase in energy consumption could lead to extensive forest destruction.
- Because large-scale projects could arouse concern over the sustainability of forests, higher tariffs should be granted to small and medium-sized facilities to diffuse them more widely.
- In Germany, FITis limited to facilities of up to 20,000 kW. This German scheme should be taken into consideration when Japan determines preferential tariffs for facilities under the FIT program.

<Reference： Estimation of forest area needed for stable operation of large biomass power generation facilities>

- Biomass power generation of 5,000 kW is estimated to need 60,000 tons of wood chips annually (or log equivalent of about 70,000 m^3) .
- If 40% of wood is used as fuel after the rest is used for lumber, plywood, or paper products, then 180,000 m^3 of wood must be produced.
- To produce the same volume of wood by clear-cutting of a forest, we would need 450 ha of forest area, assuming that lumber volume of 400 m^3 can be taken per hectare.
- The clear-cutting process could not only destroy the ecosystem, causing substantial burden on the environment, but also incur a cost of 2.0 million yen per hectare in subsequent reafforestation. Thus, reafforestation of 450 ha would cost 900 million yen.
- On the other hand, to obtain 70,000 m^3 of wood by thinning, we would need 2,000 ha, assuming that 35 m^3 of fuel is obtained per hectare. In fact, there is no single region where thinning is conducted on such a scale.
- In this regard, depending on tariffs under the FIT scheme, lumber production for fuel would be more profitable, resulting in wider random clear-cutting.
- That is, wider proliferation of biomass power generation could accelerate forest destruction, and a resulting increase in CO_2 emissions could lead to heavy burden on people and growing government expenditure.

Source: Mr. Keiji Kajiyama, Fujitsu Research Institute

[5] http://www.rinya.maff.go.jp/j/kikaku/saisei/index.html

(4) Setting tariffs for different fuel types

- Different tariffs should apply to unused biomass (e.g. forest waste wood), factory waste wood (e.g. lumber waste), and waste (e.g. construction waste wood) because they significantly vary in fuel procurement cost. Fuel procurement cost is low for factory waste wood as many lumber mills use wood chips and other material for fuel. For this reason, low tariffs should be set, compared with unused biomass. Also, similar low tariffs should be set for waste.

2. Principles for biomass utilization

With respect to the use of biomass resources for energy, the government committee[6] for the Feed in Tariffs Program recognizes the importance of deliberate review of this issue and suggests that the FIT program be designed on the basis of the following principles:

(a) Maintain cascading use of biomass (avoid competition between material and energetic biomass use),

(b) Secure traceability (identify fuel sources),

(c) Secure sustainable use (avoid destroying forests or adversely affecting biodiversity), and

(d) Use fuel sources that can contribute to global warming countermeasures from an LCA point of view.

[6] New Energy Subcommittee/ Electricity Industry Subcommittee of the Advisory Committee on Natural Resources and Energy

<Reference: An excerpt of a 2011 Report of the Feed in Tariffs Program Subcommittee>

(3) Requirements for biomass power generation

Biomass used as fuel for biomass power generation contains portions that could otherwise be used as raw materials for other purposes. Any new FIT program introduced could significantly affect the supply-demand balance of biomass used for conventional purposes, which could result in resource shortages and price surges (photovoltaic and wind power generation would not cause such problems).

Some types of biomass that could be used as fuel may raise concerns over forest destruction or adverse biodiversity effect. In formulating a FIT program, consideration should be given to these problems.

In addition, we should note that if any biomass used as fuel under the new program increases GHG emissions from collection and transport of the biomass, then it would frustrate the purpose of the new program.

In determining whether to cover power from certain biomass power generation facilities, we must ensure that (1) any conversion of biomass from conventional purposes to power generation purposes does not lead to supply shortages for conventional purposes or price surges in the biomass market, (2) the sustainable use of biomass is realized, and (3) it contributes to global warming prevention from a perspective of life cycle assessment (LCA)[Note]. Specific measures should be formulated on the basis of practical considerations of how to establish and verify requirements for individual biomass fuels supplied to power generation.

To help verify such requirements, it is also important to set up a traceability scheme to enable identification of the origin of individual biomass fuels.

To promote biomass power generation, the Ministry of Economy, Trade and Industry is required to work out an appropriate selection procedure and other specific schemes in cooperation with other concerned agencies.

Note: Wood waste from forest harvesting, most of which is unused for existing purposes, may fall under (1), (2), and (3) above.

<Reference: "Principles for Promotion of Sustainable Utilization Biomass in Japan—to Design an Appropriate FIT Program" by NPO Biomass Industry Society Network and other organizations, February 2012>

- To avoid serious impact of accelerating global climate change, the utilization of biomass energy should be promoted aggressively. However, we should endeavor to ensure sustainable utilization by taking the characteristics of biomass energy into account.
- The Act on Special Measures concerning Renewable Energy (the FIT Program) and other various policies relating to the utilization of renewable energy sources should take their sustainability into consideration. The private sector should also give similar considerations to this issue.
- In this regard, environmental NGOs and other organizations engaged in promoting sustainable biomass utilization Japan present the following proposals:

1. Contribution to reduction of greenhouse gas (GHG)
- The utilization of biomass energy must contribute to GHG reduction, which is the top objective of Japan's climate control policy.
- Calculation of GHG reductions must cover all phases from land utilization to energy conversion and utilization even if biomass is produced and consumed in different countries.
- Based on the above calculation principle, it is required to set up the lowest threshold for GHG reductions in order to promote utilization of waste wood and surplus materials from existing production systems not involving change to land use and encourage cogeneration and efficient utilization of heat.

2. Protection of healthy ecosystems and promotion of utilization
- Healthy conditions of the ecosystem must be preserved and promoted for biomass production, while maintaining its biodiversity.
- For that purpose, we must ensure legitimacy, protect ecosystems worth preserving, and maintain harmony among various ecosystem services.

3. Economic and social considerations
- Appropriate utilization biomass energy is expected to help revitalize the agricultural and forestry sector. In an FIT program, under which people are required to shoulder social burden, an integrated approach should be taken to improve energy security and revitalize the regional economy.
- For that purpose, fundamental initiatives should be taken first, including strengthening governance by improving the transparency and efficiency of the administrative system and businesses, such as the forestry business, that use ecosystem services. In addition, the FIT program should encourage regional initiatives to promote small distributed facilities, by providing preferential treatment to such facilities, including varying tariffs for different power-generating capacities and favorable treatment of cogeneration facilities.

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(Reference) Estimates for generation model plants utilizing unused woody biomass

	Cost Verification Committee model plant	Corporate plant interviewed	(a) Model plant + cogeneration	(b) Model plant + cogeneration + initial 50% subsidy	(c) Model plant + cogeneration + reduced chip prices	(d) Small or medium-sized failure + cogeneration	(e) Small or medium-sized failure + cogeneration + initial 50% subsidy
Basic data							
Installed capacity Electricity KW	5,000	5,700	5,000	5,000	5,000	800	800
Installed capacity Heat KW	-	-	10,000	10,000	10,000	1,300	1,300
Utilized capacity (individually planned)	80%	93%	80%	80%	80%	91%	91%
Utilized capacity (comparative standard)	85%	85%	85%	85%	85%	85%	85%
Capital charge (in tens of thousands of yen)	210,000	245,385	282,000	141,000	282,000	116,000	58,000
Efficiency Electricity %	20%	25.5%	20%	20%	20%	30%	30%
Efficiency Heat %	-	-	30%	30%	30%	50%	50%
Operating time Electricity h (individually planned)	7,008	8,147	7,008	7,008	7,008	8,000	8,000
Electricity (@ standard operating rate)	7,446	7,446	7,446	7,446	7,446	7,446	7,446
Heat h (individually planned)			3,500	3,500	3,500	5,600	5,600
Heat (@ comparative standard energy efficiency)							
Fuel consumption	42,048	60,000	42,048	42,048	42,048	8,400	8,400
Moisture percentage (individually planned)	16%	40%	16%	16%	16%	50%	50%
Moisture percentage (comparative standard)	16%	16%	16%	16%	16%	16%	16%
Fuel consumption (@ equivalent standard moisture percentage)	42,048	42,857	42,048	42,048	42,048	5,000	5,000
Fuel cost (individual plan @ individually planned moisture percentage) yen/t	**12,000**	**12,000**	**12,000**	**12,000**	**9,000**	**8,000**	**8,000**
Fuel cost (individual plan @ equivalent standard moisture percentage)	**12,000**	**16,800**	**12,000**	**12,000**	**9,000**	**13,440**	**13,440**
Fuel cost (comparative standard @ equivalent standard moisture percentage)	**13,440**	**13,440**	**13,440**	**13,440**	**9,000**	**13,440**	**13,440**
Actual electricity generated MWh (individually planned)	30,485	39,007	30,485	30,485	30,485	5,760	5,760
Electricity generated MWh	35,040	46,437	35,040	35,040	35,040	6,400	6,400
Captive electricity MWh	4,555	7,430	4,555	4,555	4,555	640	640
Actual electricity generated MWh (@ comparative standard)	30,485	35,651	32,390	32,390	32,390	5,361	5,361
Electricity generated MWh	35,040	42,442	37,230	37,230	37,230	5,957	5,957
Captive electricity MWh	4,555	6,791	4,840	4,840	4,840	596	596
Heat consumption (individually planned) MWh	-	0	55,845	55,845	55,845	7,700	7,700
Total energy efficiency (individually planned)	20%	25.5%	50%	50%	50%	74%	74%
Total energy efficiency (comparative standard)	20%	25.5%	50%	50%	50%	50%	50%
Heat consumption MWh (@ standard energy efficiency)	-	-	55,845	55,845	55,845	3,971	3,971
Annual cost of power generation							
Depreciation (20 years) (in tens of thousands of yen)	7,000	12,269	14,100	7,050	14,100	5,800	2,900
Operation and maintenance cost (in tens of thousands of yen)	15,800	15,800	20,540	20,540	20,540	3,700	3,700
Administrative cost (in tens of thousands of yen)	8,800	9,300	11,440	11,440	11,440	3,100	3,100
Personnel cost (in tens of thousands of yen)	7,000	6,000	9,100	9,100	9,100	600	600
Other (including insurance premiums) (in tens of thousands of yen)							
Fuel cost (individually planned) (in tens of thousands of yen)	50,458	72,000	50,458	50,458	37,843	6,720	6,720
Fuel cost (comparative standard) (in tens of thousands of yen)	56,513	57,600	56,513	56,513	37,843	6,720	6,720
Total (@ comparative standard)	79,313	85,669	91,153	84,103	72,483	16,220	13,320
Cost per KWh							
Cost of power generation (individually planned) yen/KWh	24.9	25.4	27.9	25.6	23.8	28.2	23.1
Cost of power generation (@ comparative standard)	26.0	22.0	29.9	27.6	23.8	28.2	23.1
Heat sales (in tens of thousands of yen) (individually planned)	0	0	29,010	29,010	29,010	4,000	4,000
Heat sales (@ comparative standard)		0	37,153	37,153	37,153	2,642	2,642
Actual cost of power generation (individually planned) yen/KWh	**24.9**	**25.4**	**27.9**	**25.6**	**23.8**	**21.2**	**16.2**
Actual cost of power generation (@ comparative standard) yen/KWh	**26.0**	**22.0**	**17.7**	**15.4**	**11.6**	**23.6**	**18.5**
Profit (IRR8%) yen/KWh	-	6.41	4.8	1.4	4.8	13.0	7.0
Tariff (individually requested) yen/KWh	-	**31.8**	-	-	-	-	-
Tariff (@ comparative standard) yen/KWh	-	**28.4**	**22.5**	**16.8**	**16.4**	**36.6**	**25.5**

Source: Procurement Prices Determination Committee's 4th meeting, Material 5

Note:

- To unify conditions, the utilized capacity of facility, the operating time, and the moisture content of chip were adjusted (provided as "comparative standard").
- The Cost Verification Committee model plant will be depreciated for 30 years.
- Construction costs in (a) includes those for cogeneration facilities.
- For cogeneration, heat consumption is assumed so that total efficiency is 50%.
- Sales price of heat is assumed to be 6.7 yen/kWh.

＜For inquiry about this proposal, please contact us＞
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