The “Chicken or the Egg” Problem in Regional Revitalization Project；example of wood pellet business

THE “CHICKEN OR THE EGG” PROBLEM IN REGIONAL REVITALIZATION PROJECT; example of wood pellet business

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***ABSTRACT*:** For successful market development in the regional revitalization project particularly which takes place in less populated area, the “chicken or the egg” problem is the critical issue which has to be overcome. In the dissemination of wood biomass utilization projects which have been eagerly promoted by the national government since oil price and global warming issue arose, the “chicken or the egg“ issue has been the most substantial barriers which have prevented the market growth in Japan. For biomass fuel producers, they won’t take investment risks for the development of manufacturing plants unless a certain amount of demand is secured, or at least it is foreseeable. Consumers won’t adopt biomass heating appliances unless a stable fuel supply is secured. In order to resolve the dilemma between the chicken and the egg, what have the Japanese politics done so far is to drive only one wheel and ignore the other. Investments for the manufacturing plants have been supported excessively by the government while necessary supports for the market development, such as standards for fuel, investment grant programme, and information programme for potential consumers and other stakeholders, seemed to be abandoned. As a result, there are a huge number of pellet manufacturing plants today which lack a stable supply of raw materials as well as profitable volume of demand, and consequently they are now facing a severe financial issue. In Kochi, we have observed a regional revitalization project through the utilization of wood biomass energy since 2007. Although several pellet manufacturing plants were established and a significant number of pellet heating appliances were adopted by local horticulture farmers there are still a big gap between supply and demand, not only in terms of quantity but also quality and price of the fuel. These facts show us some lessons for ongoing and future projects that both wheels should be driven at the same time under the proper management system for successful market development in the regional revitalization project.

KEYWORDS: wood pellets, pellet production,

1. INTRODUCTION

Due to the destabilization of social situation and growing concerns toward global warming issue, active approaches to R&D and implementation of biomass energy production and utilization by national government have been observed in recent years. Particularly, after 2002 when “Biomass Nippon Strategy” was established by cabinet decision and also 2005 when “Kyoto protocol” was gone into effect, biomass had become a promising solution for regional revitalization resource in sparsely populated area. A rapid spread of biomass fuel production facilities such as wood pellet plant which were supported by a variety of subsidy programmes aiming for development of sustainable

society, reduction of greenhouse gas emission as a global warming countermeasure, and revitalization of rural regions, was observed everywhere in Japan

In 2011 February, Ministry of Internal Affairs and Communications (MIC) submitted a report on revaluation of biomass policies based on “Biomass Nippon Strategy” a central role of Japanese biomass policy. According to the report, more 71.7% of the previous biomass related facilities based on “Biomass Nippon Strategy” were in deficit [1]. In addition, the report states that there were serious problems with the basis of goal settings and the methods for necessary understanding in the degree of accomplishments [2].

This paper discusses the current situation of wood pellet business in Japan based on the investigation conducted in 2008 to 2009, and also discusses the causes of failure in Japanese pellet business. (Note: This research was conducted within a research project sponsored by Research Institute for Science and Technology for Society (RISTEX), Japan Science and Technology Agency (JST).)

2. WOOD PELLET BUSINESS IN JAPAN

2.1 History

In Japan, biomass fuel for the first time started to get recognized in early 1970th when oil crisis was occurred. Due to the increase in oil price, wood attracted people’s attention as an alternative energy source. Since then, wood fuel production spread out throughout the nation and the national wood pellet production volume reached 28,000t in 1982 [3]. However, as oil price started to decline till the moderate level, people’s interests in biomass fuel become weaken and the production volume fell to 1,500t in 1999 [4].

Since 2000, rising tension in national social situation, increasing energy demand among developing nations and increasing speculative funds into oil market strongly pull up oil price. Besides, global warming issue added environmental value to wood biomass fuel which is considered as a “carbon-neutral” source. Biomass has started to gain public attention once again.

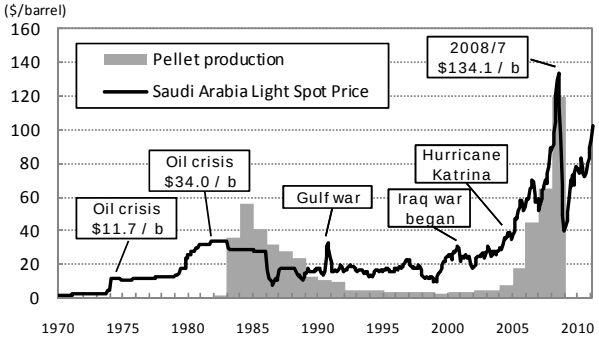


Fig 1 Comparison of oil price chart from 1970 to 2011 [5][6][7][8] and the Japanese pellet production [9]

2.2 What is Wood Pellet Fuel?

Wood pellets are a type of small solid fuel usually made of sawdust or forest residues. Since no chemical additives are used to compact sawdust, it is considered an environmentally friendly fuel which does not emit toxic substances. In addition, wood pellets are considered as a carbon-neutral, which is a concept that does not increase GHG by its emission because equivalent amount of GHG was fixed when the tree grew up, therefore, use of biomass fuel contributes to the development of sustainable society. However, emission during the transportation of raw material or the production process has to be carefully monitored.

Table 1. Description of wood pellets

Property			
Dimensions:	Diameter:	mm	6 ~ 12
	Length:	mm	10 ~ 30
Bulk density:		kg/m3	500 ~ 700
Moisture content :		%	8 ~ 12
Calorific value :		MJ/kg	17.6 ~ 19.4
Ash content :		%	0.5 ~ 7.0

2.3 Manufacturing Process

Manufacturing wood pellets has 3 fundamental steps: demolishing, drying and compressing process.

In demolishing process, raw materials such as logs, wood residues or wood chips are demolished by hammer mill and grinded into small particles. If sawdust from sawmill is used for the raw material, this process can be omitted. Secondary, moisture content in raw material must be reduced around 14%. Because the optimum percentages of moisture content differ in kinds or conditions of wood material, this process may require some proficiency to the plant workers. Finally, dried raw materials are fed into pellet mill where wood particles are grinded and pressed into small holes with a high pressure. At this point, high pressure causes the temperature of the raw material to increase greatly, and lignin binds materials tightly and helps to form pellets [10].

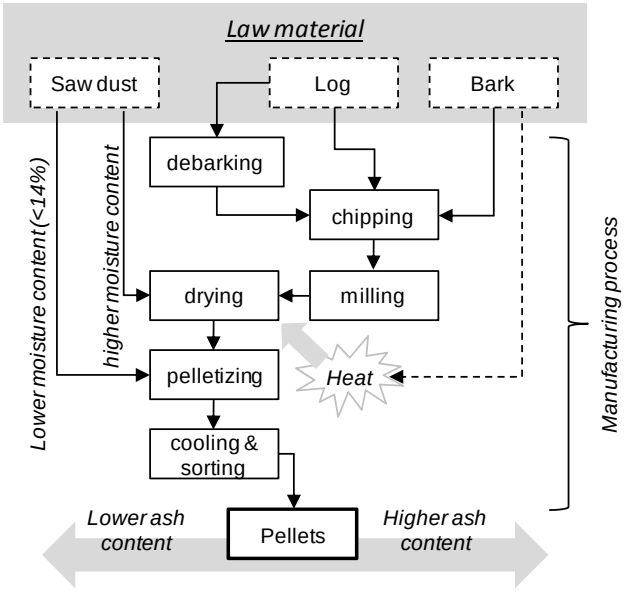
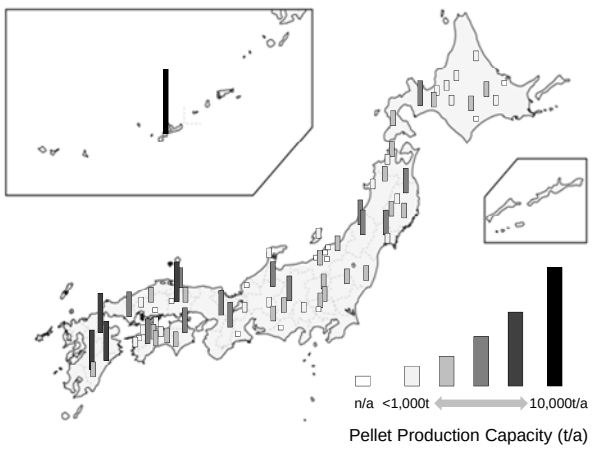


Fig. 2 Pellets manufacturing process

2.4 Distribution of Wood Pellet Plant in Japan

Today, more than 70 pellet plants are established, and it is estimated that Japanese pellet production were estimated to reach 60,000 tons in 2008 [11]. Distribution of the pellet plants in regions are as shown in Figure 3.



Hokkaido	13	Tohoku	14
Kanto	5	Chubu	16
Kinki	3	Chugoku	8
Shikoku	11	Kyusyu/Okinawa	5

Fig. 3 Distribution of pellet plants in Japan (2010)

3. RESEARCH METHOD

In order to correct necessary information such as raw material, plant scale, operating rate and business conditions to analyze wood pellet business in Japan, field investigation was conducted in the period of May/2008 to August/2009.

Email, FAX and telephone were used to make contact to the management person for each plant. As a result, we were able to get response from 22 wood pellet plants which accepted our visiting.

Investigation was conducted based on the interview to the management person and the inspection of the plant.

Table 2. Name and location of pellet plants investigated in this research

Plant name	Location	Plant name	Location
Tokachi pellet cooperative	Hokkaido	Yamagata wood energy	Yamagata
Hokkaido pellet	Hokkaido	Green watarai	Yamagata
Kokyoshizai	Hokkaido	Agri power	Nigata
Tomakomai forest owners cooperative	Hokkaido	Aidenshikogyo	Tochigi
Tsugaru pellet cooperative	Aomori	Eco environment system	Saitama
Tsugarukaihatsu cooperative	Aomori	Iijima sawmill	Yamanashi
Kuzumakiringyo	Iwate	Kamiina forest owners cooperative	Nagano
Kesen precut cooperative	Iwate	Mokushitsunenryo	Gifu
Rana system	Iwate	Toyone recycle center	Aichi
Hokusyuyoki	Akita	Yusuhara Pellet	Kochi
Tohnokosan	Fukushima	Forestenergy Kadokawa	Miyazaki

4. RESULTS

Within 22 pellet production plants which are the total number of investigation plants in this research, 90% of the plants were built after the year 2002 when “Biomass Nippon Strategy” was formulated. It is assumed that the governmental subsidies for wood pellet production business which was expanded after the formulation of “Biomass Nippon Strategy” influenced the increasing number of pellet plants after 2002.

4.1 Initial Investments

17 wood pellet plants out of 22 which is the total number of investigation plants in this research answered their initial investments for the plant establishment. In this research, more than 70% of the plants made an appropriation of ¥100 million or higher for the initial investment.

Table 6. Distribution of initial investments

Initial investment	number	ratio
> ¥500 million	1	5.9%
¥300 – ¥500 million	1	5.9%
¥100 – ¥300 million	10	58.8%
< ¥100 million	5	29.4%
n/a	5	

The average initial cost per production capacity at 1,000 tons/year which does not include plant building since the pellet production line was built within the existing sawmill plant is ¥58 million. This case was only observed in the plants which have production capacity of below 1,600 tons per year because there were only limited spaces that can be used for placing the pellet line in their existing plants. On the other hand, the average initial cost which includes the new plant building is ¥150 million per production capacity at 1,000 tons/year. As showing in Fig.4, investment cost will decline as the production capacity of the plant increases due to the economy of scale. In Fig. 5, investment cost at the production capacity of 8,000 t/a seems to be an outlier. However, because this plant introduced BTO machinery for demolishing process and alternative pellet line in order to meet 2 different kinds of raw materials, therefore the initial cost becomes relatively higher than others.

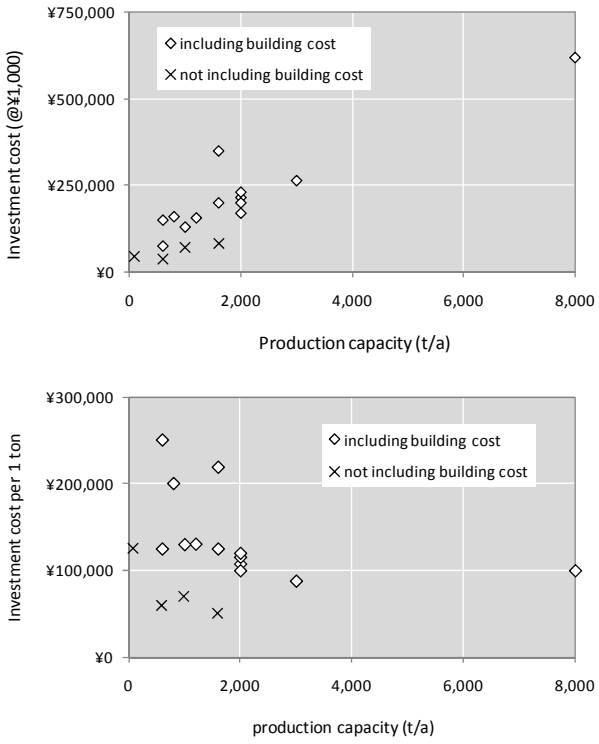


Fig. 4 Correlation between production capacity and investment cost of pellet manufacturing plants

4.2 Plant Scale and Operation

The result of this survey shows that the average production capacity was 1,649 tons per year. (Note: 2,000 operation hours per year was used to calculate the average production capacity in this research.) The number is quite smaller than the pellet plants in European countries where several ten thousand tons are the typical number of plant capacity.

According to the research, total production capacity of those 22 pellet plants was 36,280 tons per year. In contrast, total production volume which is the total production volume of a year before the

investigation was 16,847 tons. This shows that the average rate of operation was only 50.6% in those plants. Moreover, there were only 18% of the plants that exceeded the operating rate of 75%.

Either construction, building contractor, wood processing or waste disposal business is the main business for most of those plants that were founded by a private entities or a group of private entities. Their primary purpose to establish the pellet plants seems to be more on minimizing expenses for waste disposal, CSR and energy cost saving purposes than making profits by establishing new business. Therefore, it is assumed that the plant scale was set based on the volume of raw materials which they had in their business.

Table 3. Overview of the research plants

Number of plants		22
Production capacity (total)	(t/a)	36,280
Average production capacity	(t/a)	1,649
Production (total)	(t/a)	16,847
Average production volume	(t/a)	766
Average operation ratio		50.6%

Table 4. Production capacity

Production capacity (t/a)	number	ratio
> 3,000 t	2	9.1%
2,000 – 3,000 t	5	22.7%
1,000 – 2,000 t	10	45.5%
500 – 1,000 t	4	18.2%
< 500 t	1	4.5%

Table 5. Rate of operation

Operation ratio	number	ratio
> 100%	2	9.1%
75–99%	2	9.1%
50–74%	8	36.4%
25–49%	5	22.7%
< 25%	5	22.7%

4.3 Raw Materials

There were two primary kinds of raw materials that were used in those pellet plants. One derives from construction and demolition business. The other is from forestry an sawmill business.

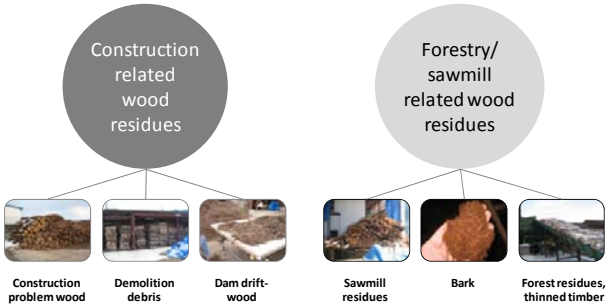


Fig. 5 Types of raw material used for wood pellets

Construction related raw material is the wood residues derived from construction sites, building demolition sites and dam sites. Disposal woods damaged by insects and lumbering woods at road construction site can be classified as a public work related residue. Construction related wood residues are disposed as industrial wastes which require treatment expenses. Therefore, if the business entity has a permission of industrial waste disposal, they will receive disposal fee as well as the raw material for making pellets. However, it is considered that those residues might contain chemicals, metals, dirt and small stones. Thus, not all the residues can be used for wood pellets. Besides, the volume of those residues depends on the contract of public works. It may affect the stability of raw material supply.

In this research, 8 plants out of 22 answered that they used this type of raw materials for manufacturing pellets.

Forestry/sawmill related wood residues are those which derived from forestry sites, such as branches and leaves, roots and thinned woods, or sawmill plants, such as sawdust, shavings, barks and timber offcuts. Sawmill residues are stable resource in terms of supply stability. Since they are basically free and do not cost for transportation, the production cost can be cheaper. On the other hand, forest residues cost a lot for skidding and

transporting. The price of the pellets made of those materials may be higher than others. However, forest residues are the one which has positive effects on forest condition if they are used.

In this research, 19 plants out of 22 answered that they used this type of raw materials for manufacturing pellets. However, only 2 plants both of which are forest owners' cooperatives answered that they used forest residues as their primary source.

Table 6. Types of raw materials used

Raw material	number	ratio
Sawmill residues	14	63.6%
Forest residues, thinned timber	7	31.8%
Construction problem wood*, dam drift-wood	5	22.7%
Demolition debris	2	9.1%

* obstructed wood aquired from road construction work

4.4 Product Type and Price

Finally, we conducted the research on the products which were made at the visiting plants.

Whole tree pellets, which contain both trunk and bark as raw materials, had the highest share in this research. Almost half of the plants we investigated manufactured whole tree pellets and 40% made white pellets, which does not use bark as a raw material. There was one pellet plant which made charcoal mixed pellets. According to the plant manager, pellets mixed with charcoal have approximately 10% higher calorific value than the others.

Table 7. Type of pellets producing

Types of pellets	number	ratio
white (no bark)	11	40.7%
whole tree	13	48.1%
bark	2	7.4%
others	1	3.7%

Pellet price differs in type and utility of pellets. Normally, industrial use, also known as bulk, is relatively cheaper than household use. In this research, pellet manufactures give 5-16% discount on industrial users compared to household. For instance, the average price of whole tree pellets for industrial users was ¥7.4/kg cheaper than its for household use.

For each type of pellets, there are quite big gaps between lowest and highest price. Price gap varies from ¥4-33/kg. It is considered that this is due to the differences in raw materials and facilities. This also shows that the pellet market in Japan is still immature market.

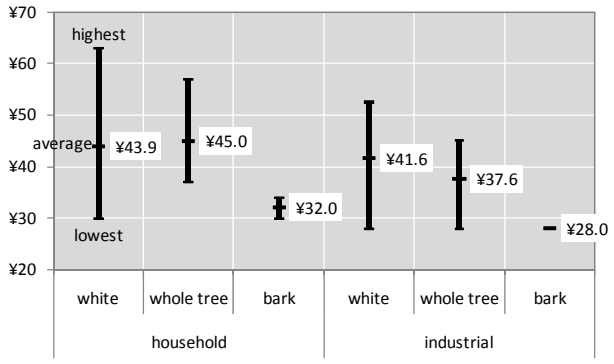


Fig. 6 Pellet price range (factory price)

5. DISCUSSIONS

During this research inspection, there were hardly any plant managers answered the pellet business was profitable. In order for the pellets to hold advantages to fossil fuels in terms of the price per calorific value, and foster the pellet market growth in Japan, pellet price should be lower ¥7-12/kg from current price range. To achieve this goal, it is considered that increase in production capacity and operating rate are the key factors for the future market expansion.

5.1 Production Cost

According to this research result, the average plant capacity was 1,650 tons per year although the number of pellet plants in Japan is so many. Compared to the pellet plants in European countries,

where more than 440 plants producing about 7.5 million tons per year in 2007 [12] and still growing rapidly, it must be said that most of Japanese pellet plants are not cost competitive. Of course, there are so big differences in the forest industry scale that we cannot just compare the plant scale between Japan and Europe. However, it is also true that the plant size affects the production cost sometimes even larger than the raw materials. According to Mani (2007), pellet plant which produces 2t/h has about 75% more production cost than which produces 4t/h [13].

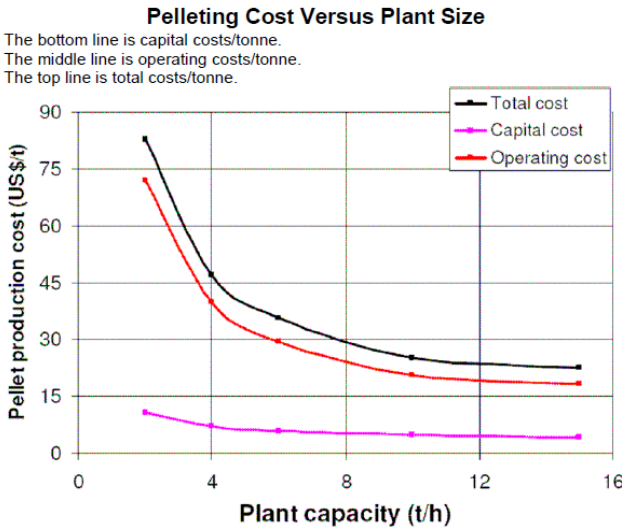


Fig. 7 Correlation between plant capacity and production cost [13]

Although previous Japanese pellet business might have some perspectives to efficiently collect raw materials that lies in the region and use them as a regional energy source, they tended to lean toward loan business where economic cycle completes in a very closed system. Plant scale was designed based on the amount of raw material which each firm possessed. As a result, those pellet plants are not cost competitive to fossil fuels due to the higher production costs. If they want to lower the product price in order to meet the consumers' needs, then the raw material must become cheaper than the present level. It leads to burdening forest with a heavy load. It is considered that this is one of the causes of failure in Japanese pellet business so far.

5.2 Reliability

It is considered that one of the reasons that most of Japanese pellet business have previously gone through a severe financial situation is due to the quite low rate of their plant operation as we have seen in the inspection. For increasing operating rate of the plants, a market creation in the region as well as a stable supply of raw material are necessary.

In this research, typical consumers for most of pellet plants we investigated were public buildings, pools, schools and households. Public buildings such as town office and town centers are

In Tohoku region, dissemination rate of pellet stoves for household users seemed quite high compared to other region. However, one household usually uses only 1-2 tons of pellets per year even in colder region. Therefore, for pellet manufacturing business, achieving many private industrial users which use pellet boiler consuming several hundred tons of pellets per year is the critical theme to be a profitable business. During the investigation, many pellet plants which also distributed pellet stoves and boilers were seen. According to the plant managers, not only price of the pellets and boilers, but also performance and reliability of those pellet combustion appliances had been the barriers for potential customers to introduce them.

Reliability of pellets has also been the big issue for Japanese pellet market. Although there are several autonomous pellet standards in Japanese wood pellet market [14][15][16], none of them have officially been adopted by the market yet. Therefore, consumers cannot really rely on the quality of those pellets. In addition, because there is no official rules and standards for raw materials, pellet quality and combustion appliances, even if the pellet is made of

100% natural wood, the ash remaining after the combustion must be treated as an industrial disposal under the current legislation although there are many request from farmers that they want to use those ash for fertilizing their farmlands. In order to achieve the market trust and expand the utilization of wood pellets, it is considered that the unified official regulation and standards in raw material, products, distribution and utilization must be established.

6. CONCLUSION

In general terms, using wood biomass has positive impacts on conservation of forest environment, forest industry, global warming and etc. However, in reality majority of the pellet manufacturing business we investigated saw more impacts on cost reduction of their primary business. It is considered that there was a lack of the vision from consumer side, such as market creation and product development. In urban areas, a company which establishes a business alone can be successful in that business since there are many potential collaborators. However, in rural region, a business must start with a market creation. In other words, although a certain amount of supply and demands are the requirements for the business to be successful, there are only a few demands in the county region. Consequently, the chances are quite slim for the business in rural region. Therefore, in a business which expects an effect on regional industrial revitalization such as wood pellet business, the creation of supply (chicken) and demand (egg) must be driven at the same time with the clear vision of regional industries. Most importantly, it is considered that the share of the vision by stakeholders in the region, the mutual cooperation by each stakeholder and the coordination of each stakeholder's interest are the requirements in order to drive both wheels at the same time.

REFERENCES

[1] Ministry of Internal Affairs and Communications (MIC), 2011. Report of Policy Assessment Regarding Biomass Utilization, p.271

[2] Ministry of Internal Affairs and Communications (MIC), 2011. Report of Policy Assessment Regarding Biomass Utilization, pp.268-269

[3] Japan Housing and Wood Technology Center (HOWTEC), 2007. *Business Report on Promotion of Wood Pellet Utilization*, pp. 10-14.

[4] Japan Housing and Wood Technology Center (HOWTEC), 2009. *Business Report on Stabilization of Wood Pellet Supply*, p. 9

[5] Ministry of Economy, Trade and Industry (METI), *International Oil Price Chart, Agency for Natural Resources and Energy*, http://www.enecho.meti.go.jp/topics/hakusho/enehaku-kaisetu/kaisetu/01.htm

[6] ENEOS GLOBE Corporation, E*neos Globe Monthly Report*, No.11-3: p.4.

[7] Mitsui Marubeni Liquefied Gas Co., Ltd. (MLG), 2009. *MLG LPG Market News*, No.9-03: p.5

[8] Mitsui Marubeni Liquefied Gas Co., Ltd. (MLG), 2010. *MLG News, Monthly Report*, No.10-03: 5

[9] Japan Housing and Wood Technology Center (HOWTEC), 2009. *Business Report on Stabilization of Wood Pellet Supply*, p. 23.

[10] The Japan Institute of Energy, 2009. *Biomass Handbook*, Ohmsha, p. 149.

[11] O. Sawabe, 2009. *For expanding wood pellet demands, the presentation slide in promotion of wood pellet utilization symposium in 2009. Business Report on Stabilization of Wood Pellet Supply (HOWTEC),* p.23

[12] European Biomass Association, 2008. *A Pellet Road Map for Europe*, p.11

[13] Campbell, K., 2007. *A Feasibility Study Guide for an Agricultural Biomass Pellet Company*, Agricultural Utilization Research Institute, pp. 13-16.

[14] Japan Housing and Wood Technology Center (HOWTEC), 2007. *A Draft of Wood Pellet Standard*, pp. 3-13

[15] Pellet club, 2011. *Voluntary standards of wood pellet fuel, PC WPFS – 1:2011*, http://www.pelletclub.jp/jp/pressrelease/03-pellet20110606.pdf

[16] Iwate Prefecture, 2004. *Report on establishment work of wood pellet standard*, http://www.pref.iwate.jp/~hp0552/biomass/kikaku/wpellet_report.pdf