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Potential Demands and Marketing Policies for Green Electricity

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We evaluate the Willingness To Pay (WTP) of business entities and consumers for green electricity by Contingent Valuation Method (CVM) and consider its implications for a policy to expand the demand for green electricity.

Estimation results show that the enterprise and the consumer have higher amount of WTP for greener electricity. As for the general citizens, mean WTP is 600 yen / month. The mean WTP by members of the Hokkaido Green Fund whose environmental awareness is considered to be high is 1,000 yen / month.

We also examine the cost-effective promotion plan of green electricity considering the characteristic of such consumer preferences.

Key Words : *renewable energy, green electricity, willingness to pay, contingent valuation method*

1. Introduction

While the unemployment rates rises with the global recession, there is high expectation to the green New Deal policy that put emphasis on the job creation through public investment spending for environmental preservation. It is worth noting that the green New Deal address that investment for the environment contributes to job creation in the short term as well as the economic growth in the long term.

Although the Democratic Party of Japan has shown a positive attitude in their manifesto, its administrations' concrete policy on the greenhouse gas reduction strategy is still unclear. In addition, a detailed visions of how to achieve the emission target by 2020 have not been established.

The estimation of the cost of mitigating climate change has been reported in the media and objection is expressed by industry. However, without information on expected loss under the business-as-usual scenario or expected effect under the mitigation policy, citizens cannot judge the efficiency of the policy and therefore would not have enough incentive to cooperate in mitigation of global warming.

As for the green New Deal policy in Japan, expectation to renewable energy such as the photovoltaic (PV) power generation is particularly high. Understanding of the potential demand and designing of an adequate institution is necessary for promoting renewable energy in Japan.

The aim of this study is to estimate potential demand for renewable energy by the business entities and consumers and to show the direction for realizing and expanding the demand.

2. The trend the PV power generation policy

There have been many manufacturers dealing with PV power generation in Japan and the production volume and the quantity of domestic introduction was the highest in the world until some years ago. Although Japan has been left behind Europe with respect to renewable energy policy including photovoltaic electricity and experienced fall in international stature, Japan's position has been renewed since the subsidy to the PV installation in the households has been revived and the purchase price of the surplus electricity generated by the PV generation has been doubled in 2009.

Table 1 summarizes the institutional support to the residential PV generation in Japan: (1) the purchase subsidies for equipment, (2) tax benefits such as

Table 1 Support for houses with the PV generation

Type / Target	Initial incentive		Middle and long term incentive	
	Subsidies for facilities	Tax benefits		Subsidies for electricity generation
Houses	Introduce measures to support grants for residential solar power 【 Amount of assistance 】 70,000 yen/kW	Residential investment-oriented tax reform 【Target】 Already built 【Tax credit】 10% of construction costs	Mortgage tax break 【 Target 】 New construction 【Tax credit】 1.0% of loans outstanding at year-end (10 years)	Feed-in tariff 10-year purchase power at twice the surplus electricity prices Green Power Certificates buying up Purchase Green Power Certificates environmental value as their own consumption

mortgage tax break, and (3) a feed-in tariff (FIT) system for surplus electricity with a price twice as high as the electricity cost (48 yen/kWh) as preferential treatments.

In contrast to Germany and other foreign counties, the Japanese FIT system has been applied only to the surplus electricity generated. The possibility to extend it to the gross electricity generated has been examined now. On the one hand, the debate is on the extent of public financial burden by increase in the electricity bill to be allowed. On the other hand, attention should be paid to the benefits of environmental contribution and the energy security that the adaption of this new institution brings.

Anecdotal evidence in Germany show that application of FIT to gross electricity generated by any renewable sources with long duration (20 years) resulted in a rapid spread of the photovoltaic generation. Although there is an upward trend in electricity rate in Germany, the renewable energy consists around 5% of the electricity rate and does not contribute much to the price increase for the moment.

3. The consumer demand for green electricity

How much are the Japanese consumers willing to pay for clean energy?

The major part of the cost to purchase the green electricity for buyers is the difference of the electricity rate between the green electricity and the existing power supply because of cost of power generation. In addition, there is a transaction costs such as time and efforts to complete the switching of contract.

As for business entities, they can expect the improvement of societal evaluation of their activities and gain of economic return when stock prices increase as a result of the improvement.

Moreover, it is often more cost-effective to buy green electricity from the green power supply businesses than to introduce other energy-saving measures by oneself. When this is the case, business entities will be motivated to purchase the green electricity.

Economic entities compare the costs and the benefits brought about by the purchase of green electricity and purchase it when the benefits exceed the costs.

This paper evaluates the amount of willingness to pay (WTP) of the customer (business entities and consumers) for the green electricity supplied by the green-power-supply businesses and considers its implication on the public financial burden.[1)]

The amount of the WTP is estimated by using the Contingent Valuation Method (CVM). The CVM is a methodology classified as a stated preference approach and it clarifies the respondent's preference directly through a questionnaire. The advantage of applying the CVM instead of other methods is twofold. First, while it is difficult to collect market data on green electricity, we can estimate demand under hypothetical prices by adopting the CVM. Further, it is easy to examine the WTP under different institutional arrangement.

Though a lot of studies have investigated the payment intention for the green electricity with the CVM, there has not been a comprehensive study that has examined the WTP by various purchasers under a same framework. There is a significant need to do so for analyzing the development possibility of the green electric power market.

(1) Survey for business entities

We conducted a mail survey for business entities with cooperation from the Japanese Agency for Natural Resources and Energy and the Japan Research Institute Co., Ltd. The total number of entities receiving questionnaire was 4,300.

a) Samples: The invitation to the questionnaire was sent to the person in charge of environmental activity in each business entity.

- Randomly sampled business entities: 2,000

From the Tokyo Shoko Research Company's Database, we randomly selected 2,000 business entities (stratified by prefectures)

- Environmentally conscious business entities: 2,000

We randomly extracted 2,000 business entities from the list of environmentally conscious business entities. Those entities included companies that published environmental reports, member companies

Q19. What is the maximum amount that your company is willing to pay for this service in addition to your current rate of electricity charge? Please choose one from the list below.

0 yen							
0.1 yen	1.1 yen	2.1 yen	3.1 yen	4.1 yen	5.1 yen	6.1 yen	7.1 yen
0.2 yen	1.2 yen	2.2 yen	3.2 yen	4.2 yen	5.2 yen	6.2 yen	7.2 yen
0.3 yen	1.3 yen	2.3 yen	3.3 yen	4.3 yen	5.3 yen	6.3 yen	7.3 yen
0.4 yen	1.4 yen	2.4 yen	3.4 yen	4.4 yen	5.4 yen	6.4 yen	7.4 yen
0.5 yen	1.5 yen	2.5 yen	3.5 yen	4.5 yen	5.5 yen	6.5 yen	7.5 yen
0.6 yen	1.6 yen	2.6 yen	3.6 yen	4.6 yen	5.6 yen	6.6 yen	7.6 yen
0.7 yen	1.7 yen	2.7 yen	3.7 yen	4.7 yen	5.7 yen	6.7 yen	7.7 yen
0.8 yen	1.8 yen	2.8 yen	3.8 yen	4.8 yen	5.8 yen	6.8 yen	7.8 yen
0.9 yen	1.9 yen	2.9 yen	3.9 yen	4.9 yen	5.9 yen	6.9 yen	7.9 yen
1.0 yen	2.0 yen	3.0 yen	4.0 yen	5.0 yen	6.0 yen	7.0 yen	8.0 yen
					More than _____ yen		

NOTE: The amount indicated is per kWh. For example, the total additional expense would be one million yen when you agreed to pay one yen per kWh and your current use of electricity is one million kWh.

Fig.1 An example of the CVM question

of the green purchasing network[2], and companies that had purchased the green certificates.

・Public sector: 300

We sampled 300 entities from the list of public sector enterprises that included prefectural offices, government-designated major cities, municipalities that declared a new energy vision, and universities.

b) Executed: From January 19 to March 25, 2005

c) The response rate: 21.7%

d) The question format: payment card method

e) The object of evaluation:

The electricity supplied by 100% green energy ('Green 100') and supplied by 30% green power ('Green 30')

f) The payment vehicle:

We prepared two forms of the questionnaire: the yen version and the percentage version. The contents of the questionnaire and an example of the payment card are shown in **Figure 1**. When an entity had multiple offices, the questionnaire was focused on the office where the electric power use is the highest.

The yen version asked respondents to reveal their WTP in addition to the current electricity charge per one kilowatt-hour (yen/kWh). The percentage version asked respondents to reveal their WTP by the ratio (%) in addition to the current electricity charge.

g) Estimated Willingness to Pay:

We calculate the mean WTP by aggregating the selected amount by each business entity and dividing it with the total number of respondents. The average WTP for 'Green 100' was between 0.4 and 0.8 yen/kWh (**Figure 2**). While WTPs of public sector enterprises such as universities and local governments was expected to be high, they were actually lower compared to other business entities. This might be due to current deteriorating financial conditions.

Assuming 10 yen/kWh is the current contract of the electric bill, the estimated WTP implies that the business entities would be willing to pay 4% to 8% additionally. This is comparable to the mean WTP estimated by the percentage version of the questionnaire (between 3% and 6%). As for the 'Green 30', the estimated mean WTP is between 0.15 and 0.29 yen/kWh. This was less than WTP for the 'Green 100.'

The scatter plots in **Figure 3** show the relationship between WTP and the power consumption. In general, the WTP is higher when the power consumption is lower. **Figure 4** shows that WTP is higher when the interest in the green electricity is higher.

(2) Survey for households

As for households, the following 1,500 samples received questionnaires by surface mail.

a) Samples:

・General citizens: 1,000

Randomly samped from telephone directly (after

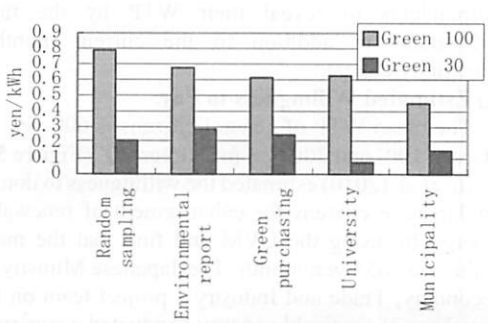

Fig.2 Estimated WTPs of business entities

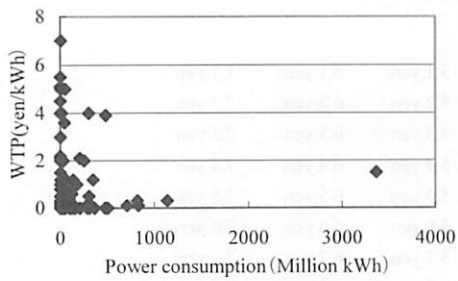

Fig.3 Power consumption and WTP

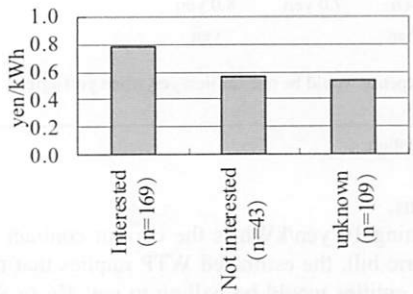

Fig.4 Degree of interest and WTP

stratification by administrative divisions)

・Environmentally conscious citizens: 500

Participants to the Hokkaido Green Fund, members of the PV network (PV-net)[3], and members of the Seikatsu Club Consumers' Co-operative Union

b) Executed: From January 19 to February 4, 2005

c) The response rate: 27.9%

d) The question format: payment card method

e) The object of evaluation:

The electricity supplied by 100% green energy ('Green 100') and supplied by 30% green power ('Green 30').

f) The payment vehicle:

We prepared two forms of the questionnaire: the yen version and the percentage version. The yen version asks respondents to reveal their WTP in addition to the current monthly electricity charge (yen/month). The percentage version asks respondents to reveal their WTP by the ratio (%/month) in addition to the current monthly electricity charge.

g) Estimated Willingness to Pay:

The mean WTP of general citizens is 600 yen for 'Green 100' and 300 yen for 'Green 30' (**Figure 5**).

Ito et al. (2010) estimated the willingness to donate of Japanese citizens for enhancement of renewable energy by using the CVM and find that the mean value was 653 yen/month. The Japanese Ministry of Economy, Trade and Industry's project team on the purchase of renewable energy conducted a survey in February 2010, and found that the acceptable burden by citizens for the introduction of renewable energy was 308.13 yen/month on average[4]. These values are roughly comparable to our estimates.

The mean WTP of the members of the Hokkaido Green Fund is the highest among the others. The mean WTP of the PV-Net members is as high as that of the general citizens. The reason for the high WTP of the members of the Hokkaido Green Fund might be because of their high awareness of spreading the renewable enrgy. On the other hand, members of the PV-Net might find an additional electric bill unrealistic since they actualy experience a fall in their electric bill by their own power generation.

When we compare the WTP between contributors to a green electricity fund and noncontributors, the former's WTP is twice as high. In addition, we find a tendency of higher WTP among higher-income groups.

Figure 6 shows that the mean WTP by households is higher than that by business entities. Though we should note the sampling bias caused by the mail survey, the high WTP for renewable energy generaly reflect the significant concern and expectation of consumers.

The results of this study show that general citizens are willing to pay 600 yen/month on average for introducing green electricity. This figure can be a basis for designing an appropriate institution for the FIT system in Japan.

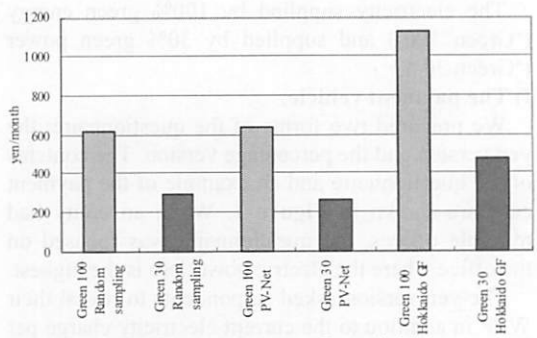

Fig.5 Estimated WTPs of households

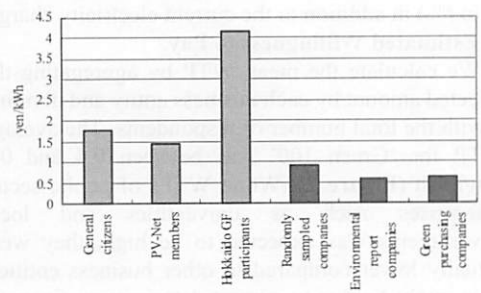

Fig.6 Comparison of WTP between subsamples

4. Institutional arrangement for promoting green electricity

We find that business entities and consumers have higher WTP for greener electricity. Moreover, mean WTP of general citizens is 600 yen/month and that of members of the Hokkaido Green Fund is 1,000 yen/month. To promote green electricity, it is necessary to adopt cost-effective measures that consider the characteristics of these customers.

In this section, we discuss the policy and institutional challenges on the supply side of green electricity based on the analysis in the previous section.

(1) Support for the supply side

a) The certification of green electricity

Recognition by consumers of the environmental characteristics of electricity generated from green energy is important factor for its supply. Certification of green powers is a mechanism to assess the quality, quantity and stability of power generation as a product by a third party. It is important to increase the reliability of certification for promoting the choice of green power. To increase the reliability of green power certificates, third-party organization that is not affected by particular interests should implement the authorization under the accurate criteria and fair and transparent process.

In Japan, the 'Green Energy Certification Center' established as an affiliated organization of the Institute of Energy Economics, provides the services of green power certificates. However, the Japanese green power certificates has been market-driven and its tradability and validity has not been secured. Effective public intervention is necessary until the market will be matured.

For example, public support is a significant factor of boosting the green-power-supply business overseas. In Canada, the certification standard of the eco-labeling scheme (Environmental Choice Program) is established based on the Canadian Environmental Protection Act Article 54[5]. In accordance with this act, certification standards for green power were established in 2002 by the Ministry of the Environment as 'eco-friendly power guidelines'. In the United States, a non-governmental organization played a key role to establishing a certification programme (Green-e) in 1997. The US government is also engaged in support activities such as subsidies for certification expenses, development of standards, advice to the management, information dispatch, and support by purchasing certified electricity[6].

While Japanese certification system has been promoted by the private sector, it is also important to consider the role of the government and to learn from the international best practices.

b) The technical aspect

Wind power generations suffer from large output fluctuation. To meet the requirements of using power transmission, a combination of wind power and other power source with enough speed and output is worth considering. Stabilization of power generation by these combinations is technically possible, though there have been few examples. In addition, grid connections of wind power have been limited in some region because of frequency variations. It is necessary to investigate the possibility of the green power supply business in this area. The reduction of the cost of grid connections will also be an important issue.

There is a possibility of combining green energy with various power sources including power storage such as a batteries and flywheels, fuel cells, hydro generation, and thermal power generation. Therefore, it is effective to develop a business model and examine full-scale experimental tests with various combinations of green electricity and adjustment power sources.

c) Financial assistance for the green-power-supply business

Private financial institutions have recently started investing in environmentally friendly businesses. Financial commodities such as eco-funds have gained popularity as well. Since the purchase of green electricity can be a screening criteria for an eco-fund, it is important to clarify the effects of purchasing green electricity, including product differentiation and improvement of the social reputation of the firm and the investor relation.

Expectations on public funds are also high. The cost of green energy is relatively higher than the conventional power supplies such as fossil fuel and nuclear energy. Green power supply is a relatively short-term business with various consumers and its risk is higher than the conventional new-energy-generation business that sells electricity to the electric power company on a fixed price for the long term. Thus, the characteristic of the project finance for a green power supply business will be different from that for the new-energy-generation business.

There would be a considerable amount of needs for policy-based lending in such a green-electricity-supply business. The Development Bank of Japan has been financing new-energy-generation facilities, implementing projects to promote environmentally conscious management, and providing low-interest loans depending on the degree to which enterprises incorporate environmentally friendly policies. Equity

finance and mezzanine loans will play an important role in financing the green-power-supply businesses.

(2) Support for the demand side

a) Improvement in cognition

Because green-power-supply business needs active participation of the consumers, it is important to improve their cognition. Therefore, it is necessary to provide information on the economic and environmental benefits of this business. In addition, it is important to respond to the various needs of the consumers when the supply side elaborates a marketing strategy.

While the green-power-supply business is based on private contract between consumers and suppliers, its success depends on the cooperation and activities by NPOs, public administration, educational institutions, and other organizations in the society. Improvement of the cognition by various stakeholders through public relations and information disclosure would be effective to expand the green electricity.

Although there are a lot of data and reports about the green electricity, information seems to be utilized ineffectively. Providing a platform for consumers to access this information is helpful for promoting the green-electricity programme. Education enlightenment will also help to improve society-wide cognition in the long run.

b) Mandatory greenhouse house gas accounting and reporting

Based on the Amendment Act on Promotion of Global Warming Countermeasures, those who discharge large amounts of greenhouse gases are obliged to report their amount of emissions to the government. The government has the obligation to aggregate and publicize this information under the Act.

If the purchase of green electricity (including the green electricity certificates) were deducted from the emissions under this scheme, there would be a significant incentive to push the demand of the green power.

The purchase of the green electricity can be a cost-effective measure to reduce greenhouse gases especially for business entities, which have already taken energy-saving measures in their establishment.

5. Conclusions

Although Japanese renewable energy is apparently booming, the vision for the long run is still unclear.

Due to the principle of a single year budgeting, the current FIT programme in Japan limits the subject to those who have installed the PV system in the past or within three years after the enforcement of the law. Support to renewable energy including the PV generation is also a temporal response to recession after the global financial crisis. In the absence of long-run visions, the renewable energy boom will pass soon and the business risk of the renewable energy will remain high.

Instead of the oppositions from industrial associations, our result shows that the people do intend to bear the cost for renewable energy. Therefore, it would be good to extend the current FIT programme to include all kinds of renewable energy.

According to the calculation of the Ministry of Economy, Trade and Industry, the cost burden for households to extending the current FIT programme to gross electricity generated by any renewable sources and network stabilization would be about 1,000 yen a month at the maximum. In order to disseminate the green power, it is important to reduce the cost of power generation and network stabilization as well as to develop the general public's understanding of the benefits of green power.

NOTES

1) The study is based on a survey by the Ministry of Economy, Trade and Industry Agency of Natural Resources and Energy (2005).

2) The Green Purchasing Network (GPN) was established in February 1996 as a collaboration between a company, the public administration and consumers to promote the purchasing of green commodities.

3) The PV Network (PV-Net) started as an NGO in which managers of Japanese photovoltaic power generation companies participated.

4) The document was distributed at the third meeting (March 3, 2010) of the committee for the purchasing of the renewable energy.

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