Applied Energy 88 (2011) 2519–2529

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

# What information should be provided in communications on biomass power generation?

Naoto Tagashira *, Yasuko Senda

*Socio-economic Research Center, Central Research Institute of Electric Power Industry, 2-11-1, Iwadokita, Komae-shi, Tokyo 201-8511, Japan*

ARTICLE INFO

*Article history:*
Received 30 June 2010
Received in revised form 7 January 2011
Accepted 7 January 2011

*Keywords:*
Renewable energy
Biomass
Green power
Mental model
Science communication

ABSTRACT

In order to promote the production and use of electricity generated from renewable energy sources, support schemes such as the Renewables Portfolio Standard and various green power programs have been implemented. When evaluating the costs and benefits associated with those schemes, people need accurate information about the characteristics of renewable generation. The objective of the present paper is to identify the kind of information to be provided to lay people in Japan in order to enhance their understanding of biomass generation. We used the two-stage "mental model" method to conduct open-ended interviews and a questionnaire survey to reveal people's beliefs about biomass generation. From the survey results, it was identified that the information to be provided should include the following: (a) definitions of biomass and biomass generation, (b) specific generation technologies, (c) the carbon neutral concept of biomass, (d) non-use of energy food crops in Japan, (e) sustainable availability of resources under certain conditions, and (f) high generation costs with their causes, such as collection costs of resources.



## 1. Introduction

Electricity generation from renewable energy sources such as solar, wind, and biomass has been increasing for reasons of climate change mitigation, energy security, etc. Because the generation costs of renewable generation are generally higher than those of conventional generation, various support measures are implemented to cover the costs. For example, green power programs, in which consumers voluntarily decide to pay higher electricity bills to support renewable energy development, are implemented around the world. Among the program types implemented around the world, the purchase of green power certificates has recently increased in Japan. The certificates represent the environmental attributes of electricity supplied from renewable sources. They can be sold separately from physical electricity. The Renewables Portfolio Standard (RPS) policy,[1] which requires electricity suppliers to source a percentage of supplies from renewable sources, has also been implemented in Japan. Under the RPS, suppliers bear the costs of meeting their targets, but those costs are shifted to consumers through electricity bills. Thus, consumers' acceptance of higher electricity bills is crucial for the implementation of the RPS.

The working group on the RPS policy in the New Energy Subcommittee of the Advisory Committee on Energy and Natural Resources [1] recommended that the government and electricity companies provide electricity consumers with information on support schemes such as the green power programs and the RPS. We think it is important to provide information not only on the schemes but also on renewable energy itself when consumers are considering whether or not to pay higher bills for those schemes.

Regarding information on renewable energy, messages to motivate electricity consumers to purchase green power were studied [2,3]. In terms of public attitude toward renewable energy in the context of support schemes in Japan, several studies exist on the preferences of energy sources used in green power programs [4,5] and the sources eligible under the RPS policy [6]; however, these have not examined the content of information given on renewable energy. The objective of this paper is to identify information content to be provided to lay people in Japan to enhance their understanding of renewable generation. We take biomass generation as an example of renewable generation, because biomass generation has increased rapidly in Japan owing to the RPS and green certificate programs. In addition, we think it is more difficult to understand this method of generation because of the wide diversity of its sources compared to generation using a single source such as solar or wind. Some studies exist on public attitude toward biomass generation. For example, Upham and Shackley [7] surveyed local public opinion about a specific power plant and Hite

* Corresponding author. Tel.: +81 3 3480 2111; fax: +81 3 3480 3492.
*E-mail address:* tagasira@criepi.denken.or.jp (N. Tagashira).

[1] Based on "Special Measures Law Concerning the Use of New Energy by Electric Utilities".

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doi:10.1016/j.apenergy.2011.01.020

et al. [8] examined consumers' willingness to pay for biomass generation. However, these have not dealt with information content to enhance people's understanding.

## 2. Method

We applied the two-stage "mental model" method originally developed to inform risk communications about climate change, power frequency electric and magnetic fields, etc. [9,10]. First, we conducted open-ended interviews with 30 individuals to determine their knowledge and beliefs about biomass generation. Several previous studies using interviews found that after about 20 interviews the rate of introduction of new concepts approaches an asymptote [9]; we therefore chose to interview 30. In addition, because Kosugi et al. [10] reported that this method works well when a target audience is interested in the field of subjects dealt with and has some knowledge of it, we recruited individuals who read about energy and environmental issues in the media and have heard of biomass generation (detailed requirements will be described in Section 3). We believe this screening makes sense because people reading information documents on support schemes for renewable energy, or the target audience in this study, is likely to meet these requirements. Second, we examined results obtained from the interviews through closed-form questionnaires administered to a much larger sample. On the basis of these survey results, we discuss information content to be provided to the target audience to bridge knowledge gaps and to remove misunderstandings about biomass generation.

## 3. Open-ended interviews

### 3.1. Design

We recruited interviewees from a consumer panel of a research company. First, we conducted a screening survey from January 29 to February 9, 2007, using the Internet, of 4173 residents in the Tokyo metropolitan area. Requirements for the sample through this screening survey were the following: (a) to be interested in environment and energy issues, (b) to read about energy and environmental issues in the media such as newspapers and magazines, and (c) to have heard of biomass and wind generation.[2] We also designed questions to exclude employees of companies related to energy or the media from the sample. The number of responses to the screening survey was 1035. Among 348 respondents meeting the above requirements, we recruited 30 interviewees, with ages ranging from 30 to 58. Concerned about extreme bias of gender in the relatively small sample of 30, we designed the number of men and women in the sample as identical. Fourteen interviewees were full-time employees, seven were full-time homemakers, six were part-time employees, and the remaining three were the self-employed.

The interviews were conducted from February 10–20, 2007. The interview protocols were structured so as to elicit respondents' beliefs related to biomass power generation. First, respondents were shown the term "biomass" and then asked to talk freely on the term. Second, they were shown "biomass power generation—power generation using biomass" and asked to do the same. For biomass power generation, they were also asked to talk about its "generation technologies," "advantages," and "disadvantages." We did this because, from results of interviews conducted with two researches and from a literature search [12–15] on biomass generation, we thought it important to investigate what respondents believe about these matters. Incidentally, we did not ask about generation resources, assuming that some respondents would lack the knowledge that biomass indicates certain resources. However, when respondents mentioned certain resources in connection with the term "biomass," we asked whether those resources were available for power generation or not.

After the interview on biomass generation, we went on to ask about other topics such as wind power generation, renewable energy, and global warming; these questions were designed for other objectives of our research. Each interview on biomass generation took 15–30 min, and the interview including other topics, about 1 h.

### 3.2. Results

#### 3.2.1. Biomass

Twenty-eight respondents knew that biomass is related to living things, some of the respondents mentioning specific resources. Only three of those respondents stated that biomass means material, while 11 regarded biomass as certain technologies or systems.

A majority of the respondents related biomass to energy: 25 referred to energy supply and 24 of them noted energy related to living things. Electricity generation was also mentioned by ten respondents. Nine mentioned plant-derived fuels: six of them used the term "ethanol" or "alcohol."

#### 3.2.2. Biomass power generation

Twenty-seven respondents related biomass power generation to living things (see Table 1). One of the remaining three regarded biomass as a term indicating a part of wind power generation facilities. For the following analysis, we exclude the remarks of this respondent because we think that this misunderstanding is an important finding, but should not be included for the target audience in this study. The remaining two respondents did not state specific generation technologies; Table 1 shows the results both including and excluding the remarks of these two respondents.

*3.2.2.1. Resources for electricity generation.* The most frequently mentioned resources were agricultural crops and waste products such as garbage. We then used the respondents' remarks to try to classify the food crops mentioned, such as corn, sugarcane, and soybean, into crops grown for energy use (energy crops), and residues, finding that more respondents saw them as energy crops.[3] Although 12 interviewees referred to microbes or bacteria, this number includes the interviewees who did not clearly mention them as resources.[4]

*3.2.2.2. Generation technologies.* For generation technologies, 11 respondents referred to combustion of gas produced by a process of fermentation of biomass resources. The same number of respondents mentioned a generation technology utilizing heat produced by a process of fermentation of biomass (we refer to this as "fermentation heat use"). Five respondents stated that combustion

[2] Choices in the question were "I can explain," "I know," "I have heard of," and "I don't know"; we recruited respondents from those with the first three. Concerned that respondents selecting "I have heard of" had few beliefs, we gave higher priority to those selecting the first two choices. Reported knowledge levels of 30 respondents were: "I can explain" (23%), "I know" (73%), and "I have heard of" (3%). Tsuchiya et al. [11] reported that for wind generation, 88% of the public answered "I can explain" or "I know" and that only 33% selected those choices for biomass generation. Given those percentages, the requirement about knowledge levels of wind generation might have less impact on recruitments than that about biomass generation.

[3] When respondents said "...grow crops for energy," "...use edible parts of crops," "Crops are also available for food," "Crops could not be available for food if used as energy," or stated expressions similar to these, we classified the crops into energy crops. When respondents referred to "Waste" or "Something residual," we classified them into residues. If a respondent used sentences in both categories for a single crop, we regarded the crop as belonging to both categories.

[4] Of nine respondents referring to ethanol combustion, six mentioned plant-derived fuels when asked "biomass," suggesting that the belief of this generation technology is related to their knowledge of plant-derived fuels.