SUMMARY

Study on Basic Zoning Information Concerning Renewable Energies (FY 2014)

The introduction of renewable energies is important not only as a countermeasure for global warming but also from such viewpoints as establishing energy security, developing autonomous and scattered energy systems and creating new industries and jobs. For this reason, the Ministry of the Environment (MoE) conducted the Study on the Potential for the Introduction of Renewable Energies in FY 2009 and FY 2010 and the Development of Basic Zoning Information in FY 2011 through FY 2013 to estimate the abundance as well as introduction potential of various types of renewable energies (residential use of PV power, use of PV for public buildings, wind power, small and medium-scale hydropower, geo-thermal power, geo-heat and solar heat) and their possible introduction amount by different scenarios with a view to developing basic data for the examination of viable measures to introduce and spread the use of renewable energies in the coming years. At the same time, basic zoning information was developed. The present work refined the potential of introducing renewable energies investigated in previous years and gathered as well as sorted out basic zoning information for the purpose of promoting the understanding and convenience of using and introducing renewable energies among citizens, public authorities and businesses, etc., thereby facilitating the introduction of such energies. In addition, the establishment and operating method of a portal size and a database system were examined for the disclosure and provision of basic zoning information.

1. Refinement of the Introduction Potential of Each Type of Renewable Energy

(1) Refinement of the Introduction Potential of Small and Medium-Scale Hydropower Generation

1) Examination of a Viable Method to Estimate the Introduction Potential Through the Development of the Breaking-Up of Virtual Power Plants with a Long Link

In the case of those virtual power plants with a link length of 5 km or more based on past study results, a method to break-up such a long link was examined to verify the effects of such breaking-up. Table 1 shows the results of comparison of the installed capacity before and after the first break-up. Table 2 shows the number and proportion of virtual power plants of which the unit construction cost following the first break-up is ¥2.6 million/kW or less. As this break-up allowed the inclusion of the flow volume along the link, the resulting installed capacity increased by approximately 1.3 times compared to the pre-break-up figure. The number of virtual power plants of which the unit construction cost is ¥2.6 million/kW or less also increased by approximately 2.2%.

Table 1 Comparison of the Installed Capacity Before and After the First Break-Up

Item	Installed Capacity
Total installed capacity before the breaking-up of virtual power plants with a link length of 5 km or more	2,330,769 kW (A)
Total installed capacity after the breaking-up of virtual power plants with a link length of 5 km or more	3,065,420 kW (B)
Installed capacity ratio: B/A ≠ 1.3	

Table 2 Number and Proportion of Virtual Power Plants of Which the Unit Construction Cost After the First Break-Up is Less than ¥2.6 million/kW

	Number of Virtual Power Plants of Which the Unit Construction Cost is Less than ¥2.6 million/kW	Proportion of Virtual Power Plants of Which the Unit Construction Cost is Less than ¥2.6 million/kW
Before break-up	1,152 sites	23.3%
After break-up	2,464 sites	25.5%
Change	Increase by 1,312 sites	Increase by 2.2%

2) Renewal of Basic Data

The elevation values, flow volume data and the formula to estimate the construction cost have been renewed. In the past, the elevation value of each segment was determined based on a digital map for elevation (50 m mesh) of the Geospatial Information Authority (GSI) of Japan. In the latest study, this method was changed to the use of fundamental geospatial data (digital elevation model with 10 m mesh) of GSI. As a result of this change, the average difference in elevation (i.e. the head of virtual power plants) decreased by approximately 1.67 m compared to the past study.

New flow volume data was gathered using the same method in the Report for the Nationwide Survey of the Abundance of Small Hydropower Generation Resources in FY 2008 published in March, 2009 by the Global Environmental Bureau of the Ministry of the Environment. As a result, the total maximum flow volume value based on the installed capacity decreased by some 10% compared to the corresponding value in 2009.

For estimation of the construction cost, it was decided to use the formula in the Handbook for Estimation of the Hydropower Plant Construction Cost published by the Resources and Energy Agency of the Ministry of Economy, Trade and Industry in March, 2013. As a result, the unit construction cost decreased across different link lengths (1,000 ~ 5,000 m with a 1,000 m pitch) by 12% to 25% compared to the results of the formula used for the 2009 study.

3) Re-Estimation of the Introduction Potential of Small and Medium-Scale Hydropower Generation

Using the results in 1) and 2) above, the abundance and the introduction potential were re-estimated. Fig. 1 shows the distribution of abundance (after correction)*. Before correction, 185,307 virtual power plant sites with a total installed capacity of 24.02 million kW were identified. After correction, the number of virtual power plant sites decreased to 32,418 with a total installed capacity of 16.85 million kW. Compared to the 2010 study results, the abundance before correction decreased by some 9% but the abundance after correction was almost the same.

* "Correction" here actually means two types of correction: correction based on the unit construction cost and correction based on the scale of the facility.

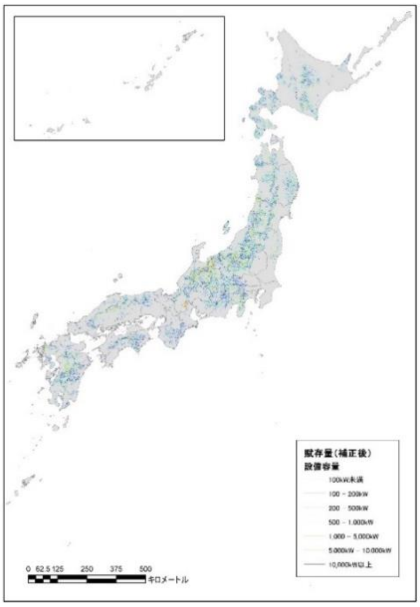

Fig. 1 Distribution of Abundance (After Correction)

(2) Refinement of the Introduction Potential of Geothermal Power Generation

Based on the distribution map of the resources density created in the Entrusted Detailed Study and Analysis of the Introduction Potential Concerning Geothermal Power Generation in FY 2013 of the MoE, the introduction potential by scenario (flash steam power generation and binary power generation) and the introduction potential at national and quasi-national parks were estimated.

1) Estimation of the Introduction Potential by Scenario

To estimate the introduction potential of flash steam power generation, three scenarios (purchase price of 38, 40 and 42 yen/kWh with a purchase period of 15 years) were set up for estimation based on the estimation conditions (project cost and specifications of equipment, etc., related costs and other relevant matters) used in the past study. As a result, the baseline introduction potential (involving no national or quasi-national park or directional drilling) was 6.18 to 6.55 million kW. The conditional introduction potential (1) (involving no national or quasi-national park but involving directional drilling) was 9.60 to 10.63 million kW while the conditional introduction potential (2) (involving a national or quasi-national park but not directional drilling) was 10.86 to 11.92 million kW.

To estimate the introduction potential of binary power generation, three scenarios were considered for each temperature range of between 120°C and 150°C and between 120°C and 180°C. These scenarios were the baseline scenario (involving no national or quasi-national park or directional drilling) and two cases of conditional introduction potential (2) (involving a national or quasi-national park but not directional drilling) with drilling excavation and without the consideration of drilling. For this estimation exercise, the same estimation conditions (except for a change of the transmission line construction cost) and three scenarios (purchase price of 40, 50 and 60 yen/kWh (inclusive of the drilling cost) or 38, 40 and 42 yen/kWh (exclusive of the drilling cost) with a purchase period of 15 years) used for flash steam power generation were also used. As a result, the baseline introduction potential (involving no national or quasi-national park or directional drilling) for the temperature range of between 120°C and 180°C with the drilling cost being included was estimated to be 52,000 to 490,000 kW. In the case of the temperature range of between 120°C and 180°C with the drilling cost being not included, the introduction potential without drilling was estimated to be 8.33 million kW to 9.5 million kW.

2) Estimation of the Introduction Potential at National and Quasi-National Parks

The introduction potential of geothermal power generation in national and quasi-national parks was estimated for each of the different cases featuring flash steam power generation (temperature of ≧ 150°C, ≧ 180°C and ≧ 200°C), binary power generation (temperature of between 120°C and 150°C and between 120°C and 180°C) and low temperature binary power generation (temperature of between 53°C and 120°C and between 80°C and 120°C) Some examples of the estimation results are shown in Table 3.

Table 3 Examples of the Introduction Potential Estimation Results for National and Quasi-National Parks (Flash Steam Power Generation with a Minimum Temperature of 150°C)

(Unit: million kW)

Category of Park Overground/ Underground	Outside National or Quasi-National Park	Ordinary Area	Class 3 Special Area	Class 2 Special Area	Special Protection Area and Class 1 Special Area
Overground	6.68	1.17	3.17	3.01	(Outside the scope of estimation)
Underground (directional drilling)	(Outside the scope of estimation)	(Outside the scope of estimation)	1.49	2.60	2.15

* The introduction potential in the underground (with directional drilling) covers an area within 1.5 km of the perimeter (as long as it is not included in an area subject to a higher level of protection).
* The perimeter means the boundary between the park in question and a lesser ranked park.

(3) Refinement of the Introduction Potential of Geo-Heat (Heat Pump)

1) Examination of the Feasibility of Estimating the Introduction Potential for Agricultural Facilities

The available literature concerning the thermal demand at agricultural facilities was gathered to establish the amount of thermal demand and affecting factors (site area, ambient temperature, indoor temperature, external wall materials, agricultural products and others). The feasibility of estimating the introduction potential was examined in reference to three possible approaches: ① estimation by mesh as a unit using the relevant GIS data, ② estimation by prefecture as a unit using statistical data on thermal demand and ③ estimation by prefecture as a unit using statistical data on agricultural products. Approach ③ was judged to be a feasible method and a trial was conducted to estimate the thermal demand for heating at agricultural facilities, usable amount of heat when geo-heat is used and the introduction potential of geo-heat. The estimated results were 11.9 billion MJ/year for the thermal demand for heating at agricultural facilities, 16.8 billion MJ/year for the usable amount of heat when geo-heat is used and 11.1 billion MJ/year for the introduction potential of geo-heat.

2) Estimation of the Introduction Potential of Geo-Heat by Scenario (Heat Pump)

Apart from a study on the basic thermal demand unit, maximum heating/air-conditioning load, annual thermal load, etc. by building category, information was gathered and sorted out regarding such matters as the initial investment amount for a typical example of introducing the use of geo-heat (installation cost of a heat exchange well for geo-heat and cost of a heat pump unit using geo-heat as the heat source), the initial investment cost of a baseline system (cost of a heat pump unit using air as the heat source, plumbing cost, trial operation cost, etc.), income plan (reduction of the payable electricity charge) and expenditure plan (repair expenditure). Based on such information, the baseline figures, COP of the absorption chiller-heater and unit cost of the maximum heating load using a oil-fired boiler were determined. This was followed by determination of the conditions for trial calculation of the project viability after some revisions, including deletion of the correction coefficient for the heat collection rate. Based on these conditions, the introduction potential was re-estimated for each scenario concerning the subsidy, etc. The results were 1.79 million to 139.31 million kW for the installed capacity and 13.7 billion to 418.1 billion MJ/year for the heat supply (Table 4).

Table 4 Introduction Potential by Scenario for the Utilization of Geo-Heat (Heat Pump)

No.	Scenario Title	Contents	Installed Capacity (million kW)	Heat Supply (billion MJ/year)
1	BAU (Business as Usual)=Status Quo	No subsidy or any other special measures are introduced.	1.79	13.7
2	Geo-Heat Energy Mix	Installed capacity: 50%; Annual thermal load: 67%	5.58	68.2
3	Introduction of Subsidy	Subsidy rate: 33%	38.78	174.5
4		Subsidy rate: 50%	139.31	418.5
5	Geo-Heat Energy Mix + Subsidy	Installed capacity: 50%; annual thermal load: 67%; subsidy: 33%	54.05	346.4
6	Purchase Assumed	Assumed purchase price (assumed to be similar to that of PV power generation (minimum output of 10 kW (whole amount purchase)): ¥36/kWh	34.17	346.3
7	Technological Development	20% off both the initial investment and running	27.78	135.6

3) Planning of a Questionnaire Survey to Refine the Basic Thermal Load and Thermal Demand Units

The categories subject to a priority study were selected from 11 categories of building for which the introduction potential, etc. was to be estimated. This was followed by the establishment of the concrete buildings subject to the said study in each prioritised category and the likely study contents were examined. A questionnaire survey sheet (draft) was also prepared in relation to determination of the basic thermal load and thermal demand units.

2. Consolidation of Basic Zoning Information on Each Type of Renewable Energy

(1) Consolidation of Basic Zoning Information on Wind Power Generation

The possibility of GIS data requiring sorting out in addition to GIS data on the basic zoning information list prepared in the past study was reviewed to update and consolidate the listed data. Information which was judged to command high priority among the listed information and which could be made into GIS data within FY 2014 was made into GIS data (Figs. 2 and 3).

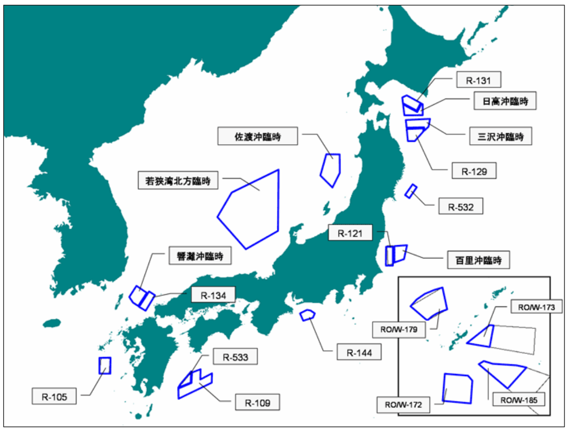

Fig. 2 Map Showing Target Practice Zones, etc. for the Japan Air Self-Defence Force

Fig. 3 Map Showing Farming Areas

(2) Consolidation of Basic Zoning Information on Small and Medium-Scale Hydropower Generation

Based on the updated introduction potential data, 27 especially promising virtual power plant sites were selected and various types of relevant information, including a local map, specifications of these virtual power plants and estimated flow duration curve were arranged in the form of a standardised case file format(26 file) (Fig. 4).

Of these promising virtual power plant sites, two sites with unclear site conditions were selected to compare the inferred data with actual data collected on-site.

Fig. 4 Example of Case File

(3) Consolidation of Basic Zoning Information on Geo-Heat Utilisation (Heat Pumps)

There are three principal sources of useful information on local areas in connection with the utilisation of geo-heat (heat pumps). These are (i) KuniJiban, a search site for national geotechnical information jointly operated by the Ministry of Land, Infrastructure, Transport and Tourism and the Airport Research Institute, (ii) Water Environment Maps published by the National Institute of Advanced Industrial Science and Technology and (iii) heat collection rate of the ground in each locality estimated in the FY 2013 study. The possibility of making the information/data provided by these sources into GIS data was examined. The likely visual presentation of such information/data to users was also explored.

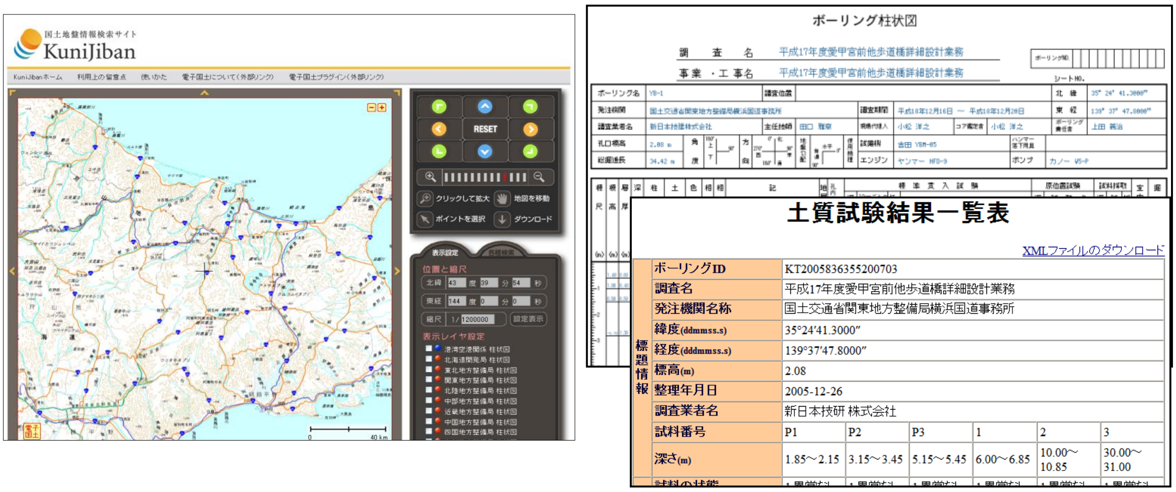

Fig. 5 Presentation of Data on KuniJiban Web Pages

3. Public Release of Basic Zoning Information and Examination of an Information System

(1) Examination of Methods to Develop and Operate a Portal Site

Based on the results of the past study, the situation of the consolidation of principal information which should preferably be dealt with by a portal site was rechecked. In regard to the types of information which have not yet been consolidated, the necessity and priority of such information was determined. A concrete way of materialising “the required functions of a portal site” was also examined. An interview survey with the administrators of those portal sites of which the operating criteria, operating conditions and operating system would constitute useful references for the planned portal site and a draft operating method for the planned portal site was prepared.

(2) Examination of the Development and Operating Method of a GIS System

Based on the results of the past study, an efficient as well as effective form of a GIS system with a low operating load was examined to handle the results of the past study, followed by further examination of the desirable functions, operation management, expandability and other aspects of this system. Also compiled were the types of information to be dealt with by this GIS system, method of transmitting updated data, screens for the principal contents concerning the database system and draft screen transition procedure. In regard to the GIS system operating method, the likely monitoring items of the operation were examined.