

SUMMARY

Study on Basic Zoning Information Concerning Renewable Energies (FY 2013)

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 and FY 2012 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, onshore and marine wind power, small and medium-scale hydropower, geo-thermal power, geo-heat and solar heat) and their possible introduction amount(except for geo-heat and solar heat) 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 as well as preparing basic zoning information. At the same time, basic zoning information was developed.

The present work refined the potential of introducing renewable energies investigated in past years and examined a viable mechanism where basic zoning information such as (i) possible impeding factors other than negative environmental impacts and (ii) intentions of stakeholders to introduce renewable energies would be gathered, sorted out and centrally offered to external users. The work was conducted for the purpose of promoting the understanding and convenience of using and introducing renewable energies among citizens, public authorities and businesses, etc.

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

(1) Refinement of the Introduction Potential of PV Power Generation for Residential Use

The installation coefficient for detached housing, etc., which has the largest introduction potential for PV power generation for housing, was revised taking the roof shape by prefecture into consideration. As a result, the introduction potential was estimated to be 210 million kW, 223 billion kWh/year. For the purpose of determining the possible introduction amount by scenario, three scenarios (purchase price of ¥30, ¥35 or ¥40/kWh) were set for separate estimation. The resulting possible introduction amount by scenario ranges from 26 to 140 million kW or from 28 to 145 billion kWh/year.

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

1) Refinement of the Introduction Potential of Onshore Wind Power Generation

In regard to the conditions of development unfeasibility introduced in the study in past years, “restriction by the Civil Aeronautics Act” was added for further refinement. An equipment use factory of 0.1 m/s of the mean wind velocity was set based on Rayleigh distribution and power curve data (onshore: 2,000 kW, maritime: 5,000 kW) to estimate the potential power generation capacity. The estimated introduction potential is 270 million kW

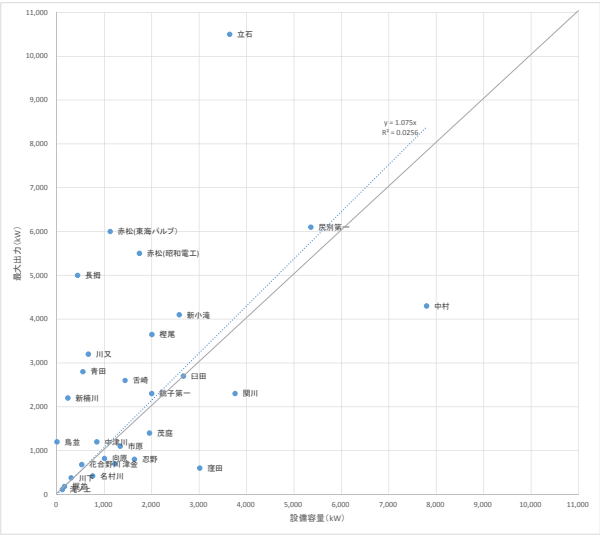
or 610 billion kWh/year. Four scenarios (purchase price of ¥15, ¥20, ¥22 and ¥25/kWh) were set to determine the possible introduction amount by scenario taking an equipment use factor of 0.1 m/s of the mean wind velocity into consideration. The resulting possible introduction amount by scenario ranges from 71 to 240 million kW or from 220 to 560 billion kWh/year.

2) Refinement of the Introduction Potential of Marine Wind Power Generation

The introduction potential of marine wind power generation was estimated this year with the same conditions of development unfeasibility used last year. Meanwhile, the wind velocity (80 m above the ground) on the wind conditions map was corrected to the wind velocity at 90 m above the ground as this is the common height for the hub of an offshore wind generator. As a result, the introduction potential (with a minimum wind velocity of 6.5 m/s and some exemptions for islands) was estimated to be 1,060 million kW or 2,700 billion kWh/year. Four scenarios (purchase price of ¥22, ¥25, ¥30 and ¥35/kWh) were set to determine the possible introduction amount by scenario taking an equipment use factor of 0.1 m/s of the mean wind velocity into consideration. The resulting possible introduction amount by scenario (with a minimum wind velocity of 6.5 m/s and some exemptions for islands) ranges from 6.5 to 840 million kW or 19 to 2,200 billion kWh/year.

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

The suitability of the equipment capacity of a virtual power plant was checked by comparing it to the maximum output of existing power plants. To be more precise, some 30 existing power plants were selected on the conditions that the plant is a run-of-river plant and its intake and outlet are both located along the same river. For each of these, the equipment capacity of the virtual plant of which the locations, elevation and gradient of the intake and outlet points were determined to be similar to those of the existing power plant as much as possible was calculated for comparison with the maximum output of the existing power plant in question. Initially, no correlation was found as the value of the coefficient of determination (R^2) was 0.0256 (value of intercept = 0). However, more detailed examination was conducted for those sites where the comparison results were judged to be greatly under-estimated or over-estimated. As a result of removing those sites for which the causes of under-estimation or over-estimation were identified, the coefficient of determination (R^2) improved to 0.5185 (value of intercept = 0), confirming sufficient correlation between the two sets of power plants.



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

A bibliographic survey and interview survey were conducted, and updated the prerequisite for the purpose of refining the introduction potential. As a result of these, the introduction potential was estimated to be 1,321 billion MJ/year.



Fig.2 Distribution Map of Introduction Amount of Geo-Heat

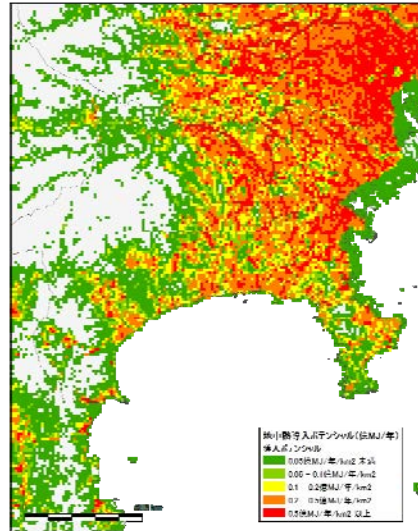


Fig.3 Distribution Map of Introduction Amount of Geo-Heat (Larger sample figures)

(5) Refinement of the Introduction Potential of Solar Heat

A bibliographic survey and interview survey were conducted to refine the introduction potential of solar heat by revising the existing data on the amount of solar radiation, heat collection efficiency, categories of target buildings and demand characteristics, etc. by category of individual buildings. As a result, the introduction potential was estimated to be 435.5 to 489.8 billion MJ/year.

2. Consolidation and Transmission of Basic Zoning Information

(1) Consolidation and Transmission of Basic Zoning Information on PV Power Generation for Public Buildings

An interview survey was conducted with those administrative bodies with jurisdiction for the categories where the increased introduction of PV power generation is hoped for. This survey featured actual examples of introduction, relevant policies and plans, available assistance for introduction and constraints and the findings were compiled in a standardized case file format.

(2) Consolidation and Transmission of Basic Zoning Information on Wind Power Generation

Constraints for the introduction of wind power generation were listed and the relevant information was gathered. Among the different categories of information gathered, some categories were considered to be more significant than others. These are “flight route radar”, “areas above the approach surface and other restricted surfaces”, “principal fishing grounds” and “designated training areas for US military forces” and GIS data for these categories were created. A questionnaire survey was conducted with 47 prefectural governments, 103 port management bodies and 111 municipalities with a high level of introduction potential and their intentions to introduce wind power generation were plotted on a map.

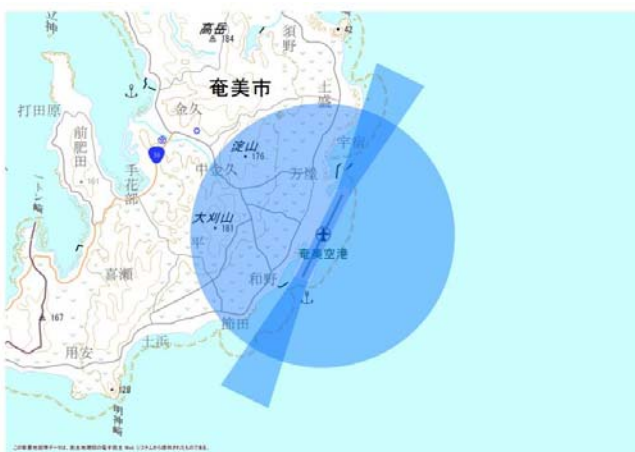


Fig.4 Area Above Approach Surface and Other Restricted Surfaces (Example: Amami Airport)

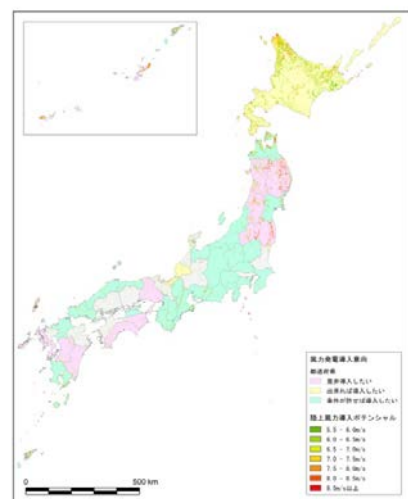


Fig.5 Map Showing Level of Intentions to Introduce Wind Power Generation

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

Using a secondary mesh (10 km x 10 km) of which the total introduction potential is 7,500 kW or higher, 30 promising sites in view of the distribution of the equipment capacity of virtual power plants, link length and topography were selected. A discharge duration curve was then prepared for each promising site based on the relative ratio of the catchment area for the site and the catchment area for the relevant block, in turn based on the discharge duration curve by block prepared by this study in FY 2009. A questionnaire survey was conducted with 28 prefectural governments of which the jurisdiction areas contain these 30 promising sites for the purpose of checking the intentions of these local governments to introduce small and medium-scale hydropower generation. Based on the findings of this questionnaire survey and the opinions expressed by the advisors, an image of a standardized case file format organizing information on promising virtual power plants (one selected from each mesh) was prepared from the viewpoint of providing necessary information to facilitate the development efforts of those bodies intending to proceed with the development of small and medium-scale hydropower generation.



Fig.6 Image of the Standardized Case File Format

(4) Consolidation and Transmission of Basic Zoning Information on Geothermal Power Generation

A questionnaire survey was conducted with 10 prefectural governments with a high introduction potential for geothermal power generation and 10 hot spring associations of which the geographical areas have a high concentration of sites with introduction potential. A map plotting the intentions of these prefectural governments and associations was then produced.

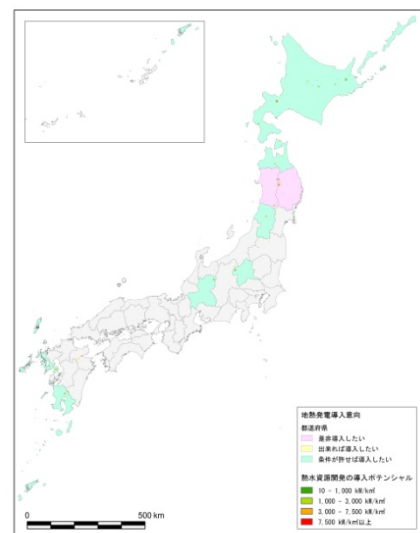


Fig.7 Map of Intentions of Introducing Geothermal Power Generation

(5) Consolidation and Transmission of Basic Zoning Information on Geo-Heat Utilisation (Heat Pump)

The latest information on three subject matters was gathered and sorted to prepare GIS data on industrial water-related national laws and municipal ordinances. The subject matters were ① laws relating to general restrictions on the use of geo-heat, ② laws and municipal ordinances relating to restrictions on groundwater extraction and ③ municipal ordinances relating to effluent standards and requirements for ground infiltration. In addition, useful information for the introduction of heat pumps using geo-heat was arranged by geographical area and information which could be developed into GIS data was sorted using the standardized case file format. An interview survey was also conducted with administrative offices with jurisdiction for those categories where the increased introduction of heat pumps using geo-heat was especially hoped for. The subject matters of this survey included actual cases of introduction, relevant policies and promotion plans, available support for introduction and constraints. The findings of this survey were then arranged using the standardized case file format.

(6) Consolidation and Transmission of Basic Zoning Information on Solar Heat Utilization

Solar radiation data by geographical area was gathered and a map showing the said data was produced.

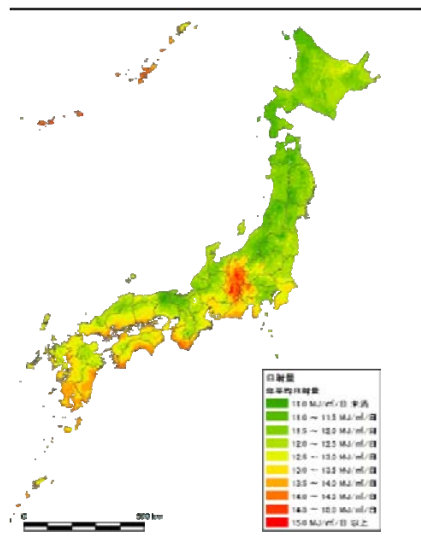


Fig.8 Solar Radiation Map by Geographical Area

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

Data from the Study in FY 2012 and FY 2013 for public release was produced while information to be handled at the portal site for renewable energies was examined by means of sorting out the principal needs concerning the promotion of the introduction of renewable

energies. In addition, multiple tentative options for the information service system were compared with reference to other information service sites.

Table 1 Comparison of Various Information Service Systems

| | | Item | Type 1 | Type 2 | Type 2+ | Type 3 | Type 4 |
|----------------------------|---------------------------|--|--|--|--|--|--|
| Functions as a Portal Site | Main Targets | Businesses and local governments | Businesses and local governments | Businesses and local governments | Businesses and local governments | Businesses and local governments | General public, businesses and local governments |
| | Composition and Functions | Simple composition with limited functions, including search and topics | Relatively simple composition with limited functions, including search and topics | Acceptance of information inputs in addition to search and topics functions | Acceptance of information inputs in addition to search and topics functions | Acceptance of information inputs in addition to search and topics functions | Acceptance of information inputs, distribution of mail magazines and videos in addition to search and topics functions |
| | Information Provided | Information relevant to the examination of business start-up potential | Information relevant to the examination of business start-up potential, promotion measures and news from local governments | Information relevant to the examination of business start-up potential, promotion measures and news from local governments | Information relevant to the examination of business start-up potential, promotion measures and news from local governments | Information relevant to the examination of business start-up potential, promotion measures and news from local governments | Information for the general public plus information relevant to the examination of business start-up potential, promotion measures and news from local governments |
| | Map Information | Supply of GIS data through a simple downloading tool | Distribution of basic minimum information via the website | Distribution of basic minimum information via the website | Distribution of basic minimum information via the website | Distribution of data through a database on the website | Distribution of data through a database on the website |
| | Operation | Simple text information only | Response to enquiries as required and preparation and renewal of data at an appropriate time | Response to enquiries as required and preparation and renewal of data at an appropriate time | Response to enquiries as required and preparation and renewal of data at an appropriate time | Response to enquiries as required and preparation and renewal of data at an appropriate time | Deployment of an exclusive operator and preparation and renewal of data at an appropriate time |
| Possible Size of Cost | Construction Cost | Design and Construction | Low | Rather Low | Rather High | Rather High | High |
| | | Gathering and Preparation of Information for the Website | Low | Rather Low | Medium | Rather High | High |
| | | Map Information Service | — | Rather Low | Rather Low | Rather High | Rather High |
| | | Sub-Total | Low | Rather Low | Medium | Rather High | High |
| | Operating Cost/Year | System Management/Improvement | — | Low | Low | Rather High | High |
| | | Gathering and Preparation of Data for the Website | Low | Low | Medium | Rather High | Rather High |
| | | Sub-Total | Low | Rather Low | Medium | Rather High | High |
| Actual Examples | Portal Site | Environmental Impact Assessment Network, MoE | Energy of Fukuoka, Fukuoka Prefectural Government | Off-Site Decontamination Measures Site, MoE | Off-Site Decontamination Measures Site, MoE | Understanding Renewal Energies, MoE | |
| | Supply of Map Information | Present state (use of a simple viewer) | Energy of Fukuoka, Fukushima Prefectural Renewable Energy Database | Energy of Fukuoka, Fukushima Prefectural Renewable Energy Database | Off-Site Decontamination Measures Site, MoE, Basic Environmental Information Database System | Off-Site Decontamination Measures Site, MoE, Basic Environmental Information Database System | |