

100% electric power potential of PV, wind power, and biomass energy in Awaji island Japan



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ABSTRACT

This study discussed the electric energy potential of renewable energy in Awaji Island, Japan. In addition, the electric energy self-sufficiency ratio of renewable energy in 2050 was estimated in order to investigate the possibility of achieving 100% electric energy potential through renewable energy. We targeted renewable energy sources such as biomass, wind power, and PV. Firstly, the available energy from biomass was calculated. Next, the electric energy potentials from wind power and PV were also estimated, taking into account the current situation of island operations and future plans for instalment. The 2010 electric energy demand in Awaji Island was then calculated using statistical data. We also designed eight scenarios combining future forecasts of population and GDP and energy shifts.

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Abbreviations: BAU, Business as Usual; GDP, gross domestic product; GIS, geographic information systems; IEA, International Energy Agency; KEPCO, Kansai Electric Power Co., Inc.; METI, Ministry of Economy, Trade and Industry; MOE, Ministry of Environment; MIC, Ministry of Internal Affairs and Communications; NEDO, New Energy and Industrial Technology Development Organisation; NLNI, National Land Numerical Information; PV, photovoltaics; SEPCO, Shikoku Electric Power Co., Inc.; WBCSD, World Business Council for Sustainable Development

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1. Introduction

Japan relies on external imports for 96% of its national primary energy needs. Energy supply conditions in Japan are extremely sensitive to global issues such as the drawdown of energy resources, climate change, and energy security. One strategy that can help mitigate these issues is the promotion of renewable energy use for Japanese distribution. The energy self-sufficiency percentage by renewable sources was only 4.4% in 2010 [1]. However, after the massive earthquake in eastern Japan and the Fukushima nuclear power plant accident in March 2011, more focus has been placed on renewable energy as an alternative to nuclear power. The Japanese government has started a Feed-in Tariff scheme, which has been in place since July 2010. This scheme aims to promote the instalment of photovoltaics (PV), wind power, small amounts of hydropower, biomass, and geothermal power [2]. Renewable energy is also important for the preservation of regional electric energy supplies in the face of major incidents such as earthquakes. The sufficient instalment of renewable energy facilities in the region can provide a faster recovery from unexpected accidents.

Based on the above considerations, the construction of energy systems utilising renewable sources in this region is needed. However, an analysis of the renewable energy distribution in the region, an understanding of this spatial distribution, and an evaluation of energy demand and population in the region are required prior to the construction of a regional energy system. The aim of this study is to estimate the electric energy potential of renewable sources in Awaji Island, Japan. In addition, the electric energy self-sufficiency ratio of renewable sources in 2050 was estimated in order to investigate the possibility of achieving 100% electric energy potential through renewable energy. This study also discusses strategies to achieve a 100% electric energy self-sufficiency ratio in Awaji Island, based on the above estimates.

A number of studies have evaluated renewable energy potentials, not only in Japan but also worldwide. For example, the MOE [3] estimated the energy potentials of PV, wind power, hydropower, and geothermal power in Japan. The Institute of public energy [4] estimated current energy self-sufficiency ratios in Japanese cities, considering renewable energy potentials and regional energy demand. Assessments of renewable energy potential using biomass, wind power, PV, and other sources were carried out [5–7]. In particular,

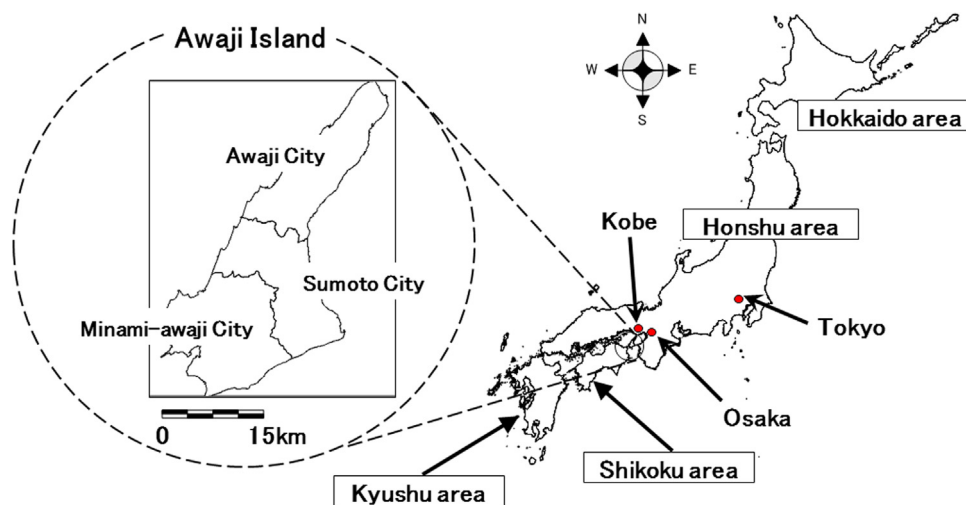


Fig. 1. Location of Awaji Island.

Table 1
Characteristics of the Awaji Island.

Coordinates	34° 23' N 134° 50'E
Land area	595 km ²
Annual average temperature	16 °C
Annual average precipitation	1,300 mm
Population (2010)	144,000
Household (2010)	52,900
Gross domestic products (2012)	3.61 billion USD* (Primary industries: 6.6%, Secondary industries: 19.0% and Tertiary Industries: 74.4%)
Shipment value	1.44 billion USD* (Manufacture of electrical machinery, equipment and supplies: 36.0%, Manufacture of food: 15.9%, Manufacture of production machinery: 14.9% and rest of the industry: 33.2%)

* 1USD=119.07JPY (28/4/2015)

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