

Electricity supply largely from solar and wind resources in Japan

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[Excerpt]

This paper reports on the national renewable electricity supply provided largely by solar and wind power, together with hydro, geothermal and biomass in Japan. Dynamic simulations were performed to calculate the electricity supply with hourly weather data regarding solar radiation and wind speed for the electricity demand in a target year approximately 2050. Simulations with different parameters reveal the relationships between energy storage, excess energy and back-up energy.

The optimal mix of solar and wind power was analysed following statistical methods reported in European studies. Using national weather data of Japan, dynamic simulations of the annual renewable electricity supply and the analysis of the results are presented.

The main conclusions drawn are as follows,

- 1) Preliminary statistical analyses show that the standard deviation and the stored energy derived from the mismatch equation for Japan are smaller than the results reported for the European case. The Japanese case shows that a combination of 75% solar and 25% wind minimises the standard deviation.
- 2) Dynamic simulations show that energy storage is effective in reducing back-up and excess power, but the marginal effect is reduced when the storage capacity increases. The realistic electricity storage capacity is estimated to be approximately 5 times that of pumped hydro today.
- 3) To minimise the sum of back-up, excess power and battery loss in the dynamic simulations, the optimal combination is the shares of 50% solar and 20% wind of the annual load, with the remaining 30% supplied by other renewable sources and back-up power. The optimal ratio of solar and wind power is nearly the same as that determined by the statistical study.