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Cost Estimation of Wind Farm with Battery-supported Output Power Limit Operation

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Abstract. Due to shortage of a controllable capacity during night, a secondary battery is strongly expected to a newly installed grid-connected wind farms in some areas of Japan. However, the battery is nowadays too expensive for a wind farm developer to keep their generation cost competitive. It is therefore strictly needed to establish an optimal battery strategy to satisfy both of stability of output and cost-effective installation.

In this reports, a fundamental case study is discussed to estimate the cost for battery installation to a wind farm with output power limit operation. Using real wind condition data from a typical meteorological observatory, an annual electric energy generated from wind farms with various battery capacities is estimated regarding with a nighttime wind condition. As the result of the annual production estimation, it became clear the relationship between the battery capacity and the energy production cost.

Key words

Wind turbine, Secondary Battery, Output Power Limit Operation, Reservoir, Balancing.

1. Introduction

Wind power generation now achieves a remarkable breakthrough with 159-GW worldwide install capacity at the end of 2009 [1]. In contrast, Japan's situation with 2,186 MW at the end of 2009 would be just a symbolic "yellow signal" of the fact that Japan is almost certain to miss its goal for 3,000-MW installation by 2010, which was the political target set by METI (Ministry of Economy, Trade and Industry) in 2001.

The main reason is considered to be Japan's special condition of electric network. The land of Japan extends from northeast to southwest, divided by a several cannels. Moreover, the country is divided to two different frequency areas at the middle of its land and the four main islands are divided into nine areas for nine grid-operating companies (see Fig.1). Although huge metropolitans with heavy electricity consumptions lie in "Tokyo", "Chubu" and "Kansai" grid areas, such areas have few suitable sites for wind power generation because of limited space due to highly populated areas in flat plains or steep mountains. On the other hand, windy and low-populated areas suitable for wind farm installation are distributed in "Hokkaido", "Tohoku" and "Kyushu" grid area (see Fig.2). As easily understood from the figure, a kind of "mismatch" between electricity consumption and installed wind power capacity can be seen in Japan presently.

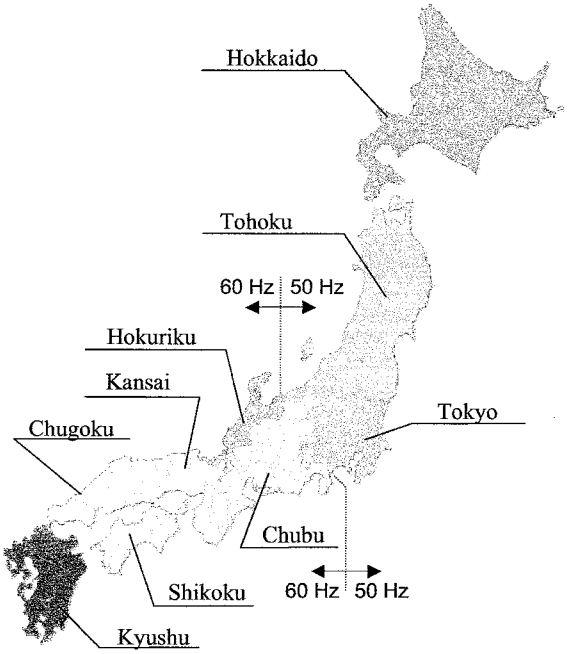

Fig.1. Nine grid areas in the main islands in Japan

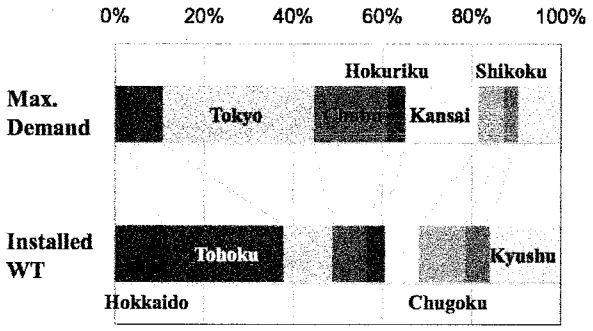

Fig.2. Maximum demands and installed wind turbines in nine utility grids in the main islands of Japan
(Data from NEDO web site, 2010 and METI web site, 2010)