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Renewable Energy Development for Buildings

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Abstract

At the background of urbanization in China, energy consumption of buildings has been ranked as the second largest sector among the industry, building and transportation. Consequently, the renewable energy adopted in buildings has been quickly developed since the Chinese policy, which shifts 60% of total photovoltaic applications to the building sector, was enhanced. This paper discusses suitability of renewable energy applied in buildings, including solar thermal energy (ST), photovoltaic (PV) and geothermal heat pump systems (GSHP), based on GIS database and operation data analysis. GIS-based tools are also developed for evaluating suitability of renewable energy applied in buildings.

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Keywords: photovoltaic (PV); solar thermal (ST); geothermal heat pump (GSHP)

1. Background

New goals of renewable energy development are established in new Chinese policies, in which the proportion of non-fossil energy including renewable energy is expected to reach 15% and 20% respectively in the years of 2020 and 2030 [1-2]. As shown in Fig1, in the next five-year plan (2016-2020), China has also set up application goals of renewable energy in the building sector. In this plan, the proportion of renewable energy consumption in new buildings of the demonstration areas should accounts for more than 10% of the total energy consumption [3-4].

The development research of renewable energy in buildings of China has been tried by the top-down approaches. The application scope and technical level of solar energy and GSHP have been rapidly

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progressed since 2006, when the government began to propel the technologies of renewable energy and then realize the generalized appliacation in buildings across the country. From the Chinese next five-year plan, 60% of PV application capacity will be executed in building field for enhancing digestion on spot.

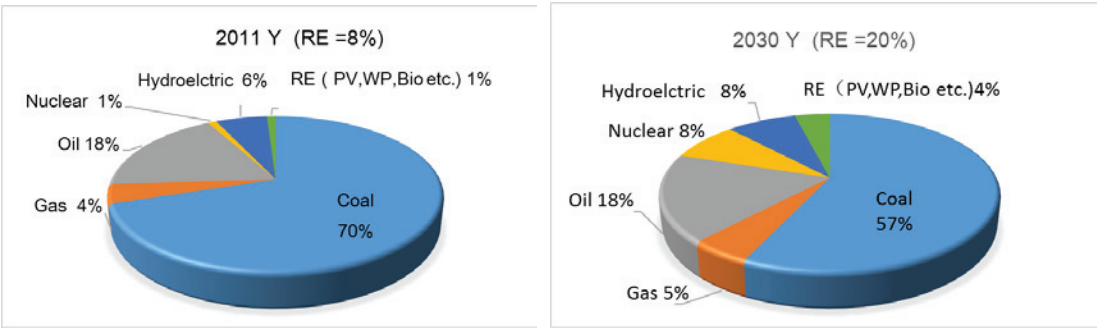

Fig.1 Renewable energy development in China

2. Introduction

In fact, the application of renewable energy in buildings focuses mostly on the PV, ST and GSHP, which takes advantage of thermal storage and temperature difference in the shallow soil and surface water. The biomass energy is applied mostly in rural regions and we had few applications of wind power in building excepting some super high-rise buildings.

The renewable energy application has strongly regional characteristics, which mainly consist of three pivotal as follows: local resource endowment, building energy demand and the optimization of energy balance. In short, the key point would be how to match the energy supply with the energy demand of buildings and yield system performance. There are three basic issues on renewable energy application in buildings, which include the regional suitability, suitability of buildings and technical and economic feasibility.

Based on the surveys and basic analysis of recent practical projects, some general issues are discussed in this paper.

3. Suitability of Renewable Energy for Buildings

Regarding the development of the renewable energy applied in buildings, no matter the PV, ST or the GSHP application, they depends mostly on regional conditions, so the supporting research of integration of comprehensive information are still in urgent need.

(1) Application of PV

Taking the application of PV as an example, the commonly used indicators for evaluation of solar radiation condition are the peak sunshine duration hours (the hours converted from the total radiation quantity by radiation intensity of 1000W/m^2) (Fig. 2). However, because of the rough converted computation with the total radiation quantity, the potential prediction of solar power generation is usually overrated, by ignoring the filtration management of the low-effective or non-effective radiation ranges. According to the results of testing, the modified evaluation method is proposed by considering the modification of the low-effect ranges. From Fig. 3 and Table 1, it is obviously that the modified results show a double-effect of rectifying. In other words, in the poorer radiation resource, the proportion of effective radiation occupies lower.