Joint heat-electricity scheduling optimization for reducing wind power curtailment

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Abstract

As a kind of clean and low-carbon energy, wind power is developed rapidly in China recently. However, wind power curtailment has been a serious problem in Northeast China. In this area, combined heat and power (CHP) units constitute the major source of urban district heating (DH) system. As a result of the strong inherent coupling relation between power and heat load, the flexibility of CHP units has been restricted in winter, which significantly reduce the peak-load regulation capacity of CHP units. Consequently, the space of wind power connected to the grid is squeezed by CHP units. The existing DH network has a large number of pipe volumes and buildings, which is inherently a huge energy storage system. Therefore, this paper firstly studies the dynamic characteristics of the urban DH network, and builds the mathematical model to describe their heat-storage capacity and dynamic response from heat source to end-user. Based on the forecasts of available wind power and heat demand, a joint heat-electricity optimal scheduling problem is then proposed and solved to minimize the wind power curtailment on the condition that the heating demand is guaranteed. Finally, a simulation of a DH system with coal-fired CHP units and a wind power plant is given to demonstrate the effectiveness of the proposed joint heat-electricity optimal scheduling method.