

# **Economic Operation Study of Power System with Wind Power Generation and Storage**

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**Keywords:** *Power systems, Economic dispatch, Optimal operation, Wind power, Storage*

## **Abstract**

With the development of smart grid, distributed generation (DG) such as renewable energy has received considerable attention in recent years, and investments in this area have been increasing steadily, especially in wind power generation. Unfortunately, despite its environmental advantages over many other sources of energy, wind power generation has two drawbacks: (1) it is intermittent and (2) it is prone to large forecast errors. Moreover, in many regions, the peak of wind energy production is often reached at night, when load demand is low. As a result, much of the energy produced by wind is sold during these periods in which electricity prices are also low. Therefore, from a strictly economic point of view, wind power generation is often not competitive compared to other traditional power sources. However, wind power generation has benefits to the grid during peak load period and short-term electricity markets. This paper reports that the storage can be used as a means of controlling the energy supplied to the power grid, that is, wind farms store the energy produced during periods of low prices and sell to the grid during periods of high prices. This approach also enables wind generators to counter the unpredictability of wind power generation by using storage as a buffer to meet their delivery targets. This paper analyzes economic dispatch problem for power system with the storage first. Then the complicated economic operation problem containing wind power generation and the storage provider is studied. The problem is solved by a two-stage optimization method. In the first stage, the all loads and renewable energy resources are fixed and 80% capacity will be used in storage. It means that wind power generations are not controllable or adjustable during the stage one. In the second stage, the renewable energy resources are variable at some range, but will be balanced by the storage first. A modified IEEE 30-bus system, which contains the wind farm and storage device, is used for testing.