Economic and Environmental Impact Assessment for Wind Power Promoting Policies in Energy Spot Markets with Different Flexibilities

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***Abstract*--A unit commitment model has been developed in order to identify and quantify the economic and environmental impact of subsidizing wind generators on the energy market. Subsidies such as the production tax credit and renewable portfolio requirements provide incentives for wind and other renewable generators to submit negative energy bids in US RTO markets, which has resulted in concerns about distortions in unit commitment decisions.**

Four test systems have been designed to illustrate how different impacts these policies could have. The results show that larger negative bids forces the system to accept more wind generation during periods of negative prices. This leads to more start-ups and shut-downs of the conventional generators and higher total system costs, no matter how flexible or inflexible the generation mix is. However, CO_2 emissions do not always decrease when more wind is injected into the system under conditions of negative prices. The impact of increasing the magnitude of negative bids on CO_2 emissions is heavily dependent upon the generation mix and flexibility of the system. The assumed carbon price has a large influence on the CO_2 impacts of large negative bids.

In general, policies that encourage large negative bids by renewable generation contradict both the goal of lower energy costs and the goal of lower CO_2 emissions. There would be both economic and environmental benefits to renewable support policies that would encourage flexibility in renewable operations by maintaining subsidies even if renewable generators are voluntarily or involuntarily curtailed.

***Index Terms*--Unit commitment model, curtailment cost, CO_2 emission, carbon price, wind power, system flexibility**

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