Demand Response to Integrate Wind Production in Power Systems

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ABSTRACT

One of the major challenges faced by current power systems is the integration of renewable energy sources contributing fluctuating energy and one of the solutions is using flexible demand response to shift demand to periods with lower demand or periods with high penetrations of renewable energy. This report has focused on the potential of demand flexibility arising from the high thermal inertia of well- isolated buildings and we have proposed an optimal power flow model including traditional fossil-based thermal generated power, wind power production units, a DC load flow to represent a transmission system and a thermal model of flexible customers' houses. This model allows us to determine the optimal amount of flexible demand required to integrate a given amount of renewable energy production at the minimum cost. We can also determine the optimal location of this flexible demand in the transmission network.

Through the work of this report we are able to conclude that flexible demand response through thermal inertia of well-isolated buildings can to a great extend be used to reduce wind power production imbalances. Although for low wind penetration levels flexible customers do not add too much value while medium wind penetration levels only provide a small amount of flexibility therefore only a small amount of flexibility provided by all the customers is needed to integrate this amount of wind penetration. Generally, that the more flexible customers are, the more wind penetration can be integrate using only thermal inertia in buildings, and for high wind penetration levels customer flexibility is very much needed to utilize the entire power production. Furthermore, the value of having flexible customers depends on the flexibility of existing thermal power generating units, the wind penetration level and the willingness of the customers to deviate from the comfort temperature.