Consumption management in the Nord Pool region: A stability analysis

Integration of fluctuating renewables like wind and solar power is nowadays a hot topic, but this comes at a cost of decreased stability of the power system. The deterioration often translates into so-called spikes and drops in the electricity spot price, very large (even extreme) deviations from the regular spot price, followed by a reversion to roughly the original level a few days later. We use the spikes and drops as an strong indication that there is an imbalance in the physical power system in this paper.

Independent Spike Models (ISM) is a popular class of models for the electricity spot price that uses regime switching, typically having three regimes (base regime, spikes and drops). We fit a such model to Nord Pool spot data to characterize the size and intensity of these deviations, and proceed by augmenting the standard second generation, three factor Independent Spike Model by relating the spike and drop intensity to several factors and find strong statistical support for relating the consumption to the spike and drop intensity.

The model is then used to quantitatively evaluate the effects when modifying the consumption in order to mimic how additional renewables are integrated into the power system or conversely the effects when smoothing consumption using strategies that can be implemented in smart grids. We use this tool to obtain a direct measure of how much the spike and drop intensity can be reduced by smoothing the consumption and see that even a small increase in the variability of the consumption translates into decreased stability (more spikes and/or drops) of the power system.