How to Specify Storage Systems Needed in Our Future Electricity Grid

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Our future electricity grid will face a growing share of intermittent feed-in by renewable energy sources (RES) such as wind power and photovoltaics. The balancing of these intermittent RES with the aim to match electricity demand is one of the biggest challenges we have to deal with during the upcoming decades.

Means to comply with this challenge include grid extension, demand and supply side management and energy storage. Among these, energy storage can be considered to be the most versatile and powerful but so far also the most expensive means to facilitate RES integration. Consequently, we would rather avoid energy storage unless the electric grid is really in need of. Here, current studies come to the insight that electrical grids with shares higher than 20 – 30 % of intermittent RES for covering the electricity demand are hardly manageable without additional energy storage capacities [1].

Currently, a huge portfolio of energy storage technologies in different states of technical maturity is competing to be applied for RES integration. A major question is, which kind of storage we will need in the future based on the type of intermittency to be compensated. A well reasoned answer to that question is crucial for future electricity systems to be reliable and affordable even at high shares of intermittent RES.

A first step to approach this question is to be aware of advantages and disadvantages of energy storage when compared to other means for an enhanced RES integration. Furthermore the presentation gives an overview on the wide range of storage technologies and their corresponding grid services. Grid services relevant for an enhanced RES integration will be highlighted. Finally, it will be shown how such promising grid services can be translated into an optimized storage configuration in terms of charging/discharging ratios and storage volumes. This is exemplarily done for a reference case based on the situation in the northern German grid with high shares of dispersed wind power feed-in being located far from load centers [2].

References:

[1] P. Denholm, E. Ela, B. Kirby, and M. Milligan, “The Role of Energy Storage with Renewable Electricity Generation,” Golden, Colorado, 2010.
[2] D. Wolf, A. Kanngießer, M. Budt, and C. Doetsch, “Adiabatic Compressed Air Energy Storage co-located with wind energy—multifunctional storage commitment optimization for the German market using GOMES,” *Energy Systems*, pp. 1-28, Dec. 2011.