Upgrading the Grid for Wind Energy - Optimization Before Reinforcement Before Building New Lines

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Abstract

Instead of building new lines in many cases momentary reductions of possible wind energy input during the frequent but very short wind peaks allow almost all of the wind energy supply except a few short extreme peaks to be fed into the grid. If an increase in transmission capacity is still necessary, the replacement of conventional conductors of existing lines by high temperature conductors combined with real time monitoring of conductor temperature is often the preferable solution. It meets no resistance from citizens and costs by far less than the planning and building of new lines.

(1) The new German Renewable Energy Act (´EEG 2009´) requires: Optimization before reinforcement before building new lines.
(2) The power output of modern wind turbines is completely controllable within seconds by changing the pitch, i.e. the attack angle of the rotor blades. Any reported overload of the relevant transmission lines can thus be avoided within their typical reaction time of several minutes.
(3) The possibility to reduce input in case of expected overload distinguishes a largely wind energy devoted supply line from a consumer devoted distribution line which has to carry the momentary demand at any time.
(4) A detailed analysis of wind speed statistics tor Germany shows that momentary reductions of possible wind energy input during the frequent but very short wind peaks result in very small losses in total wind energy yield. Similar results are expected for other countries or regions with strongly intermittent wind.
(5) This strategy also complies with the principle of economic optimization: The additional cost for upgrading the grid must not exceed the additional benefit from an increased input of renewable energy. Due to the very strong intermittent fluctuations of the source wind, above a certain limit to be determined by wind statistics this increased benefit per increased grid capacity falls rapidly below the additional cost.
(6) For long distance transmission in Germany the break even point lies below 70% of the total wind generator power installed. Similar results are expected for other countries and regions with strongly intermittent wind. The windmill owners may even be compensated for their occasional losses from the considerable savings in investment cost for the avoided new additional lines.
(7) Because of its fluctuating character wind energy has to be backed up with fast sources of control and reserve energy anyhow. Thus when temperature monitoring shows that a reduction of wind energy input is required to avoid overload, this reduction is not carried through to the electric energy consumers.
(8) High temperature conductors and online temperature monitoring have been developed and set to work on a large scale world wide in the last decade. Their installation on existing lines increases the power capacity by 50% to 80%, even more for fluctuating power like wind energy, and costs less than half of building a new line. Therefore they are particularly suited for wind energy related grid reinforcements.

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