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Options for managing the variability of wind power explored

As wind power becomes more important in the energy mix, so too does the need to manage its variability. A new study has reviewed the options and indicates that, although state-of-the art technologies exist to maximise gains from wind power, they need proper and insightful management.

In 2008, wind power installed capacity reached 65 GW in EU-27. The European Commission has estimated that this could increase by four times by 2030 with targets and political support. However, uncertainty in the predictability of wind power means there will be a growing need for methods to reliably balance power supply through both long-term (over five hours) and short-term (up to about five hours) solutions. The study assessed several options for managing variability in wind power.

1. Spatial Distribution of wind turbines

One way to smoothen wind power output is to carefully distribute turbines on a local scale. Previous research indicates that if turbines are spaced at a distance of 170metres apart from each other, this can smoothen short-term variations (i.e. those where variation occurs within a timescale of a few minutes). However, in order to decrease variations within longer periods, greater distance may be needed between turbines or connected wind farms.

2. Enhanced cross-border power transmission

The exchange of power between national electricity systems could compensate for variability of power both in the short- and long-term. With current technologies, the most efficient means of bulk-power transmission over long distances is High Voltage Direct Current. There is a lack of research into the potential of this option, but the European Wind Energy Association's 'Integrating Wind'[1] study indicates that if EU cross-border power transmission capacity increased by around 33 GW (from 2008 to 2020), then the contribution of wind power's firm generation capacity would increase from around 8 per cent to 12 per cent in the 10 EU countries with the most amount of installed wind power.

3. Power Reserves

Even if the variability of wind power is smoothened by spatial distribution of turbines, additional power reserves would still be needed to ensure continuous supply. The balance can be achieved by both short-term reserves and long-term reserves. Reserves vary in the time they take from start-up to full load operation, for example, batteries have an almost instantaneous start-up time to full load operation, whilst conventional pumped hydro-power plants require several minutes before they can provide full load. They also vary in the amount of energy they can store, for example, batteries provide additional power for relatively short times compared to some hydropower plants.

A specific form of electricity storage is electric vehicles with secondary (or 'rechargeable') batteries, which could potentially regulate load by changing the time in which the battery is charged. Research has indicated that, in Germany, a fleet of 9 per cent Plug In Hybrid Electric Vehicles and 4 per cent Battery electric vehicles would be necessary in 2015 to provide the required storage capacities for excess wind power.

Options for regulating wind power in future years will be supported by initiatives, such as the European Strategic Energy Technology Plan[2], that will facilitate cross-border interconnections, technologies for smoothing wind power variability and electricity storage, including electric vehicles. However, each electricity system has different properties and the most appropriate combination of options must be identified through a case-by-case technical and economic analysis.

1. See: www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/TradeWind_Report_01.pdf
2. See: http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm

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