Policy issues plague hydropower as wind power backup

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Kerr Dam and its associated reservoir. Credit: Seth Blumsack, Penn State

Theoretically, hydropower can step in when wind turbines go still, but barriers to this non-polluting resource serving as a backup are largely policy- and regulation-based, according to Penn State researchers.

"We have a very clear realization that we need to make energy systems more sustainable," said Seth A. Blumsack, assistant professor of energy policy. "We want to reduce the environmental footprint—carbon dioxide and conventional pollutants."

Americans also expect to have the system continue to work exactly as it is without blackouts and with low cost electricity. While wind and solar power are emission-free once installed, they are also subject to the whims of nature. The wind can suddenly cease to blow and an area can

have minimal sunlight for days.

"Wind is the fastest growing renewable energy source in the U.S.," said Alisha R. Fernandez, graduate student in energy and mineral engineering.

The U.S. Department of Energy recently examined the feasibility of producing 20 percent of U.S. electricity from wind by 2030.

"Texas is either there or close," said Blumsack. "During certain periods, as much as 30 percent of their energy is generated by wind."

Reliance on wind requires that there be some backup technology to fill in when the wind does not blow. The technology has to be capable of coming on line quickly. Two types of electrical generation that fit this bill are natural gas and hydropower, but natural gas is not carbon neutral.

The researchers looked at the Kerr Dam in North Carolina as a case study. They report their results in a recent issue of *Environmental Research Letters*. The power produced by the Kerr Dam goes into the PJM segment of the electric grid—Pennsylvania through Virginia on the East Coast, west to Indiana and also includes the Chicago area—but agreements made before establishment of the PJM market mean that the Kerr Dam also supplies other local outlets.

Hydroelectric dams cannot simply release water to meet some electricity demand or hold back water when electricity is in low demand. Plants operate using guide curves that consider not only electric production, but also drinking water needs, irrigation, fish and wildlife requirements, recreation and minimum levels for droughts. These guide curves are created by the government agencies regulating the particular dam—in the case of Kerr, the U.S. Army Corps of Engineers—but in other places it could be the U.S. Bureau of Reclamation, the Tennessee Valley

Authority, the Colorado River Authority or other entities. In practice, the guide curves are currently based on one-week weather forecasts and their parameters take into account the requirements of a large variety of interested parties.

The researchers determined that the Kerr Dam could accommodate the unexpected variations in wind energy, but only if those operating the dam were allowed to meet the guide curve requirements over a two-week rather than one-week period of time.

"Changing guide curves is complex, time-consuming and may even require an act of Congress," said Blumsack. "Another problem is that two weeks is at the outer margin of weather prediction."

If hydro plants do not pledge to sell their electricity to make up for the variability of wind energy, they sell their excess on the spot market. The researchers found that changing the pricing of electricity so that backing up wind is more lucrative than the spot market would not make these multipurpose hydro facilities more prone to supply backup to wind power.

"Operational conflicts may be significantly reduced if the time length of the guide curve schedule was altered, yet such regulatory changes prove quite challenging given the institutional barriers surrounding water rights in the U.S.," said the researchers, who also include Patrick M. Reed, professor of civil engineering, Cornell University.

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