Drive like the wind: Electric vehicles and smart charging can help integrate renewable energy

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A new PNNL report finds that the Northwest Power system would be able to balance 10 Gigawatts of additional windpower if 2.1 million vehicles, or 13% of the Northwest's fleet, were electric.

In a new report, researchers at the Department of Energy's Pacific Northwest National Laboratory show how electric vehicles — increasingly available to consumers in today's marketplace — could help operators more seamlessly add more renewable energy sources like wind into the Pacific Northwest's energy grid. The Northwest increasingly is looking to add more windpower to meet growing energy demands and policy requirements to tap more renewable energy sources.

The report finds the future Northwest power system would be able to

better utilize fickle wind energy if about 13 percent, or about 2.1 million, of vehicles in seven Northwest states were plug-in electric models and equipped with Grid Friendly™ charging technology. The study also finds consumers would need to have the ability to charge their vehicles during the day, and a small percentage of charging stations would need to be available publicly or at the workplace.

The report examined grid conditions in the Northwest Power Pool, which covers Idaho, Montana, Nevada, Oregon, Utah, Washington and Wyoming; many of them home to abundant wind resources and wind energy projects. In particular, the PNNL report examined the implications of adding another 10 Gigawatts of wind to the region's grid by 2019, which regulations such as the Renewable Portfolio Standards require.

"Electric vehicles, coupled with grid-friendly charging, offers a great opportunity, right now, to help electric companies integrate additional windpower into our electric system," said Michael Kintner-Meyer, PNNL staff scientist and study co-author.

An electric vehicle solution for the grid

Windpower is an increasingly popular source of renewable energy. But it is unpredictable and not always available when the grid needs it. On windy days, grid operators have to find a way to use the excess energy or store it. But today, the U.S. grid has very limited storage capabilities.

Many people think of electric vehicles as electricity consumers. But the PNNL researchers say a partially charged vehicle sitting at work or at home represents a potential asset for grid operators; a vehicle's ability to start and stop charging, to adjust for varying windpower, could serve as a shock absorber on the grid. To explore the feasibility of using electric vehicles to balance windpower, the researchers looked at the driving

habits of about 37,000 people — when they were at home, at work or in transit.

They determined 2.1 million light-duty electric vehicles with a 33-mile electric range would be needed in the Northwest to provide the on-again, off-again balancing requirements for integrating 10 Gigawatts of additional wind technology in the region. That means about 13 percent of the existing light-duty vehicle stock in the Northwest would need to go electric. Currently there are only a small number of electric vehicles on the road, but the number is expected to increase now that major automobile manufacturers are selling plug-in electric vehicles such as the Chevy Volt and Nissan Leaf.

The researchers also estimated the ratio of public-to-residential charging stations needed to fully absorb the additional variability from wind power. And they found they really don't need that many nonresidential stations. Based upon existing transportation and driving data, the PNNL team determined approximately one of every 10 new charging stations will need to be available to the public or located at the workplace to offer the majority of balancing services to the grid 24/7 if Grid Friendly charging technology is used. And the team notes there are other public and consumer drivers for access to public charging stations beyond the need for integrating renewable energy.

Rather than charging a vehicle at a constant rate, Grid Friendly technology can recognize grid conditions and constantly vary the rate at which the battery is charged, based upon a variety of factors, including how much electricity is being generated at any given time. In doing so, the fluctuations in electricity produced by wind farms could be absorbed by a fleet of vehicles starting or stopping their charging cycle, rather than requiring new power plants to provide that balancing service.

"We don't need to wait for vehicle-to-grid, or V2G, services, which

would require that the electricity would be released back into the grid," said Kintner-Meyer. "We could perform grid-friendly charging now that would provide valuable services to the grid for integrating wind energy."

Kintner-Meyer says the study findings should also help utilities, businesses and municipalities who are considering installing public charging stations understand the capital costs needed. Of course, public charging would also lessen range anxiety — the concern drivers of electric vehicles have about being stranded on the road with an empty battery, Kintner-Meyer notes.

"By using electric vehicles to support additional windpower in the Northwest, and reducing the need to build new power plants to support it, we could potentially defray some of the cost for both electrifying our transportation system and integrating wind technology into the grid, driving down our regional dependence on imported oil, as well as vehicle emissions," said Kintner-Meyer.

More information: Frank Tuffner, et al. Using Electric Vehicles to Meet Balancing Requirements Associated with Wind Power. July 2011. *PNNL*-20501 (energyenvironment.pnnl.gov/pdf …t_Final_7_8_2011.pdf)

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