Power Systems Engineering Research Center

Quantifying and Mitigating the Impacts of PV in Distribution Systems

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PSERC Public Webinar
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2:00-3:00 p.m. Eastern Time (11:00-12:00 p.m. Pacific)

Description: High penetrations of photovoltaic (PV) systems impact distribution system operations in a number of ways, spanning voltage and other power quality, resistive losses, requirements for transformer bank and conductor capacity, reverse power flow and protection equipment operation and transformer aging. This talk begins with a simulation-based investigation of these impacts at varying PV penetrations and across a diversity of distribution system topologies and climates in California. The simulations are driven by a unique distributed PV data set that includes real 1- and 15-minute production from small PV systems across the scale of a distribution feeder. We first interpret the impacts in terms of engineering metrics, including voltage excursions, peak capacity requirements, and resistive losses. Then, using cost and circuit-level peak load growth data from Pacific Gas and Electric, we interpret the impacts in economic terms. We find that in most cases the economic impacts are small relative to avoided energy costs. However, we do see that in a limited number of cases the voltage quality impacts are moderate. Using this result and other anecdotal evidence as motivation, in the second part of the talk we discuss a new approach for volt-VAR optimization with reactive power capabilities of PV inverters. Relative to existing approaches, the strategy we describe is decentralized and model-free but identifies optimal setpoints for inverter reactive power across a variety of objective functions. This work is joint with Michael Cohen, Paul Kauzmann and Daniel Arnold.

Biography:
Duncan Callaway is an assistant professor in the Energy and Resources Group at the University of California-Berkeley. His research interests focus renewable energy integration in electric power systems and the role that demand response, energy storage and vehicle electrification have to play in facilitating renewables integration. His work builds on methods from the fields of control and optimization and machine learning. Prior to returning to academics he held several engineering positions in industry, focusing on building energy efficiency and photovoltaic system design. He is a recipient of the NSF CAREER award.

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PSERC's Webinar Coordinator: Venkataramana Ajjarapu, Iowa State University, vajjarap@iastate.edu.

Professor Ajjarapu welcomes your feedback on PSERC webinars and suggestions for future ones.