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Grid storage consideration for high penetration of wind and solar power

Wind and solar energy are currently the most promising sources of grid electrical energy that can reduce carbon dioxide emission into the atmospheric. Although electric grid penetration of both wind and solar are rapidly increasing around the world, due to their unpredictable and intermittent nature energy storage will likely be needed in order to provide grid power balance. In this study we model the grid storage requirements for high penetrations of wind and solar power, examining the effects of combining wind and solar, drawing from a large geographical distribution of sources and over capacity. We also examine the effects of a small dispatchable balancing power on storage requirements. We use load data from the Midcontinent Independent System Operator (MISO) energy market that operates in the central region of the United States for the years 2007-2010 as a case study. Solar and wind production is modeled using results from the National Renewable Energy Laboratory Solar and Wind Integration Data Sets. Our results show for optimized solar to wind ratios large decreases in required energy storage capacity occur when the overcapacity is increased from 0 to 30%. Additional significant reductions in energy storage capacity occur when a small dispatachable balancing power is allowed. However, the corresponding storage and balancing power capacities are a significant fraction of the solar and wind capacities and have correspondingly low capacity factors.

Biography

James Robert Doyle is a Physicist who currently studies models of the electrical grid when high penetrations of wind and solar are present. He also has spent most of his career studying materials for photovoltaic applications including hydrogenated amorphous silicon and germanium and zinc oxide. He has completed his PhD in Physics from the University of Colorado at Boulder in 1989 and Post-doctoral Research Associate at the University of Illinois and has worked as a Faculty at Macalester College, USA.

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