Large-Scale Electric Energy Storage Integration in Grids with Integrated Renewable Energy Resources

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Abstract

The electricity business is unique, as it is the only industry sector that sells a commodity – the *MWh* – without sizeable inventory. The marked lack of utility-scale storage in today's power system drives electricity to be a highly perishable commodity whose production is the prototypical just-in time manufacturing system. Moreover, the limited storage capacity in today's grid severely restricts the flexibility with which the grid can be operated – a particular concern for systems with deepening penetrations of integrated renewable energy resources. However, a grid with increased storage capacity may offer major benefits, such as the time-shift of energy utilization to shave the peak demand, improved harnessing of energy from renewable resources and reduction in the reserves requirements that must be met by fossil-fired power plants that pollute. Storage also has numerous applications in both short- and long-term planning and in operations over a broad time spectrum. Notwithstanding the multiple benefits that storage resources offer and their unique and salient features, the pace of *ESR* deployment has been slow in the past mainly due to the high costs of the technology. In recognition of the need of a bold move to reduce the costs of storage through increased demand, California (*CA*) has mandated the installation of 1,325 *MW*s of cost-effective energy storage by 2024 by the three major investor owned utilities (*IOU*s) – *PG&E*, *SCE* and *SDG&E* – under the jurisdiction of the *CPUC*. The procurement of the storage capacity to meet these objectives must be carried out within the *CPUC* framework that specifies the eligibility criteria for storage projects, the targets for each *IOU*, the procurement schedule and the targets for specific grid interconnection points. The *CPUC* mandate is a significant development as it is likely to engender similar measures in other venues, as well as act as a catalyst for the speedier large–scale storage deployment. This presentation discusses the critical importance of energy storage, the current status of storage and the barriers to large–scale storage deployment and the challenges and the opportunities in the push for storage deployment. These challenges encompass storage technology improvement, modeling and tool development, regulatory, environmental and policy formulation areas. These issues must be resolved to make the goal of large–scale deployment of storage in future grids reality and to facilitate sustainable paths to meet the future energy needs.

Short bio note for George Gross

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George Gross is Professor of Electrical and Computer Engineering and Professor, Institute of Government and Public Affairs, at the University of Illinois at Urbana-Champaign. His research and teaching activities are in the areas of power system analysis, economics and operations, renewable, demand response and energy storage resource integration, utility regulatory policy and industry restructuring. He was formerly with the Pacific Gas and Electric Company, where, Dr. Gross founded the company's Management Science Department and held other key management, technical and policy positions. During 1992-93, Dr. Gross was at the Electric Research Power Institute to develop research directions on open access transmission. George Gross is a co-founder of POWERWORLD and served on its Board of Directors from 1996 – 2001. A Fellow of IEEE, Dr. Gross received the *Franz Edelman Management Science Achievement Award* by the Institute of Management Science. Dr. Gross is the author of a large number of publications and book chapters. He was a Visiting Professor at the Politecnico di Milano, University of Pavia and the Politecnico di Torino during the academic year 1999 – 2000. George Gross earned his undergraduate degree at McGill University in Montreal, Canada, and he did his graduate studies at the University of California, Berkeley.

Dr. Gross has consulted on electricity issues with utilities, government organizations and research institutions in North America, Europe, South America, Australia and Asia. He has lectured widely and has given numerous invited presentations at leading universities and research institutions throughout the world. His numerous publications have appeared in the leading journals in the field and his research results have been presented at a wide array of international conferences. He has made a broad range of contributions in various areas of power system planning, operations, analysis and control. He is a multiple winner of best paper awards.

His work on smart grid issues has focused on both the technical and the regulatory aspects. The principal areas of involvement include the design of AMI architectures to ensure cyber security, the deployment of AMR for demand response, the integration of demand-side response, renewable and energy storage resources into the grid, flexibility assessment and quantification, and the economics of smart grid implementation. He has co-organized one of the first workshops on the public policy issues in Cyber-Security and Privacy for Smart Grid Technology. His various papers in the smart grid area are highly cited.