

# Energy Storage—Part II: Realizing the Value

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**L**arge-scale deployment of energy storage across the electricity supply chain has a number of challenges that are not entirely related to engineering or technology. The roll out and integration of energy storage in the electricity infrastructure is at a nascent stage. Realization of the full value of energy storage as a resource has not been fully understood as policies, regulatory regimes, and market mechanism are not yet fully in place. Thus, the primary focus of this special issue is to explore regulatory and policy issues, market mechanisms, and business models for large-scale deployment and operation of energy storage systems.

Regulatory policy and markets play a major role in the deployment and operation of new technologies in the electricity market. This is particularly true in regulated electricity markets, which comprise the bulk of the electric grid around the world. In the case of energy storage deployment in nonregulated markets, so far cost and performance metrics have hampered significant deployments. In their paper, Masiello *et al.* review the complexities of business and regulatory aspects of energy storage and present business models for investments to deploy and operate energy storage systems. While the emphasis of this paper is primarily on large-scale deployment strategies in the United States, the business models can be extended to most regulated energy markets around the world. Though energy storage provides applications and benefits across a range of asset categories, so far storage has been treated as a single asset class. They discuss alternate business models that consider storage as a unique asset class which provides a range of services/benefits, and potential market mechanisms to monetize these benefits.

**This special issue explores regulatory and policy issues, market mechanisms, and business models for large-scale deployment and operation of energy storage systems.**

Over the last few years, there have been significant advancements in the regulatory process to make accommodations for valuing and monetizing energy storage. The most significant regulatory decisions for energy storage have come from regulators in California, New York, and Ontario in North America, in particular, the California Public Utilities Commission decision mandating deployment of 1.325 GW for energy storage and the U.S. Federal Energy Regulatory Commission's order to develop pay-for-performance tariffs for ancillary services. In his paper, Kintner-Meyer reviews the development of regulatory framework in North America for large-scale deployment of energy storage in the grid.

Market mechanisms that adequately value storage assets are under development. In their paper, Kleinberg *et al.* review the valuation of energy storage based on economic benefits for functional applications at the transmission and distribution level. This paper attempts to quantify the value of storage under different forms of energy and when used to deliver different functions across the power supply chain, from transmission to distribution. They stress the fact that storage valuation cannot be separated from optimal control of storage operation. The

paper gives lists of potential values in terms of economics, performance, and reliability, and then quantifies these value terms using case studies. In the following paper, Silva-Monroy and Watson summarize core issues that

arise when integrating storage devices into market management systems, ranging from high-level modeling of storage devices for purposes of economic dispatch to the potential need for new mechanisms to more efficiently allow

for storage to participate in market environments. Finally, Pickard summarizes the need for greater investments into energy storage deployment to accommodate large-scale deployment of renewable energy sources. ■

#### ABOUT THE GUEST EDITORS

**Babu R. Chalamala** (Fellow, IEEE) received the B. Tech. degree in electronics and communications engineering from Sri Venkateswara University, Tirupati, India, in 1987 and the Ph.D. degree in physics from the University of North Texas, Denton, TX, USA, in 1996.

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Dr. Chalamala is a Member of the Materials Research Society and a Life Member of the Electrochemical Society. As Chair of the IEEE Photonics Society Technical Committee on Displays, he was instrumental in launching the IEEE/OSA JOURNAL OF DISPLAY TECHNOLOGY. He is also active in the Materials Research Society, where he served as General Chair of the 2006 MRS Fall Meeting. He served as a Guest Editor of the *MRS Bulletin*, the PROCEEDINGS OF THE IEEE, and the IEEE JOURNAL ON SELECTED TOPICS IN QUANTUM ELECTRONICS. He currently serves on the Editorial Board of the PROCEEDINGS OF THE IEEE.

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Dr. Masiello has served as Chairman of Power System Engineering, Chairman of Power Industry Computing Applications, member of the Editorial Board of the PROCEEDINGS OF THE IEEE, and member of the Advisory Board of IEEE SPECTRUM and *Power and Energy* magazine. He is serving on the U.S. Department of Energy (DOE) Energy Advisory Committee and chairs its Storage subcommittee. He is the recipient of the 2009 IEEE Power Engineering Concordia award for Power System Engineering and is a member of the National Academy of Engineering.

