THE IMPACTS OF REGULATION, POLICY, ADVANCED TECHNOLOGIES, AND MARKET DYNAMICS ON THE DEPLOYMENT OF ENERGY STORAGE PROCESSES

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A number of factors are now coalescing that can be expected to lead to significant market opportunities for energy storage in the near term. These include, but are not limited to, government policy and regulatory initiatives; new requirements in wholesale electric markets, particularly related to the transmission and distribution of power; an increase in the percentage of intermittent power sources available (especially in certain regions of the United States) leading to more significant requirements associated with, for example, frequency and voltage control; new larger megawatt-hour systems that can be utilized for dispatch during peak periods; the increased utilization of distributed energy systems; the impact of electric vehicle storage and the charging impact on the grid; and the possible integration of storage into smart grid platforms.

As the U.S. energy delivery system adapts to meet changes in supply and demand patterns; changes in policy, as well as new and proposed regulations; requirements for increased efficiency; and capital and market constraints, it appears that energy storage can play an increasingly significant role. This paper focuses on each of the factors listed above and discusses how available and emerging technologies will impact each. The paper examines impacts associated with advanced battery systems, compressed air energy storage, pumped hydro, flywheels, and ultra-capacitors. With respect to battery storage, technologies such as advanced lead-acid, sodium sulfur, lithium-ion, and flow batteries are examined in detail, and technologies that should be favored, in the near term, for specific applications are identified. In addition, the possibility and plausibility of "stacking" applications for specific technologies is addressed.

With respect to utility-scale energy storage systems, a new and compelling interest has been emerging. Many applications, from substation and transmission upgrade deferral for utility-scale applications to distributed energy storage for community-scale applications, have now been identified that are best solved by energy storage solutions of a duration of 4 or more hours. However, near-term focus by system developers for energy storage applications has been on power applications, those applications requiring megawatt (MW)-scale power for only short periods of time, typically 15 to 45 minutes. Although there is significant interest in bulk energy storage for applications requiring MW-scale power for 4 or more hours, currently there is only one turnkey system in the market that can deliver on this requirement, and this supplier is backlogged for the next several years in filling current orders. Consequently, opportunity exists for new players in the bulk energy storage world.

What is really needed to continue the enabling of energy storage in the bulk storage arena are changes in regulatory policies and directives as they define generation, transmission, and distribution assets. This would occur by broadening the definition of what types of devices are included in each category. These changes in policy can lead to new rules and directives that define tariffs for the purchase of these services by the appropriate energy managers, including Independent Power Producers and the major Independent System Operators and Regional Transmission Organizations throughout the system. These changes could then direct downward to local utilities (rural and municipalities) that desire to employ bulk energy storage systems in their operations, but currently have no way to recover the cost of deploying these technologies. The definition of these new terms and conditions, in turn, would provide the necessary motivation to the bulk storage systems developers to make the appropriate financial and technical commitment to bring cost-effective

bulk storage turnkey solutions to the market. This would lead to a truly effective Smart Grid.

With respect to the aforementioned regulatory and policy initiatives necessary to spur the growth of storage utilization, both domestically and internationally, such regulation and policy initiatives continue to evolve. The paper examines federal and state initiatives, as well as initiatives abroad. With respect to the federal regulatory initiatives, the Federal Energy Regulatory Commission (FERC) has one regulation recently put into effect (FERC Order 1000), as well as Notices to Proposed Rulemaking (NOPRs) and Notices of Inquiry (NOIs), which can be expected to ultimately drive growth in the U.S. market. With respect to state initiatives, California regulations (including AB 2514) have made California by far the leading market for storage in the United States. With respect to China, storage is specifically mentioned in the 12th Five-Year Plan as an important technological development in clean energy (primarily electric vehicle [EV]) applications. However, State Grid is conducting various test programs for different storage technologies as a precursor to policy design. The implications of the evolving policy and regulatory landscape, nationally and internationally, are addressed.

BIOGRAPHICAL NOTES

Conference presenter: Gabriel Miller, Ph.D., Chief Scientific Officer of Hudson, is responsible for technical analysis of clean technologies at Hudson. Dr. Miller is a retired Professor of Chemistry at New York University (NYU) and previously was a Professor of Engineering as well as a Professor of Energy and Atmospheric Science at NYU. Dr. Miller has conducted numerous studies at NYU and in a number of energy and environmental fields as a consultant. In the 1980s, he headed research programs in a number of renewable energy fields that have recently regained importance. His work addressed a variety of combustion systems, including studies of human exposure to toxic emissions from municipal solid waste facilities, and analyses of power plant systems for compliance with the Clean Air Act Amendments of 1990. Dr. Miller has led projects in boiler design, gas and oil-fired cogeneration, hydrolysis of waste to glucose, municipal solid waste and sludge incineration, biofuel combustion, coal and wood waste fired fluidized bed combustion, wind energy, hydropower, power transmission by microwaves, wastewater system requirements, and air and odor impacts for health risk analyses. He also managed production of engineering feasibility studies, as part of due diligence for bond issues, as well as compliance with the Clean Air Act Amendments of 1990. Dr. Miller serves as Executive Director of the Society for Energy and Environmental Research (SEER), where he oversees studies in bio-fuel production. He earned a B.S. degree, M.S. degree and Ph.D. in Aerospace Engineering from NYU.

Garth P. Corey, Consultant to Hudson, recently retired as a Principal Member of the Technical Staff of Sandia National Laboratories (SNL), and had project management responsibilities with the Energy Infrastructure and Distributed Energy Resources Department. Throughout his SNL career, he was involved in high-technology energy storage research and development and demonstration projects. He is a member of the IEEE Power and Energy Society and active with the PES Stationary Battery Committee. In addition to continuing his association with SNL as a consultant with responsibilities related to electric energy storage systems, he remains active in a consulting role to the energy storage industry in the evaluation of emerging energy storage technologies and systems for bulk storage and distributed energy storage applications on the national grid.