Testimony on Grid-Scale Energy Storage

before the

Senate Energy and Natural Resources Committee United States Senate

By

The Institute of Electrical and Electronics Engineers - United States of America (IEEE-USA)

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Thank you for the opportunity to provide testimony for the record of this important hearing on grid-scale energy storage. IEEE-USA believes that expanded, long-term utilization of massive electrical energy storage systems (MES) will help maximize the utilization of new renewable sources of energy and will enhance the overall reliability of the grid.

Massive Electric Storage systems convert electric energy to other forms of energy that can later be reconverted back into electric energy to meet transient energy requirements. A variety of energy storage technologies exist, including, but not limited to, hydrogen storage, superconducting magnetic energy storage, supercapacitors, hydroelectric pumped storage, compressed air, various batteries and flywheels. Great opportunity exists for further developing these and other technologies.

Several important benefits can be derived from developing and deploying MES:

- Energy storage capability can increase the energy autonomy of the United States by enabling deployment of renewable energy technologies, and mediating the differences in energy generation and demand.

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- Energy storage can be used to improve both the quality and continuity of energy production. Energy storage can ensure the continuity of supply by acting as a back-up power source, and can improve power quality by correcting voltage sags, flickers and surges in the transmission grid, and helping to maintain frequency control

- Energy storage can also be used for load leveling as previously described. This is the practice of storing energy during off-peak times, and using that stored energy to meet demand during peak consumption times.

- Deploying energy storage has the potential to reduce the amount of power generation required to meet peak demand. To ensure that peak energy needs are met, utilities and/or users normally have to engage the use of other generating facilities to meet demand during peak times. If energy could be stored, then the need for additional facilities that increase energy generation capacity only during peak times could be significantly reduced or eliminated

- Also, as energy demand increases in the future, utilities may be able to delay investment in added generation facilities and infrastructure

- Although increases in energy efficiency can also increase the nation's energy autonomy, improvements from that sector are limited, and must be bolstered by energy storage

- Finally, the impacts of climate change and air pollution on public health and welfare have put forward an urgent charge towards carbon-neutrality. Reducing the amount of energy generated during peak demand periods, and incorporating renewable energies into the grid will help to minimize greenhouse gas emissions.

In addition to providing opportunities for optimizing economic operation of the electrical system, expanded deployment of MES will be a critical component enhancing the reliability of renewable energy resources. Output of renewable sources as well as energy demand are variable and change on a seasonal, daily, hourly and transient basis. For example, the availability of tidal power is cyclical; it varies on a thoroughly predictable but continuously changing cycle. Wind and solar power are subject to rapid and often unpredictable changes in output. Some energy storage technologies are useful for managing the impact of this short-term variability, while others hold promise for longer-term smoothing of output.

Given the differing limitations and state of development of technologies and the variation in energy storage applications, developing a broad range of these energy storage technologies is highly desirable and would provide greatest

flexibility when deployed in combination with variable renewable energy resources.

Despite the necessity of energy storage, incentives to promote aggressive research and development have yet to be suitably augmented. Policy makers must aid in promoting and facilitating the expansion of energy storage technologies through appropriate enhancements to laws and regulations. Regulatory treatment of energy storage at both federal and state levels must take into account its significant benefits.

To realize the prospective benefits of MES as an integral and enabling component of a balanced national energy policy, IEEE-USA recommends:

- An R&D initiative to develop affordable energy storage technologies to integrate intermittent renewable energy into the electric system
- That Congress fully fund the energy storage R&D program authorized in the *Energy Independence and Security Act of 2007*
- That the regulatory treatment of energy storage takes account of its special benefits

The Future of Massive Energy Storage

Hydroelectric pumped storage is the most well-established MES technology and relies upon reversible pump/generators. Low-priced electric power is used to pump water into a reservoir where it is stored, subsequently released and reconverted into electricity when higher electrical demand is reflected by higher electricity prices. Using this technology is dependent upon the availability of appropriate geography, and is limited by efficiency, typically 70 to 80 percent.

Compressed air energy storage (CAES) systems are also currently being used economically in location-specific applications taking advantage of natural geologic formations.

Other MES technologies can be developed and used to help meet grid-wise electrical demand provided they provide sufficient capacity for energy storage and are economical. For any electricity storage technology to be economically viable, the marginal price of electricity must be greater than the costs required to store energy and to retrieve energy, plus the value of the energy lost in the process.

The research, development and deployment timeline of these technologies depends on this country's willingness to invest in energy storage technologies and necessary infrastructure. Battery technology, for example, has attracted

considerable investment in past years, but no technology has yet become a decisive leader. Issues such as lifetime, efficiency of recovery, practicality of design, realistic cost, and application details remain unresolved for many potential approaches. Expanded use of existing or proposed storage technologies will thus depend upon technical advances that address the limitations of the various technology options.

The Energy Independence and Security Act of 2007 (P.L. 110-140, Title VI, Subtitle D, Section 641) includes provisions relating to research, development and deployment of energy storage. Major provisions of the Act relating to the massive electric storage systems, include, among other things:

1. Supporting research and development in energy storage systems for electricity transmission and distribution

2. Creating an Energy Storage Advisory Council responsible for preparing a five-year research plan

3. Establishing Department of Energy (DOE) energy storage research centers

4. Demonstrating DOE energy storage demonstration projects

5. DOE investigation of secondary applications of energy storage equipment and examination technologies and processes, for final recycling and disposal of energy storage equipment

6. Review of program after five (5) years of operation by the National Academy of Sciences. Although the provisions of the Act support research, development and deployment of energy storage, the lack of appropriated funding incapacitates the Act's intent, leaving the Act only symbolic in its convictions.

IEEE-USA supports these provisions and urges Congress to fully fund the associated research and development.

Our recommendations on massive electrical energy storage are part of a comprehensive approach to addressing America's energy needs, which is outlined in our National Energy Policy Recommendations, available on-line at: http://www.ieeeusa.org/policy/positions/energypolicy.pdf

This statement was developed by the IEEE-USA Energy Policy Committee and represents the considered judgment of a group of U.S. IEEE members with expertise in the subject field.