Towards net-zero emission power system: Deploy long-duration electricity storage technology for power systems with high penetration of renewables

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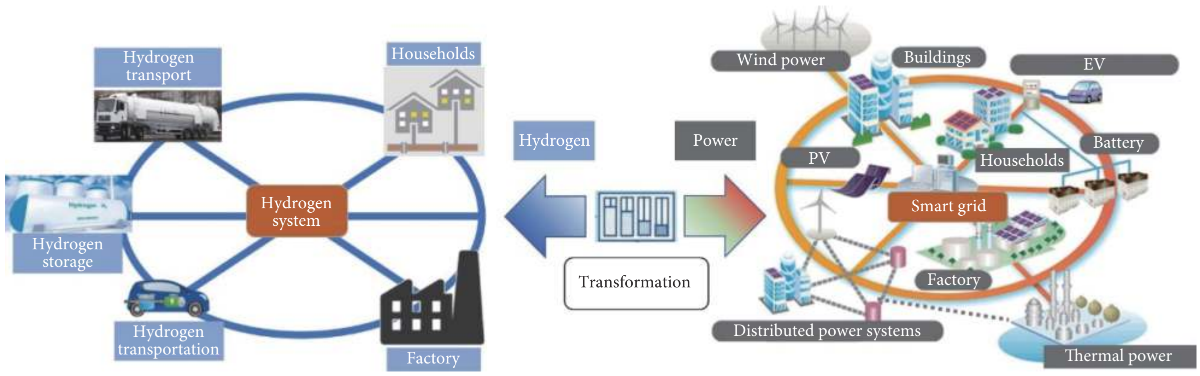
In a system with a high number of renewable energy sources, some capacities are expected to be firm, controllable, large scale, and long durational to meet balanced energy and low-carbon demands. Due to such requirements, flexible technologies such as demand response, short-duration storage, and other forms of energy storage (e.g., hydrogen and thermal storage) are emerging; however, little is known regarding the system benefits of long-duration electricity storage or the optimal energy storage portfolio. Pudjianto and Strbac from Imperial College London have filled this gap by analyzing the role and quantifying the value of long-duration electricity storage in facilitating a cost-effective transition to a low-carbon energy system. Their research illustrates the importance of energy storage in influencing long-term system development and enabling a more efficient investment in low-carbon technologies. Most of the benefits are derived from the savings in low-carbon generation investments.



Using an integrated electricity and hydrogen systems optimization model, the researchers could evaluate the contribution of a long-duration energy storage system and optimize investments in the energy supply capacity, energy network, and energy storage while minimizing the short-term system operation costs through hourly system operation representation. A spectrum of case studies was performed for a 2050 net-zero emission system background of Great Britain. Their analysis showed that long-duration storage can facilitate more variable renewable energy sources, and the high storage capacity can affect how the energy system will evolve and thus help to reduce system cost.

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For better density and efficiency: Technique of novel high-voltage SiC based power converters

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Medium-voltage power converters have been widely used in diverse applications, such as electric grids, electric ship propulsion, and railway traction. Improving the efficiency and power density of such converters is crucial for cost and availability concerns.

Compared with power converters based on conventional Si power semiconductors, novel high-voltage SiC based power converters are expected to be employed in future application. However, the implementation of the latter is limited owing to its high-voltage insulation and high electromagnetic interference.

A research team from Virginia Tech, USA, presented its latest progress on a high-voltage SiC-based power electronics building block (PEBB) using many key technologies, such as a high-performance enhanced gate driver, an auxiliary power supply using wireless power transfer, and a printed circuit board (PCB)-based planar DC bus with minimized stray inductance.

The obtained PEBB exhibits a power density and efficiency of 11.9 kW/L and > 99%, respectively, considerably higher than those achieved using conventional solutions. Power converters can be fabricated using a flexible combination of PEBBs. Progress on a PEBB-based modular multilevel converter is also presented.

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