Cost Analysis Highlights Hydrogen's Potential for Electrical Energy Storage

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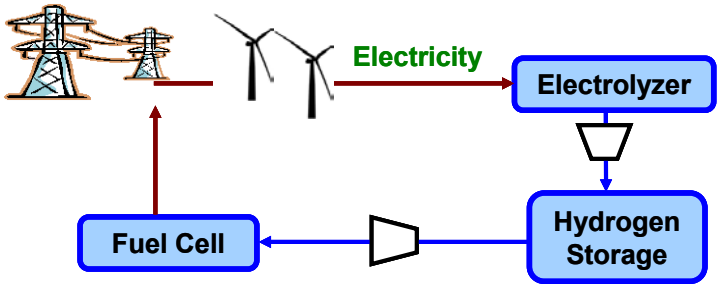
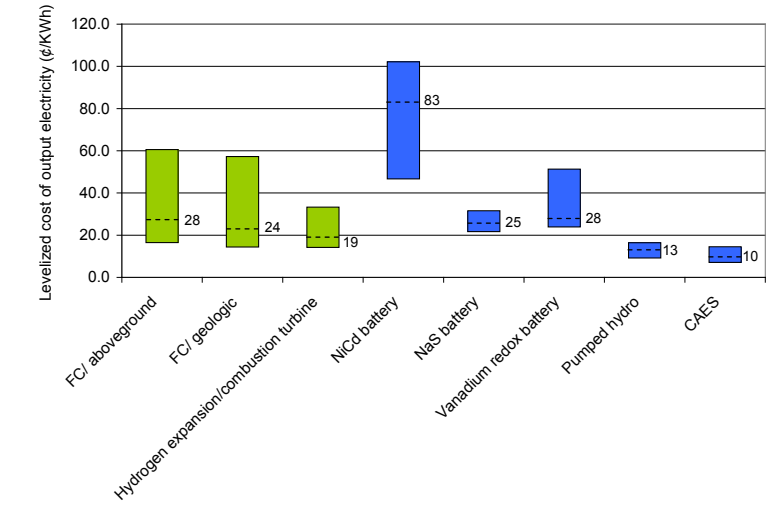
Accomplishment: NREL researchers compared hydrogen to other energy storage technologies for a defined energy storage scenario (first reported in February 2010). The cost analysis showed that if cost reductions in hydrogen technologies were achieved, hydrogen could be competitive with batteries. Advanced hydrogen storage systems could also be a cost competitive alternative to pumped hydro and compressed air energy storage (CAES) under certain circumstances.



Hydrogen electrical energy storage and dispatch scenario

Context: As renewable electricity becomes a larger portion of electricity generation, new strategies will be required to accommodate fluctuations in generating energy. One primary strategy to integrate large amounts of renewable energy is using energy storage to absorb excess electricity-generating capacity during low demand and/or high rates of generation by renewable sources. After absorbing the excess electricity generation capacity, the stored energy can be reconverted into electricity during high demand and/or low renewable generation.

Energy Storage Cost Analysis: NREL developed a cost survey of the most promising and/or mature energy storage technologies while comparing them with configurations in which hydrogen was the energy carrier. NREL used a simple energy arbitrage scenario for a mid-sized energy storage system with a 300-MWh (megawatt-hour) nominal storage capacity charged during off-peak hours (18 hours per day on weekdays and all day on weekends) and discharged at 50 MW per six peak hours on weekdays.



Ranges of levelized cost of output electricity for electricity storage systems

NREL compared several storage configurations for hydrogen with battery, pumped hydro, and CAES technologies. Using HOMER, an optimization model for distributed power, NREL calculated for each storage technology the levelized cost (or total annualized cost) of the initial capital investment, interest, replacement costs, disposal and/or salvage value, and variable and fixed operating costs over the lifespan of the facility divided by the total yearly energy output from the system.

This analysis evaluated two scenarios for producing hydrogen in excess of that needed for the storage system. In one scenario, five 280-kg tanker-truck loads (or 1,400 kg/day) were produced for the vehicle market. In the second scenario, enough excess hydrogen was produced to feed 500 kg/h into a hydrogen pipeline.

Significance of Accomplishment: With cost-reducing advances, hydrogen technologies could be competitive with battery systems for energy storage and could be a viable alternative to pumped hydro and CAES at locations where these technologies are not favorable. R&D efforts focused on increasing round-trip efficiency would reduce the levelized cost of energy for the storage system and improve environmental performance. Using hydrogen for energy storage could provide additional utility-scale energy storage options and unique opportunities to integrate the transportation and power sectors.

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