

Cache Energy Control for Storage: Power System Integration and Education Based on Analogies Derived from Computer Engineering

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Abstract: Energy storage is an enabling technology for power system integration of renewable sources, while data storage enables computer system integration. In this paper, a functional analogy relating energy and data storage is derived. Battery or hydrogen storage can provide large energy capacity similar to a hard disk providing large data capacity. Supercapacitors or flywheels provide fast and frequent access to cache energy similar to the computer's RAM providing fast and frequent access to data. In analogy to computer engineering, a cache control that coordinates the operation of a multilevel storage consisting of such complementary capacity and access oriented storage technologies is designed. It is illustrated how for an industrial distributed energy system with renewable generation, local load, fueling station, and connections to the electricity and gas distribution networks, the cache control provides energy management to support a modular plug-and-play-like system integration. The benefit of the analogy in education is evaluated on a representative sample of electrical engineering students at the University of Washington. While familiar with computing, students do not typically have the same level of exposure to power engineering. The understanding of distributed energy systems concepts is shown to improve thanks to this bridging analogy between computer and power engineering.