Electrochemical Capacitors Can Reduce Energy Inefficiencies, a Significant Contributor to Global Warming

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There is no denying the reality of global warming. Its clearly evident negative effects are a direct result of our ever-increasing use of fossil energy without regard for what that may do to our planet. Although by itself insufficient to halt global warming, one of the most responsible responses we can make is to increase the efficiency of applications that consume major quantities of fossil-fuel-derived energy. The great practicality of improving energy efficiency is easy to see, in that it is often simple to implement, can be widely applied, and is reliably projected to produce significant positive results. Well-known examples include adding thermal insulation to buildings, changing interior lighting from incandescent to fluorescent technology, and increasing the gas mileage of automobiles. Through such means, coupled with greatly increased reliance on solar, wind, and nuclear energy as well, we can reduce energy waste and temper its dire consequences.

Non-stationary machinery, including vehicles like automobiles, buses, trucks, and trains, as well industrial equipment like cranes, fork-lifts, and elevators, show great potential for energy efficiency improvement. The key component in energy efficiency improvement is highly-reversible energy storage that permits the transformation of kinetic energy to potential energy for reuse as kinetic energy. Hybrid gas-electric vehicle technology, where kinetic energy from braking action is stored electrically in a capacitor or chemically in a battery for reuse a short time later in acceleration, exemplifies this process.

Electrochemical capacitor technology is well suited for such important energy conservation applications. It offers excellent cycle life, exceptional power performance with resulting good cycle efficiency, and long operational life even in harsh environments. And in recent years capacitor products have evolved to the point where they now satisfy the performance requirements of some of the largest-volume applications. More importantly perhaps for practical reasons, continuing efforts at cost reduction are succeeding in driving down the costs of capacitors to levels commensurate with the financial requirements of the applications they are used in, as currently, for example, in public-use vehicles like city transit buses.

The growing challenge to technology developers in the most immediate present is to create capacitor modules and systems that meet the very specific operational requirements of individual applications. Earlier issues like cell performance, durability, cost, and even availability are increasingly being replaced by concerns about thermal management, system reliability, and product safety. In short, technology issues are simply evolving from component engineering to system and reliability engineering, a normal route for any component once it has achieved technical acceptance. Capacitor costs will continue to decline naturally as markets expand and the technology matures. And capacitor performance characteristics will improve continually with research and development efforts that will have grown in step with the technology’s demonstrated industrial significance.

A number of important tasks lie on the road to widespread and common electrochemical capacitor technology use, particularly the development of configuration architectures that best exploits each and every component to achieve optimal system performance. What, in a specific hybrid electric vehicle for example, should be the value of the operating voltage of an electrochemical capacitor working in concert with associated electrical items like electric motors, power electronics, and electrical interconnects? Questions like this will become increasingly important and in fact indispensable in the future, if electrochemical capacitor technology is to fulfill its natural industrial calling to help solve the energy inefficiency problems that contribute to today’s global warming.