Terrestrial energy

On the morning of Monday, August 29, Hurricane Katrina came on shore, causing devastation and flooding along the Gulf Coast from New Orleans, La., to Mobile, Ala. The city of New Orleans and the safety of its population were compromised as floodwalls were breached and water poured into the city, creating an environment with no running water, no sewage system, no electricity, no air conditioning, no transportation, no phones, no shops, and no food. More than 100,000 stranded people became totally dependent on others for rescue, safety, and survival. Hundreds of the city's people did not survive. A tragedy of catastrophic proportions, the disaster brought home the immense dependence we all have on power and energy systems.

Devastation can be seen along the beach at Biloxi, Miss., Sept. 15, 2005, following the storm surge of Hurricane Katrina. (USAF photo by Senior Master Sgt. David H. Lipp.)

Nine major oil refineries in Louisiana and Mississippi, which account for 11% of total U.S. refining capacity, were temporarily shut down. Pipelines were compromised, and the U.S. distribution system was affected. An explosion at a nearby chemical plant added to the chaos in New Orleans later in the week. Gasoline prices at the pump spiked upward toward an unprecedented $5 per U.S. gallon.

Less than a month later, another devastating storm, Hurricane Rita, came ashore between Galveston and New Orleans, adding furiously to the flooding and affecting oil refining capacity in the Houston, Beaumont, Port Arthur, and Lake Charles areas.

Renewed interest is again on alternative energy, but the weaning process will take decades. Among the paramount issues facing the terrestrial energy community is the question of why alternative energy sources, such as coal, solar, wind, hydro, and nuclear, have not come to the forefront, and what can be done to remedy this situation.

Significant advances in the terrestrial energy field have resulted from collaborative efforts among government, industry, and university R&D communities. These efforts are a clear response to the rapid changes that occurred this year in the world's energy situation. Among these changes were anticipated shortages in fossil fuel supplies, as energy demand continued to grow in fast-developing Asian economies; growing concerns about the emissions of greenhouse gases and hazardous pollutants, including particulates and oxides of nitrogen and sulphur; development of more efficient and less polluting combustion systems; and renewed interest in alternative energy sources, including fuel cells, wind power, nuclear, solar, and geothermal energy.

New initiatives by the Dept. of Energy are focusing on the development of clean vehicle technology and on hydrogen production, storage, and utilization systems. For instance, a major new effort is the FreedomCAR (Cooperative Automotive Research) and Fuel Partnership, which seeks to develop emissions-free and petroleum-free vehicles, including large-scale hydrogen production and its use in transportation vehicles.

NASA Glenn has been working on the solid oxide fuel cell (SOFC) and solar-powered fuel cell programs for aerospace applications. The SOFC program focuses on the detailed understanding, analysis, and optimization of reforming and desulfurization processes for commercial jet fuel. The second program seeks to develop a lightweight closed-loop solar energy storage system using regenerative fuel cells that can enable a 100-day HALE-ROA (high-altitude long-endurance remotely operated aircraft) solar electric flight demonstration. Such a demonstration would pave the way for low-cost replacements for GEO and telecommunications satellites, dramatically reducing entry barriers to wide-area Earth survey and high-bandwidth telecommunications.

Coal will continue to be a major fossil fuel source for power generation worldwide, because of its vast reserves and low costs. However, innovative new technologies are needed to significantly reduce pollutants emission with measurable increases in efficiency from coal-based power plants. To this end, the Dept. of Energy is focusing on the development of high-efficiency, clean coal technologies with significant reduction in the emissions of sulphur/nitrogen oxides, particulates, and greenhouse gases.

by **Suresh K. Aggarwal**
David G. Lilley