Berkeley's David Bailey

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Research Highlights . . .

PNNL thinks small to power today's electronic soldier

On the battlefield, having a reliable source of power to operate the advanced electronic devices a soldier carries is essential. But today's heavy and cumbersome batteries fall short in satisfying the military's needs. Researchers at DOE's Pacific Northwest National Laboratory have developed the smallest power system yet. The catalytic fuel processing reactor system provides a low-watt power source for hand-held wireless equipment, sensors and other small but essential devices required by today's troops. The power system is about the size of a cigarette lighter and converts liquid fuel to electricity via a microscale fuel processor coupled with a microscale fuel cell developed by Case Western Reserve University in Ohio. An integral part of the system is PNNL's revolutionary fuel reformer, which enables the system to convert fuel and water into hydrogen-rich gas.

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NREL highlights leading utility Green Power programs

DOE's National Renewable Energy Laboratory recently released its annual ranking of leading utility "green pricing" programs that allow consumers the choice of supporting additional electrical production from renewable resources such as solar and wind. More than 300 utilities in 32 states now offer these programs. Ranked by sales of green power, the green pricing program of Austin (Texas) Energy is first in the nation, followed by Sacramento Municipal Utility District, Xcel Energy (Colo.), the Los Angeles Department of Water and Power (LADWP), and Portland General Electric. Visit the Website for additional rankings.

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NETL facility tests CO_2 capture

To accelerate DOE's evaluation of viable options to reduce CO_2 emissions from fossil-fuel-based power plants, DOE's National Energy Technology Laboratory (NETL) has designed and constructed a modular, versatile facility on site to test new ideas for CO_2 capture and sequestration. The Modular Carbon Dioxide Capture Facility (MCCF) can operate on coal, natural gas, or both to simulate coal-fired combustion processes. It can be used to evaluate promising CO_2 capture and separation processes, while addressing DOE's Carbon Sequestration Program goal to develop efficient, cost-effective CO_2 disposal systems. By offering its MCCF to the research community at-large, NETL's Carbon Sequestration Science Focus Area welcomes partnerships with stakeholders interested in capture/ separation techniques within sequestration scenarios.

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FRICON takes the rub out of nanotech

Loss of energy and efficiency because of friction costs the economy billions of dollars annually. With the rapid development of nanotechnology, a new approach to controlling friction was urgently needed. Researchers from the Center for Engineering Science Advanced Research at DOE's Oak Ridge National Laboratory have developed FRICON, an extremely efficient, fast and robust control scheme. FRICON's efficiency is not limited to nanodevices and microelectromechanical systems—the method can be implemented on systems of any size. Because friction is omnipresent in scientific, engineering and technological applications, the scheme has broad relevance and applicability.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Water-desalination project demonstrates power of photovoltaics

In an effort to promote renewable energy sources for water-desalination projects around the world, researchers from four centers at DOE's National Renewable Energy Laboratory worked together to design and test a 16-kilowatt solar cell, or photovoltaic (PV) system that will power a water desalination system at the King's Palace in Aqaba, Jordan.

The four centers, Technology Transfer, the National Wind Technology Center, Electric and Hydrogen Technologies and Systems and the National Center for Photovoltaics, redesigned a commercial desalination unit to pump well water for remote and water-stressed communities in Jordan, Israel and the Palestinian Authority.

Water-desalination

The trailer-mounted unit is equipped with two tanks large enough to hold two to three days worth of desalinized water. Water is first pumped through filters that remove large and small particulates before being forced through membranes that trap the salt and allow the pure water to go through.

"The end result is water as pure as our drinking water in the United States," said Peter McNutt, principal engineer.

The unit is powered by a three-phase power system that can be tied to the electricity grid, powered by diesel fuel or powered by PV. This particular unit is equipped with a 16-kilowatt system, designed by RMS Electric Inc. in Boulder, Colo.

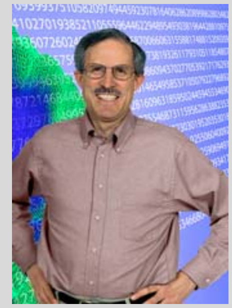
"There is a big need for water in Jordan and energy is limited so if you're able to put something relatively portable like a PV system to pump and purify water, it's helping a lot of people", McNutt said.

The demonstration unit was shipped to Jordan in April. Additional units will eventually be sent to the West Bank and to remote villages under the jurisdiction of the Palestinian Authority.

Technion, Israel's Institute of Technology, will lead the effort to teach residents of Jordan and the Palestinian Authority how to assemble and maintain the units.

Submitted by DOE's National Renewable Energy Laboratory

REAL MATHEMATICIANS REALLY DO COMPUTE



David Bailey

David Bailey is chief technologist for DOE's National Energy Research Scientific Computing Center (NERSC). But when he and Canadian mathematician Jonathan Borwein began collaborating in 1985, the attitude was "real mathematicians don't compute."

Bailey and Borwein's new book, *Experimentation in Mathematics*, aims at a younger generation of mathematicians who use computer-powered "experimental mathematics" to uncover surprising results. The May issue of *Scientific American* suggests the book, not due until September from publisher A K Peters, Ltd., is already eagerly anticipated.

Bailey and his colleagues' own experimental discoveries include a formula for finding any binary digit of pi without calculating the digits preceding it and a recent proof that an entire class of fundamental constants is "normal."

Born in Provo, Utah, Bailey's role models were his neighbors, mathematicians at Brigham Young University. While an undergraduate there, his precocity landed him a job programming computers to do physics. "I cut my teeth on computers at BYU," he says.

On moving to NASA's Ames Research Center in 1984, he was promptly assigned to "shake down" NASA's first Cray-2 supercomputer. To test how well it could sustain a long calculation, he computed the first 29 million digits of pi on two of its four processors—which came up with two different answers. It took nine months to get the bugs out.

At NERSC, Bailey tests supercomputer performance and develops algorithms for scientific calculations. His love for the fundamentals is alive and well.

"To this day I live in two worlds, theoretical math and scientific computing," he says. "I'm trying to marry these two by applying advanced computing to problems in pure mathematics. Experimental mathematics is the outcome."

Submitted by DOE's Lawrence Berkeley National Laboratory