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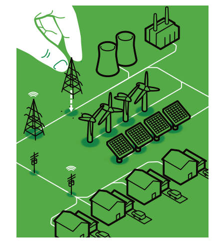
smart-grid showcase

In this special issue, we highlight IEEE's involvement in helping to build the smart grid.

IEEE

INSIDE

TECHNOLOGY



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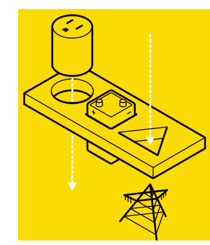

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ONLINE

AVAILABLE 6 DECEMBER AT WWW.IEEE.ORG/THEINSTITUTE

ELECTION RESULTS Find out who is the 2011 IEEE president-elect.

MEMBER RECOGNITIONS Read about IEEE members recently honored for the quality of their work.

IEEE AROUND THE WORLD

REGION 3 Southeastern United States

■ **Jamaica Section** establishes IEEE Education Society chapter.
■ **Northwest Florida Section** establishes Graduates of the Last Decade (GOLD) affinity group.
■ **Daytona (Fla.) Section** establishes chapter of IEEE Aerospace and Electronic Systems Society.
■ Student branch formed at **Union University, Jackson, Tenn.**

REGION 4 North Central United States

■ Student branch formed at the **University of Wisconsin-Stout.**

REGION 5 Southwestern United States

■ **Corpus Christi (Texas) Section** establishes IEEE Power & Energy Society chapter.
■ **Galveston Bay (Texas) Section** establishes IEEE Computer Society chapter.
■ **Pikes Peak (Colo.) Section** establishes GOLD affinity group.

REGION 6 Western United States

■ **San Fernando Valley (Calif.) Section** establishes IEEE Power & Energy Society chapter.
■ **Oakland East Bay (Calif.) Section** establishes Life Members affinity group.
■ Student branch formed at **California Baptist University, Riverside.**
■ **Alaska Section** establishes IEEE Power & Energy Society chapter.

REGION 7 Canada

■ **London (Ont.) Section** establishes IEEE Engineering in Medicine and Biology Society chapter.

REGION 8 Europe, Middle East, and Africa

■ **Latvia Section** establishes IEEE Computer Society chapter.
■ **Tunisia Section** establishes IEEE Industry Applications Society chapter.
■ **Lebanon Section** establishes joint chapter of the IEEE Antennas and Propagation, Microwave Theory and Techniques, and Magnetics societies.
■ **France Section** establishes IEEE Control Systems Society chapter.
■ **KTH Royal Institute of Technology, Stockholm,** establishes Women in Engineering (WIE) affinity group.
■ Student branch at the **University of Cape Town** establishes chapter of IEEE Power & Energy Society.
■ Student branch at the **Usikov Institute of Radiophysics and Electronics, National Academy of Sciences of Ukraine, Kharkov,** forms chapters of the IEEE Solid-State Circuits, Dielectrics and Electrical Insulation, and Magnetics societies.
■ Student branch formed at **Yanbu Industrial College, Yanbu al-Sinaiyah, Saudi Arabia.**
■ Student branch formed at the **University of Lugano, Switzerland.**
■ Student branch formed at **Akdeniz University, Antalya, Turkey.**

REGION 9 Latin America

■ **Centro Occidente (Mexico) Section** establishes IEEE Computer Society chapter.
■ **Veracruz (Mexico) Section** establishes GOLD affinity group.
■ Student branch formed at **Tecnológico de Estudios Superiores, Jocotitlán, Mexico.**
■ **Peru Section** establishes IEEE Control Systems Society chapter.
■ Student branch at the **Universidad Nacional del Callao, Peru,** establishes IEEE Computer Society chapter.
■ Student branch at the **University of San Martín de Porres, Peru,** establishes IEEE Communications Society chapter.
■ **South Brazil Section** establishes IEEE Aerospace and Electronic Systems Society chapter.
■ **The Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, in Brazil,** establishes WIE affinity group.
■ **The Universidad Tecnológica de Panamá, Panama City,** establishes WIE affinity group.
■ Student branch at the **University of Buenos Aires** establishes IEEE Circuits and Systems Society chapter.
■ Student branch at the **Universidad Distrital Francisco José de Caldas, Bogotá,** establishes IEEE Robotics & Automation Society chapter.
■ Student branch formed at **Universidad Privada Boliviana, Cochabamba, Bolivia.**
■ Student branch formed at **Universidad Diego Portales, Santiago, Chile.**

REGION 10 Asia and Pacific

■ **Beijing (Changsha) Section** establishes IEEE Communications Society chapter.
■ **Beijing (Chongqing) Section** establishes IEEE Computer Society chapter.
■ **Beijing (Guangzhou) Section** establishes IEEE Instrumentation and Measurement Society chapter.
■ **Beijing (Nanchang) Section** establishes IEEE Industry Applications Society chapter.
■ **Beijing (Shenzhen) Section** establishes IEEE Society on Social Implications of Technology chapter.
■ **Beijing and Harbin sections** establish joint chapter of IEEE Instrumentation and Measurement Society.
■ **Macau (China) Section** establishes joint chapter of IEEE Antennas and Propagation and IEEE Microwave Theory and Techniques societies.
■ **Nanjing (China) Section** establishes IEEE Nanotechnology Council chapter.
■ **Xian (China) Section** establishes IEEE Microwave Theory and Techniques Society chapter.
■ **Shanghai Section** establishes IEEE Signal Processing Society chapter.
■ **Singapore Section** establishes IEEE Sensors Council chapter.
■ **Thailand Section** establishes IEEE Computer Society chapter.
■ **Sri Lanka Section** establishes IEEE Microwave Theory and Techniques Society chapter.
■ **Bangalore (India) Section** establishes IEEE Consumer Electronics Society chapter.
■ **Madras (India) Section** establishes IEEE Electron Devices Society chapter.
■ WIE affinity groups established in India at **KMCT College of Engineering, Kerala,** and **Dr. N.G.P. Institute of Technology, Coimbatore.**
■ Student branch at the **Rajasthan College of Engineering for Women, Jaipur, India,** establishes IEEE Computer Society chapter.
■ Student branches formed in India at **Chengannur College of Engineering, Jodhpur Institute of Engineering & Technology, Sambhram Institute of Technology,** and **Graphic Era University.**
■ Student branch at the **University of Engineering & Technology, Lahore, Pakistan,** establishes IEEE Power & Energy Society chapter.
■ **Hamdard Institute of Information Technology, Karachi, Pakistan,** establishes WIE affinity group.
■ Student branch formed at the **University College of Engineering & Technology, Islamia University of Bahawalpur, Pakistan.**
■ **Islamabad, Lahore, and Karachi** sections, in Pakistan, establish joint chapter of IEEE Control Systems Society.
■ Student branch formed at the **Telkom Institute of Technology, Bandung, Indonesia.**

New IEEE Offices in Asia

IEEE HAS OPENED an office in India's Bangalore central business district to increase its presence in the country. The office will help IEEE continue its outreach efforts to local representatives from academia, government, and industry. A ribbon-cutting ceremony was held on 29 October.

The office staff will work to encourage India's participation in global standards development as well as to promote the IEEE Computer Society's software development certificate program. The certificate is geared to entry-level and midcareer software engineers hoping to advance their careers. Other plans call for the office to implement a continuing-education program.

Meanwhile, in Singapore, the IEEE Asia Pacific Operations Center recently moved from the Fleming Science Park to Fusionopolis. A ribbon-cutting ceremony was held on 1 November at the new location, a relatively new R&D complex in the Singapore neighborhood of Buona Vista. Fusionopolis houses a number of research organizations, high-tech companies, and high-level government agencies.

Eta Kappa Nu Becomes IEEE's Honor Society

ETA KAPPA NU (known as HKN), a nonprofit public-service organization with nearly 200 university chapters, has become the honor society of IEEE. The merger, which forms IEEE-HKN, expands the organization's operations and chapters beyond North America. HKN will have broader access to professionals and students around the world who are IEEE members.

HKN recognizes excellence in scholarship, leadership, and service and has more than 100 000 inductees who were chosen on the basis of their technical, scientific, and leadership achievements.

IEEE-HKN will be governed by a new board of governors to be elected by HKN chapters. The president of the board will serve as a voting member of the IEEE Educational Activities Board and will be an ex officio on the IEEE Foundation's board of directors. All HKN chapters will continue to operate as they have in the past. Beginning next year, new HKN inductees must also be IEEE members.

If you are an HKN member, e-mail ieee-hkn@ieee.org with your IEEE member number so that your records can be updated.

Three New Journals Coming in 2011

IEEE PLANS TO launch three journals in 2011, covering circuits and systems, photovoltaics, and terahertz science.

The *IEEE Journal on Emerging and Selected Topics in Circuits and Systems* will be aimed at research in smart systems, ambient intelligence, sensor networks, nanotechnology, smart power, bioinspired electronics and bioinformatics, security, and green circuits and systems. The quarterly, sponsored by the IEEE Circuits and Systems Society, is to include in-depth research as well as more general articles geared to a wide audience of scientists and engineers.

The biannual *IEEE Journal of Photovoltaics* will cover fundamentals and new concepts, PV systems, thin-film solar cells, concentrator solar cells, organic PV, and advances in PV characterization. The IEEE Electron Devices and IEEE Power & Energy societies are sponsoring the journal.

IEEE Transactions on Terahertz Science and Technology will be dedicated to research on devices and systems operating in the terahertz frequency range. The biannual is expected to cover basic science and applications of the THz spectrum to biology, medicine, imaging, atmospheric and environmental science, remote sensing, radio astronomy, spectroscopy, telecommunications, and security. Other articles will explore nondestructive evaluation and ultrafast science using pulsed THz beams. The IEEE Microwave Theory and Techniques Society is the journal's sponsor.

All three publications will be available through the IEEE Xplore digital library, from various IEEE online collections, and by individual subscription.

For more information on each journal, visit the sponsoring society's home page, starting at http://www.ieee.org/societies_communities.

CALENDAR

DECEMBER

6 1877: The **first phonograph recording** is made by Thomas A. Edison, who recites the nursery rhyme "Mary Had a Little Lamb."

12 1901: At Signal Hill in St. John's, Nfld., Canada, Guglielmo Marconi and his assistant receive the **first transatlantic radio signals**, from Cornwall, England.

13 1994: First meeting of the **World Wide Web Consortium**, which aims to promote common Web protocols.

16 1776: Birth date of **Johann Wilhelm Ritter**, a pioneer of electrochemistry who developed what is considered the first storage battery, based on the principles of the voltaic pile.

23 1947: The **transistor** is demonstrated for the first time at Bell Labs in Murray Hill, N.J., by John Bardeen and Walter Brattain, along with supervisor William Shockley.

26 1791: Birth date of **Charles Babbage**, credited with the concept for a programmable computer.

28 1895: For the first time, an audience pays to watch **moving pictures** when the Lumière brothers demonstrate their Cinématographe, in Paris.

JANUARY

2 1926: Harold Wheeler invents the **diode automatic volume control**, which regulates the sound range of radio receivers.

5 1980: **Hewlett-Packard Co. begins selling its first personal computer**, the US $3250 HP-85, equipped with a built-in 5-inch monitor, a printer, and a cassette tape for data storage.

9 1894: New England Telephone and Telegraph puts the **first battery-operated telephone switchboard** into operation, in Lexington, Mass.

14 1878: **Alexander Graham Bell** demonstrates his telephone to Queen Victoria.

22 1984: Apple Computer Co. introduces the first **Macintosh computer,** in a TV commercial during the broadcast of Super Bowl XVIII.

26 1924: In Bavaria, Germany, the **Bayernwerk regional power transmission grid** begins transmitting from the Walchensee hydroelectric power station.

FEBRUARY

1 1958: The **Explorer 1 satellite** is launched and goes on to confirm the existence of the Van Allen radiation belt, a cluster of charged particles around Earth.

5 1840: Birth date of **Hiram Stevens Maxim**, inventor of the electric pressure regulator.

10 1883: Birth date of **Edith Clarke**, the first woman to receive an electrical engineering degree from MIT.

15–20 **IEEE Meeting Series** in Miami.

24 1910: **First commercial radiotelephone service** for the general public begins operation in North America.

26 1939: **RCA's first experimental TV broadcast** takes place at the World's Fair in New York City.2

Historical events provided by the IEEE History Center. **IEEE events** indicated in red.

CLOCKWISE FROM TOP LEFT: ARAVIND TEKI/ISTOCKPHOTO; HULTON ARCHIVE/GETTY IMAGES; APPLE; JONATHAN LARSEN/ISTOCKPHOTO; ALCATEL-LUCENT BELL LABS

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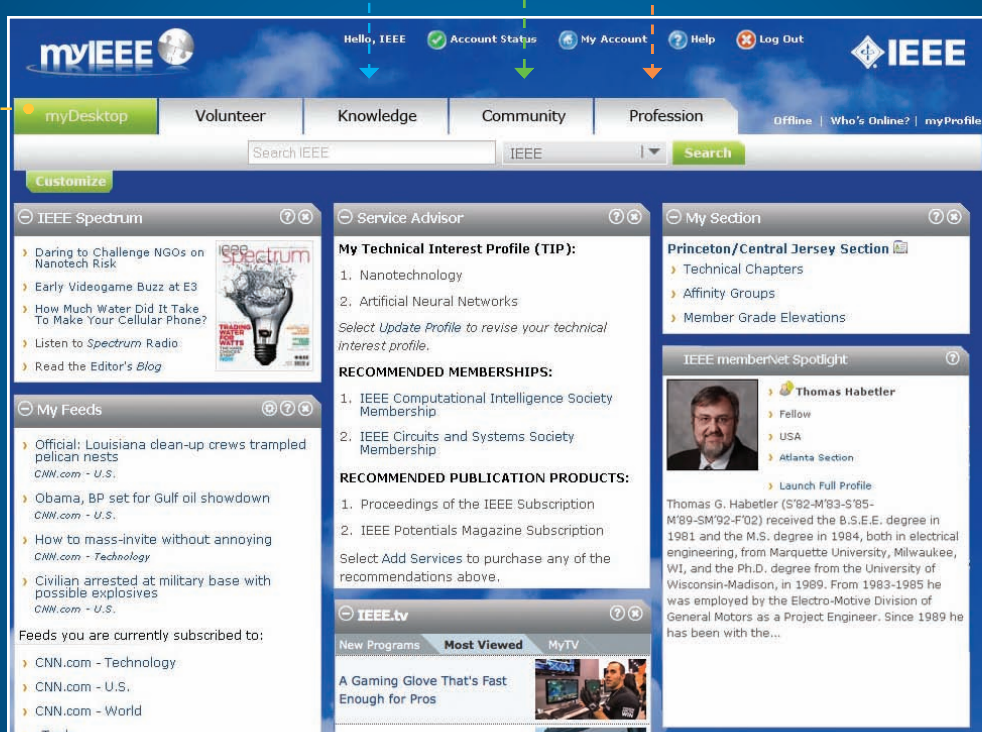

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IEEE
Advancing Technology for Humanity

The Smart Grid: A Primer

BY KATHY KOWALENKO

FROM DEVELOPED countries such as Italy, South Korea, the United Kingdom, and the United States to developing ones like China, India, Poland, and Vietnam, nations are investing in smart-grid systems. Cumulative global smart-grid spending by governments and utilities is expected to total US $200 billion worldwide from 2008 through 2015, according to Pike Research, a firm that analyzes global clean-technology markets. That spending doesn't even include investments needed merely to keep aging electric transmission and distribution infrastructures running.

But what exactly is a smart grid, and how might it affect you?

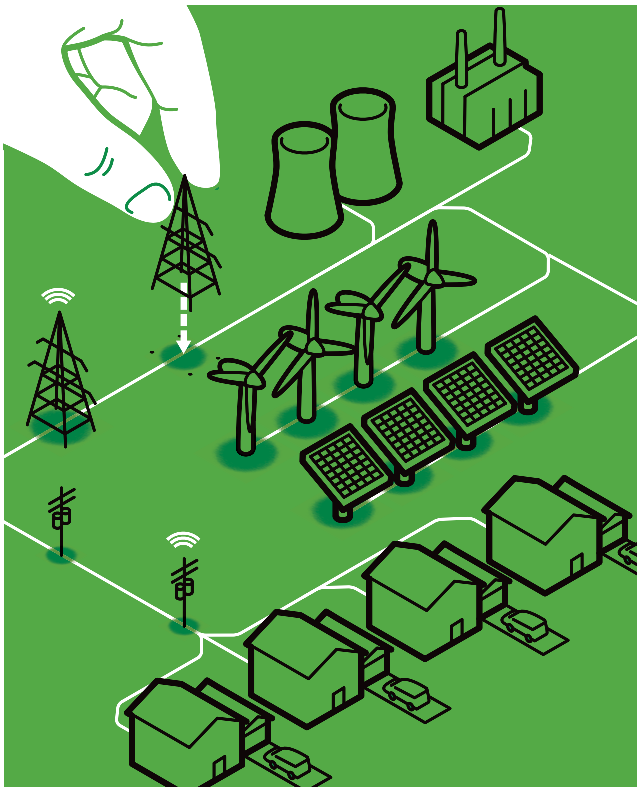
GRID GUIDE

The electricity grid is made up of four main components: generation, transmission, distribution, and customers. Generation refers to the production of electricity from sources of energy, such as coal and natural gas. The transmission system carries the electric power from the generators over long distances to a distribution system, which brings the power to the customers. Distribution systems can include power stations of their own.

Developing countries often have antiquated systems. But even more modern systems, which in a developed country such as the United States can be 50 years old or more, are typically inefficient, unreliable, polluting, incompatible with renewable energy sources, and vulnerable to cyberattack. In other words, problems with electric grids abound.

A smart grid would help make everything better, thus improving reliability, security, and efficiency, which are of critical importance given that electric power consumption worldwide is expected to triple by 2050.

The key to making things better is two-way data communications among all the elements, so that information about the grid's condition can be shared and acted upon. To do that, many devices, including those on the customers' premises, must be computer controlled and interactive. Smart-grid designers would overlay today's systems with the sensors, controls, and wireless devices needed for digital communications and for monitoring and controlling grid activities. And customers could save money by turning off heavy-duty motors and appliances during peak hours.



BOUNTIFUL BENEFITS

The anticipated benefits are less pollution, lower bills, and fewer outages. However, tumult could erupt when utilities ask customers to pay for new equipment like smart meters.

More and more countries are seeking to implement energy conservation measures, and they're requiring utilities to get energy from renewable resources such as solar and wind power. But because those sources operate intermittently, they present a challenge for transmission and distribution systems. A smart grid would help make it easier to integrate photovoltaic, wind, and other intermittent power sources.

The smart grid is expected to reduce or even prevent power outages by anticipating equipment failures and rerouting electricity transmission to compensate. New grid technologies will also detect and isolate power outages to contain them. (Nowadays, it's often only when someone calls in a downed power line that the utility learns about it.) Self-healing systems would use real-time data to detect and isolate faults and to reconfigure the distribution network to minimize the number of customers affected.

Smart grids are expected to be more resilient and better able to handle not only peak electricity demand but also severe weather conditions such as hurricanes, ice storms, and floods. And in systems that have time-of-day electricity pricing, customers could save money by shutting off appliances and using less power at times when electricity is most expensive.

When all-electric vehicles finally hit the streets, utilities could be paying you to plug in your car and feed them energy. A bidirectional vehicle-to-grid interface would let a plug-in car take energy from the grid when it is being charged and put it back on the grid when it is garaged. In effect, the cars would act as tiny distributed power stations.

BUILDING THE GRID

IEEE, its members, and other organizations are working to make the smart grid a reality. They're concerned with the countless technical considerations required to support a multitude of networks and interfaces. That includes creating a common technical platform for all the players to build on. They're addressing such functions as load control, data analysis, maintenance, and security management.

Sensing, measurement, and control devices will be expected to support today's applications and new services without the need to replace core infrastructure and associated equipment. That requires an open infrastructure in which devices from different manufacturers can be mixed and matched. Requirements for communication between the grid and those smart appliances, electric vehicles, and solar panels are being defined. Other projects involve creating systems for storing the energy that comes from intermittent power sources, like wind turbines and electric cars.

"IEEE is leveraging its strong foundation and collaborating to evolve standards, share best practices, publish developments, and provide educational offerings to advance technology and facilitate the smart grid's successful deployment throughout the world," says Wanda Reder, chair of IEEE Smart Grid, the group that oversees IEEE's activities in the area. ■

JAMES PROVOST

Smart Standards for the Smart Grid

BY IVAN BERGER

THE U.S. POWER-GRID infrastructure is a century old, but its technology is mainly from the 1950s," notes Dick DeBlasio, chief engineer at the U.S. Department of Energy's National Renewable Energy Laboratory, in Golden, Colo. Many other countries' grids also go back to the 1950s, if not earlier. Despite a recession-inspired lull in power demand, and some slowing of demand growth through adoption of green technologies, the world's power grids need to be beefed up to carry more power—and smartened up for greater system-wide efficiency. Doing that takes new technologies. It also calls for lots of standards to harmonize everything. That's where IEEE comes in.

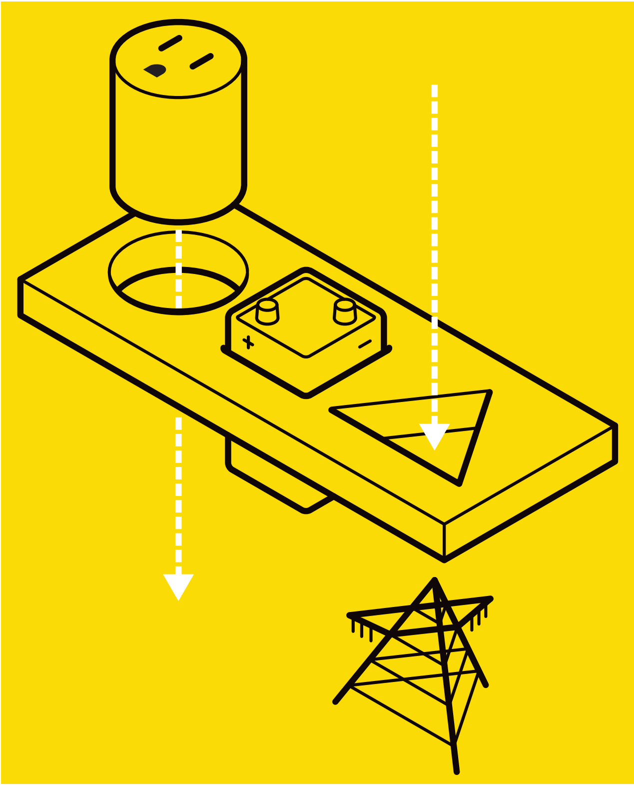
DeBlasio, an IEEE life member, is IEEE's smart-grid liaison to the National Institute of Standards and Technology (NIST). The IEEE Standards Association, along with other groups, is collaborating with NIST to create the *Smart Grid Interoperability Standards Roadmap*. It identifies the short- and long-term plans under way for developing the grid's architecture and the standards and infrastructure that will be needed.

The smart grid involves modernizing the generation, delivery, and use of electricity. "I consider it a system of interconnection and interoperability among distributed electric power sources such as solar, wind, other generation technologies, and storage—with two-way power flow and communications between power sources and end loads," says DeBlasio.

DeBlasio chairs IEEE's P2030 standards working group (which is developing guidelines for smart-grid interoperability) and IEEE Standards Coordinating Committee 21 (which sponsors the standard known formally as the IEEE P2030 Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation With the Electric Power System and End-Use Applications and Load).

"Most of our power-side standards are systems-level," DeBlasio says, "so the guide is intended to work with NIST's smart-grid road map. It's easier to develop standards when you have a guide like this than if you have to build from scratch each time."

More than 100 IEEE standards apply to the smart grid, and about three dozen more are in development. Here are some of the standards being developed [see more on p. 11].



COMMUNICATIONS

What is expected to make the smart grid smart is its ability to carry information and monitor itself, pinpointing outages and problems, telling controls when to run appliances most economically, and using weather information to predict the output of wind and solar installations.

"Transformers, relays, and so on have the potential to be Internet nodes you can query as to status, so communications protocols will be required," says Chuck Adams, president of the IEEE Standards Association.

Using the grid as a communications link for power management could make it viable for general narrowband and broadband communications, especially in rural areas that are connected to the grid but lack broadband links. That would involve IEEE 1901 for communications over power lines.

"The long-term goal is not just two-way power but also two-way communications and two-way IT management," says Adams, an IEEE senior member. "In particular, we need to look at integration of regenerative energy, because the power generated by sources such as wind varies and because mismanagement can bring down the system."

An IEEE standard addresses that: IEEE 1547, on interconnecting distributed power-system resources. IEEE is working with the International Electrotechnical Commission's (IEC) Technical Committee 8 to make IEEE 1547 a joint IEC/IEEE product.

Power companies need to be able to plan when they'll run their stationary power plants, which take a while to bring up to speed, and when they can count on wind power, Adams adds. Another challenge is what to do with generated energy when there's not enough demand, so IEEE is getting into standards for managing energy storage.

In the consumer electronics arena, IEEE is looking at interoperability and communications between appliances and the grid. "When you plug in a new refrigerator, the maker will know it's online, be able to detect and address problems, and update the software used to run it," Adams says. And the appliance will know to schedule power-hungry operations such as defrosting for the hours when power cost is low, he adds. Such intelligent appliances are already being introduced.

Then there's the IEEE P2030.1 for electric vehicles, which covers two-way power flow and communications between plugged-in electric cars and the grid.

The more interconnected a system is, the greater its vulnerability to mischief. "By modernizing communications, we create openings [for hackers]," DeBlasio says. "This could open up possibilities of upsetting the communications system and, therefore, the grid." The NIST smart-grid interoperability panel has a subpanel considering the grid's vulnerability, and the P2030 working group is addressing it as well.

COORDINATION

Certainly, no single standards community or standards organization will be able to do all that's required. IEEE will probably need to partner with other organizations. For example, communications via the grid are likely to use Internet Protocol, Adams notes, and that probably will involve the Internet Engineering Task Force.

Adams adds that the European Telecommunications Standards Institute is looking at communications infrastructure, as well as such standards as GSM and its 3G and 4G extensions. IEEE is strong in that area, with networking standards such as the IEEE 802 wireless standards.

IEEE also has relationships that allow joint standards development with the International Organization for Standardization and IEC.

"And as a member of the International Telecommunication Union, IEEE can bring proposals and input to their projects," Adams says. "Most of the industry today is global, so industry wants to be able to develop and manufacture products that can be used worldwide." ■

JAMES PROVOST

Help Wanted: Power Engineers

Working to increase the dwindling supply of power professionals

BY ANNA BOGDANOWICZ

THE UNITED KINGDOM, Canada, and other countries will soon experience a shortage of power engineers, with the shortage in the United States expected to be the most acute. During the next five years, about 45 percent of U.S. engineers working for electric utilities will be eligible for retirement, according to recent studies. And with countries making huge investments in building smart grids, the power industry is facing a major challenge. A lack of skilled power engineers could jeopardize the grids.

The IEEE Power & Energy Society (PES) says the key to strengthening the workforce is to improve power engineering education. To this end, the society has been working on an initiative called the Power and Energy Engineering Workforce Collaborative (PWC).

As part of the effort, PES in June established the US $1 million IEEE Power & Energy Society Scholarship Fund. Administered by the IEEE Foundation, the fund is aimed at enticing high school and undergraduate students to study power engineering.

The society has been working on the workforce shortage since 2007, when it launched the PWC. The collaborative is composed of PES members, university administrators, industry executives, and government officials.

During the past two years, the PWC has been busy. Last year it published a report, *Preparing the U.S. Foundation for Future Electric Energy Systems: A Strong Power and Energy Engineering Workforce*, that outlined the challenges facing the industry as well as potential solutions. PES and IEEE-USA have been working together to outline how $100 million in funds from the American Recovery and Reinvestment Act—the economic stimulus plan enacted last year—could be spent on training workers needed for the smart grid. IEEE-USA last year sent its recommendations to members of Congress.

In addition, the PWC has developed a career service Web site, http://www.pes-careers.org, where students can get advice on pursuing careers in power engineering. The IEEE PES has also held student job fairs at several of its meetings in North America.

JAMES PROVOST

"Engineering the Future," an article published in the July/August issue of *IEEE Power & Energy Magazine*, highlighted the PWC's objectives and progress. Although the initiative is focused on the United States, "similar efforts should be effective for other countries," the article stated.

Establishment of the PWC came about partially in response to a 2003 survey of 40 U.S. and 27 non-U.S. academic institutions. The study showed U.S. universities were struggling to replace retiring power engineering faculty, and it predicted that a lack of power engineering professors will lead to fewer programs and hence fewer students pursuing degrees in the field, making the shortage even worse.

The study also found that universities in the United States on average replace four power engineering faculty retirees with three faculty members, while there are five replacements for every four such retirees at non-U.S. universities.

"We've seen an increase in interest from students in renewable energy and the smart grid," says IEEE Senior Member Wanda Reder, who established the PWC. "But we need an ample number of professors to accommodate that demand. Many professors I've talked to said their class sizes have been increasing."

RETIRING ENGINEERS

About 7000 of the power engineers in the United States—roughly half of them—are expected to retire from the profession or leave for another reason in the next five years. They will be taking with them their knowledge of how to maintain the current electric power system, with which the new smart grid will be integrated. Their replacements will have to get up to speed on all aspects of the current system while adding expertise in communications, information technology, and other fields.

WHAT TO DO

The PWC has outlined several recommendations for tackling the problem. One is to double the number of undergraduate and graduate students in power engineering—which is easier said than done. The PWC estimates that about 900 undergraduate students are graduating each year who have an interest in power engineering jobs. There also seems to be an increase in students choosing the major, according to recent reports.

To attract more students to the field, the group recommends providing $4 million in funding for 2000 undergraduate power engineering scholarships. In addition, it suggests the creation of 2000 internships and other job opportunities for electrical engineering students. That would give them a chance to see what the power industry is all about, the group says.

To handle the anticipated increase in students, the PWC recommends that schools hire 80 power engineering faculty members during the next five years. To fund those positions, university power engineering research support should be raised from $50 million to $100 million annually during the next five to eight years, the group says.

"While it is difficult to know exactly what future power engineering workforce needs will be, doubling student graduations over the next five to eight years is the right direction to head in," the PWC says. ■

SUCCESS IN LATIN AMERICA

While many countries are struggling to fill the power engineering gap, Latin American universities are seeing record enrollment in the field. Learn more online on 6 December at http://www.ieee.org/theinstitute.

OPINIONS

MARKETPLACE OF IDEAS
LETTERS
PRESIDENT'S COLUMN

MARKETPLACE OF IDEAS

PAT SULLIVAN/AP PHOTO

THIS MONTH'S QUESTION:

Smart Grid Speed Bumps

Proponents of the smart grid point out that because smart meters could allow customers to find out how much energy they're using, they could lower their electricity bills by turning off power-hungry appliances or use them at off-peak times. But this good news could come with a rate increase. The Maryland Public Service Commission in June rejected an increase sought by Baltimore Gas and Electric to pay for the installation of smart meters and a new communications network, and other states have taken a similar stance.

Would you be willing to help pay for the smart grid in your community? Do the proposed benefits of smart meters outweigh the costs?

Respond to this question by e-mail or regular mail. Space may not permit publication of all responses, but we'll try to draw a representative sample. Responses will appear in the March issue of The Institute *and may be edited for brevity. Suggestions for questions are welcome.*
MAIL: The Institute, *IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141 USA* ***FAX:*** *+1 732 562 1746* ***E-MAIL:*** *institute@ieee.org*

RESPONSES TO SEPTEMBER'S QUESTION

Punishment for Plagiarism

A lecturer at Institut Teknologi Bandung (ITB), in Indonesia, was stripped of his doctorate this year after it was found he plagiarized a paper he claimed to have written. The article was published in the proceedings of an IEEE conference and posted in the IEEE Xplore digital library. Having a paper published was a prerequisite for obtaining his degree. After an allegation was made, IEEE investigated and determined he had copied the work of an Austrian researcher.

The lecturer, who has since resigned from ITB, was prohibited from publishing in all IEEE publications for three years, beginning in April 2009.

IEEE added a note to IEEE Xplore that says the article is in violation of IEEE's publication principles because it contains a nearly complete duplication of the other researcher's paper, which was published in 2000 in the Proceedings of the 11th International Workshop on Database and Expert System Applications.

What is a fair punishment for plagiarism? Do you think it's a big problem in the engineering field?

A Common Issue

The biggest problem I see with engineers is their lack of professionalism. Cheating, whether it's plagiarism or copying someone's answer on a test, is too often used to get ahead. The lecturer should also have all his future papers peer-reviewed before they are accepted for publication or used to earn a degree. Until ethics are considered a valuable commodity for engineers, punishment is the only way to reduce incidents of plagiarism.

SONDRA K. TODD
Wichita, Kan.

A Rare Occurrence

Getting stripped of one's doctorate is definitely a lesson learned. Plagiarizing a scholarly work published by IEEE is nothing short of atrocious. Thankfully, the peer-review process in the engineering world almost never fails to reject plagiarized and low-quality articles. What's puzzling is how the article got published in the proceedings of an IEEE conference.

AKHAN ALMAGAMBETOV
Syracuse, N.Y.

Shifting Values

Plagiarism is a problem because technology has made it easy to find and copy material online. Meanwhile, our weakening ethical values fail to keep pace with technology advances. I'm not justifying plagiarism, but we should take into consideration that society now condones what in the past was unacceptable. Moral and ethical values are changing.

MANUEL PEREZ
El Paso, Texas

It's Academic

Plagiarism is an issue that concerns academics who are afraid that someone will steal their work and keep them from gaining tenure. The world would be better off if everything were open and available for all to use. The business world operates through plagiarism. It is stupid to reinvent the wheel or to waste time footnoting every recycled idea. Any company can impose rules on its employees, but they should not try to impose their rules on the rest of us, especially when these academic types are in the minority.

WILLIAM ADAMS
Springfield, Va.

Restoring Faith

The revocation of the lecturer's doctorate was a necessary step in the quest to keep honor and integrity in the value of an advanced degree. Prohibiting him from publishing for three years was light punishment. Quickly investigating, challenging the individual, and making the public aware of the issue was probably the best course of action we could have taken as a professional society.

ROGER KAIN
Vista, Calif.

It Could Happen to You

The way plagiarism is uncovered concerns me. As the volume of electronic material increases, there are fewer ways to say certain things in an original way. Eventually, if there are thousands of documents on a subject, you might inadvertently duplicate another person's words. My advice is to carefully consider any document you write that may be distributed to the public. Your reputation could be on the line—literally.

DAVE SMITH
Beaver, W.Va.

LETTERS

Cars of the Future

The technology presented in "Keeping Cars From Crashing" [September, p. 5] undoubtedly would lower the rate of automobile accidents, even with cars traveling at high speeds. But we must also build electric railways for cars on the highways and design a traffic control system for them. That is a necessary step in developing an intelligent energy strategy.

OLIVER H. WINN
Corona Del Mar, Calif.

Two simple techniques that can help avoid collisions are to turn on your headlights when using your windshield wipers and to use your hazard blinkers when reversing. At a trivial expense, automobile manufacturers could produce cars that perform those two safety features automatically. I don't understand why they wait for legislation to force them to take such steps.

ROBERT G. HUENEMANN
Hollister, Calif.

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IEEE MEDIA
Publisher James A. Vick
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THE INSTITUTE (ISSN 1050-1797) is published quarterly by The Institute of Electrical and Electronics Engineers Inc., 3 Park Ave., 17th Floor, New York, NY 10016-5997; tel. +1 212 419 7900. Periodicals postage paid at New York, NY, and at additional mailing offices. Canadian GST# 125634188. Annual subscription rate: US $26.95. The editorial policies for IEEE's major publications are determined by the IEEE Board of Directors. Unless otherwise specified, IEEE neither endorses nor sanctions any positions or actions espoused in THE INSTITUTE. Major IEEE boards review items within their purview prior to publication. When published in THE INSTITUTE, individual viewpoints of elected IEEE officers are labeled as such. They are reviewed by the individuals to whom they are attributed, unless they are a matter of record. The editorial staff is responsible for selection of subject matter and its placement within the issue. POSTMASTER: Send address changes to THE INSTITUTE, IEEE Operations Center, Coding Department, Box 1331, Piscataway, NJ 08854-4141, USA.

Lending a Helping Hand

THE CLOSE of 2010 marks the end of the first full decade of the 21st century. It has been 10 years of political and economic change and upheaval, as well as some life- and landscape-altering events such as earthquakes, tsunamis, and floods.

IEEE has also changed in the past 10 years. One of the most important changes took place about four years ago when the IEEE Board of Directors clearly defined the IEEE core purpose as fostering "technological innovation and excellence for the benefit of humanity." In fulfilling this purpose, the Board concluded that "the IEEE community and its technologies will positively impact global prosperity and quality of life."

A recent example is a forum on the electrification of sub-Saharan Africa held in Johannesburg in August and hosted by IEEE and its South Africa Section. According to the International Energy Association, less than 30 percent of the population in the region has access to adequate electric power. Lack of electricity is a major impediment to meeting the humanitarian needs of nearly half the continent and hampers the region's economic development. The forum explored how IEEE can use its resources to help, including working with groups already focused on the region's huge technological challenges.

The work in southern Africa is just one of many hundreds of humanitarian-focused activities involving IEEE and its members. Many of these activities are partnerships between IEEE and other organizations that help tap needed expertise as well as multiply the impact of our efforts.

Our most recent example of partnering is Engineering for Change, a collaborative effort with the American Society of Mechanical Engineers. The goal is to bring engineering and technology professionals, along with other problem solvers, together with nongovernmental organizations, industry, and communities to tackle basic quality-of-life issues, including access to clean water, electricity, and sanitation. The Engineering for Change project received support from the IEEE Board of Directors in June, and a program is scheduled to be launched in early 2011.

In another example, chapters of the IEEE Graduates of the Last Decade group, Engineers Without Borders–USA, two universities, and others have cosponsored humanitarian workshops for the past three years. The objective is to make engineering students and young professionals aware of how they can apply their skills and knowledge to assist humanitarian workers. Workshop attendees were also encouraged to become directly involved in humanitarian projects.

When disasters occur that affect the academic and technological infrastructure of a region, we will continue to determine the best role we can play

But many of the humanitarian challenges that IEEE has identified need more than just partners' and members' skills and intellect. They need money. That's what the IEEE Foundation provides, through its Humanitarian Technology Fund. The fund awards grants to projects that apply technology in meeting basic human needs such as clean water, power, and communications.

Some humanitarian challenges require extraordinary responses. The earthquake in Haiti in January and the floods in Pakistan in August are prime examples. In such instances, IEEE will provide money to help reestablish technical education and training once the region has been stabilized.

That's the impetus behind the Engineering Educational and Professional Development Rebuilding Fund that IEEE set up for each of those two countries. The decision to establish the funds was influenced by the impact and scope of the disasters, the availability of immediate help for those affected from local and international organizations, and advice that IEEE's leadership received from members on the ground.

Those are our first two forays into areas where IEEE has provided matching funds. The money came from sources other than member dues or assessments. When disasters occur that affect the academic and technological infrastructure of a region, we will continue to determine the best role we can play.

There's no doubt that IEEE will get more opportunities to achieve its mission of benefiting humanity. If you haven't already done so, I hope you'll consider offering your time, talent, and money to the humanitarian projects supported by IEEE or support the work of other organizations doing humanitarian work.

Also, please post the humanitarian projects in which you're involved on the IEEE Humanitarian Technology Network (http://www.ieeehtn.org) so others can learn from your work and successes.

If you know of a humanitarian activity IEEE should be involved in, please let me know by sending a message to president@ieee.org.

Pedro Ray
IEEE President and CEO

BILL CRAMER/WONDERFUL MACHINE

Get Smart About the Grid

BY KATHY KOWALENKO

IEEE HAS a variety of publications and services designed to get you up to speed on the smart grid. Here's a sample of what's available.

PUBLICATIONS

IEEE Power & Energy Magazine

This bimonthly from the Power & Energy Society is dedicated to disseminating information on all matters of interest to electric power engineers and other professionals in the industry. Feature articles focus from a technical perspective on advanced concepts, technologies, and practices associated with all aspects of electric power. The magazine also covers nontechnical areas such as business, environmental, and social concerns.

IEEE Transactions on Smart Grid

Publishes research papers related to energy generation, transmission, distribution, and delivery. The quarterly covers theory, technology, policy, and implementation of the smart grid, and it publishes surveys of ongoing work and papers evaluating power systems affected by the grid.

Topics include cyber- and physical security, distributed energy, intelligent monitoring and outage management, plug-in vehicles added to the grid as power sources, and low-carbon transportation alternatives. The journal is a joint publication of 10 IEEE societies: Communications, Computational Intelligence, Computer, Control Systems, Industrial Electronics, Industry Applications, Instrumentation and Measurement, Power & Energy, Power Electronics, and Signal Processing.

IEEE Transactions on Sustainable Energy

This quarterly publishes research on the theory and development of sustainable energy technologies and systems related to energy generation, transmission, distribution, and delivery. It also offers articles on design, implementation, and the evaluation of power systems affected by sustainable energy. The journal is sponsored by seven IEEE societies: Industrial Applications, Industrial Electronics, Ocean Engineering, Photonics, Power & Energy, Power Electronics, and the Society for Social Implications of Technology.

These publications are available through the IEEE Xplore digital library, at http://www.ieeexplore.ieee.org, as well as from IEEE online collections, by individual subscription, or by membership in IEEE societies. The digital library also holds more than 2500 other papers on the smart grid published over the years in more than 40 IEEE journals.

IEEE.TV PROGRAMS

A Smart Grid for Intelligent Energy Use

This 8-minute video, which explains the grid and its importance for reducing our carbon footprint, includes interviews with engineers working in the field, business leaders, and public policy specialists.
http://www.ieee.org/portal/ieeetv/viewer.html?progId=107465

Power Engineering: Careers That Make Technology Work

An 18-minute video that provides an overview of career possibilities in power engineering and shows professionals in the field discussing the nature of their work.
http://www.ieee.org/portal/ieeetv/viewer.html?progId=70345

WEB SITES

The IEEE Smart Grid Web Portal

A one-stop source for information about IEEE's involvement in helping make the electricity grid smart. It has sections for conferences, publications, standards, tutorials, and news. The site presents a conceptual model that illustrates how the smart grid operates and the standards needed for each component. The model was designed by the U.S. National Institute of Standards and Technology, which has been collaborating with IEEE and other standards bodies to develop a framework for the grid. The framework is divided into seven domains: transmission, bulk generation, distribution, customers, operations, markets, and service providers.
http://smartgrid.ieee.org

Smart Grid Information Clearinghouse

Developed by the Advanced Research Institute at Virginia Tech, this Web portal holds information related to smart-grid technologies, standards, rules and regulations, case studies, public awareness and education, and job opportunities. The U.S. Department of Energy provided funds for developing the site, and the IEEE Power & Energy Society and EnerNex Corp. assist with its contents. The clearinghouse is meant to serve as a decision-support tool for state and federal regulators.
http://www.sgiclearinghouse.org

IEEE Smart Grid LinkedIn

Find others with a common interest in the grid by joining this group.
http://www.linkedin.com/groups?mostPopular=&gid=3188262

WEBINARS

Perspectives on Smart Grid: From Generation to the Meter and Into the Home

IEEE Fellow Alan Mantooth covers the basics of the grid and its nomenclature, as well as power generation, transmission, distribution, and standards. A professor of electrical engineering at the University of Arkansas, Mantooth is executive director of the university's National Center for Reliable Electric Power Transmission. The webinar is sponsored by the IEEE Graduates of the Last Decade.
https://admin.na5.acrobat.com/_a758482253/p16767121

Spotlight on Products

IEEE has several smart-grid standards ready and in the works.

IEEE 1901

Completed: September 2010

The IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications deals with high-speed communication devices—called broadband-over-power-line (BPL) devices—that operate over electric power lines. The standard specifies transmission frequencies below 100 megahertz and applies to all BPL devices. The standard also defines mechanisms for interoperability between different BPL devices and explains how to ensure the desired bandwidth and quality of service. It also addresses security issues, including the privacy of communications between users and security-sensitive services.

PC37.118.1

Expected completion: September 2011

IEEE Draft Standard for Synchrophasor Measurements for Power Systems defines the frequency of synchronized phasors, or synchrophasors, and the rate of change of frequency measurements. It also describes time tag and synchronization requirements.

P2030

Expected completion: December 2011

The IEEE Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation With the Electric Power System and End-Use Applications and Loads includes the criteria for functional performance and evaluation, the engineering principles used for interoperability, and terminology. It also covers best practices for the smart grid.

P1901.2

Expected completion: March 2012

The IEEE Draft Standard for Low Frequency (less than 500 kilohertz) Narrow Band Power Line Communications for Smart Grid Applications specifies communications between low-frequency devices operating over AC and DC power lines. Coexistence is assured with BPL devices by minimizing out-of-band emissions in frequencies greater than 500 kHz. It addresses how the grid will communicate with utility meters, electric vehicles at charging stations, and home networks. Lighting and solar panel power-line communications are also covered.

PC37.118.2

Expected completion: July 2012

The IEEE Draft Standard for Synchrophasor Data Transfer for Power Systems defines a method for the exchange of synchrophasor measurement data by power-systems equipment. It specifies the types and uses of real-time communications between phasor measurement units, phasor data concentrators, and other applications, as well as content and data formats.

PC37.238

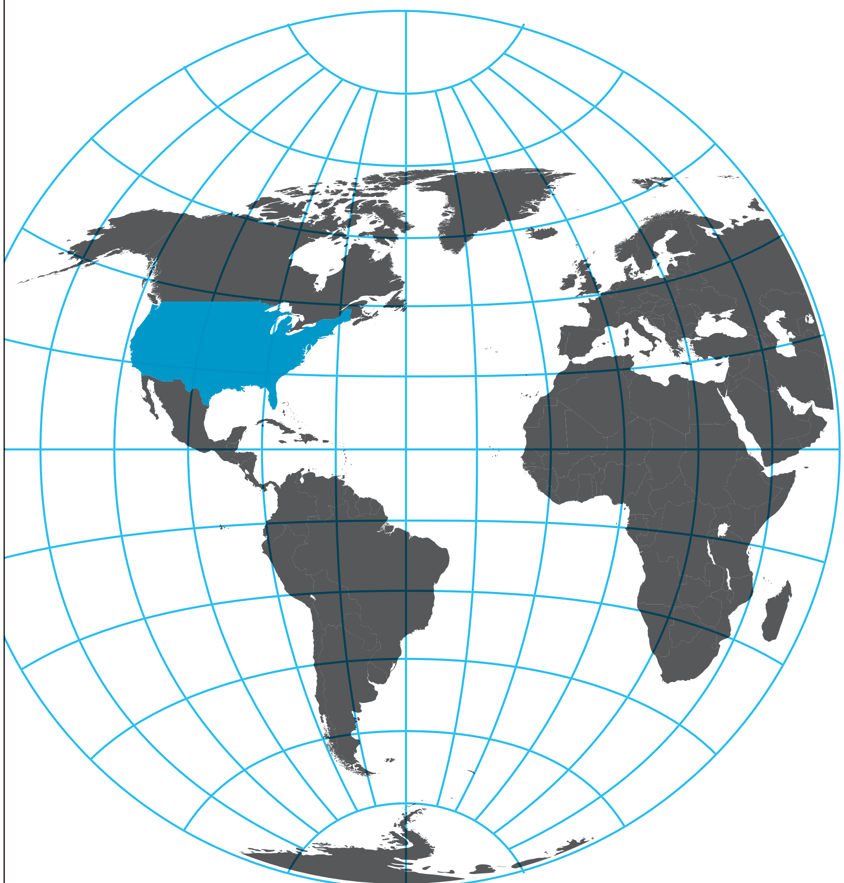
Expected completion: July 2012

IEEE Draft Standard Profile for Use of IEEE 1588 Precision Time Protocol in Power System Applications specifies a common profile for using IEEE 1588-2008 in power-system protection, control, automation, and data-communications applications over Ethernet. The profile specifies the preferred physical layer (Ethernet), higher-level protocols used for precision time protocol messages, and configuration parameters.

P1547.8

Expected completion: December 2012

The IEEE Draft Recommended Practice for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE 1547 outlines methods that can increase the usefulness of that standard. IEEE P1547.8 also deals with interconnecting distributed resources and electric power systems.



Conference on Innovative Smart Grid Technologies
Anaheim, Calif.
17–19 January

Topics include the effect on the smart grid of electric cars and distributed generation and storage, smart sensors and the metering infrastructure, cybersecurity systems, and standards.
SPONSOR: IEEE Power & Energy Society
VISIT: http://ewh.ieee.org/conf/smart-grid/2011

IEEE Power and Energy Conference at Illinois
Urbana, Ill.
25–26 February

This student-led conference promotes academic and research collaboration among universities in IEEE Region 4 that are working on future technologies. It covers power electronics, energy markets, and renewable and sustainable energy.
SPONSOR: IEEE Power Electronics Society
VISIT: http://peci.ece.illinois.edu

IEEE Sensors Applications Symposium
San Antonio
22–24 February

Sensors are expected to play an important role in smart-grid power management. Symposium topics include biosensors, MEMS and nanosensors, networked sensors, multisensor data fusion, and remote sensing.
SPONSOR: IEEE Instrumentation and Measurement Society
VISIT: http://sensorapps.org

IEEE/PES Power Systems Conference and Exposition
Phoenix
20–23 March

This year's theme is the next-generation grid. Topics include software needs of the restructured grid, advanced computational methods for power systems planning, intelligent monitoring, and integrating wind and solar energy.
SPONSOR: IEEE Power & Energy Society
VISIT: http://www.pscexpo.com

India International Conference on Power Electronics
New Delhi
28–30 January

With an eye on the restructured power systems needed for the smart grid and energy sustainability, the conference will cover power electronics, drives, and power system technology.
SPONSORS: IEEE Power Electronics Society, Delhi Section's IEEE PELS/Industrial Electronics joint chapter
VISIT: http://www.iicpe2010.org

International Symposium on Power Line Communications and Its Applications
Udine, Italy
3–6 April

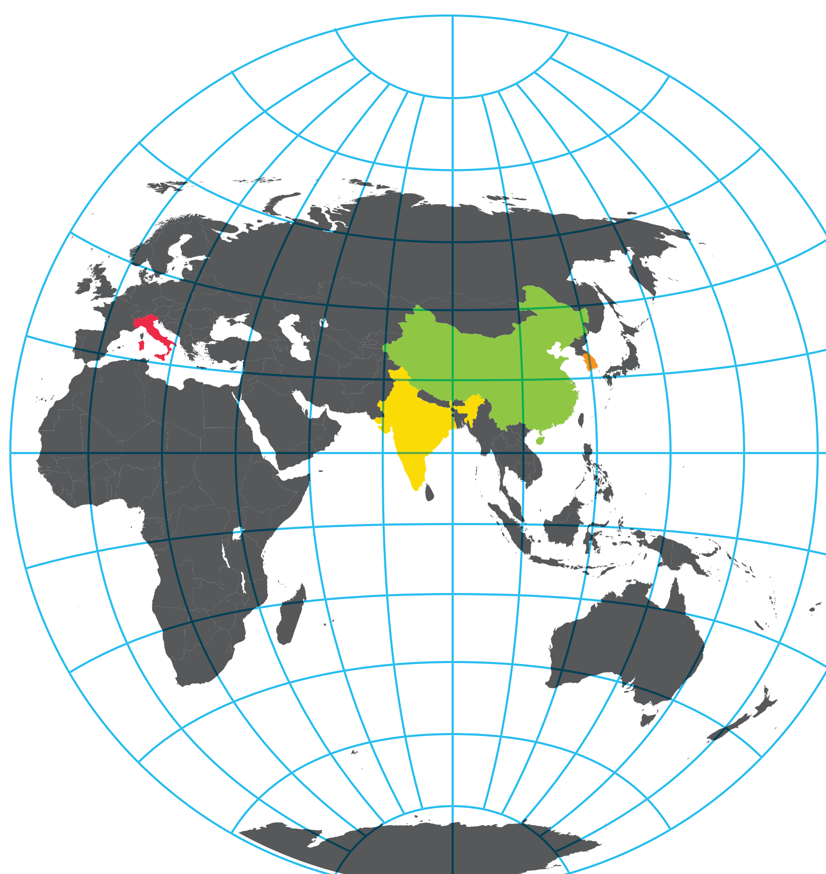
Covers power line communication systems and standardization activities, including access; home networking, in-vehicle, and utility applications; the smart grid; and green communications.
SPONSOR: IEEE Communications Society
VISIT: http://www.ieee-isplc.org

Asia-Pacific Power and Energy Engineering Conference
Wuhan, China
25–28 March

Sessions highlight hydropower and thermal- and nuclear-power engineering, new and renewable sources of energy, power transmission and distribution techniques, and power systems management.
SPONSORS: IEEE Power & Energy Society, IEEE Wuhan Section
VISIT: http://www.appeecconf.org/2011

IEEE International Conference on Power Electronics & Energy Conversion Congress and Exposition Asia
Jeju, Korea
30 May–3 June

Topics include power semiconductor devices, microgrid and distributed generation, and power electronics for home appliances.
SPONSORS: IEEE Power Electronics Society, Korean Institute of Power Electronics
VISIT: http://www.icpe2011.org



JAMES PROVOST

SOCIETY SPOTLIGHTS

IEEE societies are playing an important role in developing smart-grid technologies. Here's what some are doing:

IEEE Power & Energy Society

http://www.ieee-pes.org

The society has taken the lead in coordinating IEEE's smart-grid activities. Its members are involved with developing, building, installing, and operating whatever is needed for electricity generation, transmission, distribution, and control. PES's projects include providing content to the IEEE Smart Grid Portal (http://smartgrid.ieee.org), which deals with IEEE's involvement in developing the grid; articles on smart-grid research in its *IEEE Power & Energy Magazine*; numerous conferences that present information about the grid; and education outreach programs for bringing more students into power engineering (see p. 7).

IEEE Geoscience and Remote Sensing Society

http://www.grss-ieee.org

Remote sensing involves several applications related to the smart grid, including forecasting wind and solar fluctuations that can affect the grid, as well as monitoring the long-term impact of renewable energy systems on the environment. The society publishes research articles in *IEEE Transactions on Geoscience and Remote Sensing*, *IEEE Geoscience and Remote Sensing Letters*, and the *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*. It also holds an annual conference.

IEEE Instrumentation and Measurement Society

http://www.ieee-ims.org

Members of the society develop instruments to measure power going to and coming from the smart grid. The society publishes two journals, *IEEE Transactions on Instrumentation and Measurement* and *IEEE Instrumentation & Measurement Magazine*, and sponsors three annual conferences and numerous workshops that present smart-grid articles and papers.

IEEE Power Electronics Society

http://www.ieee-pels.org

The society is involved with power devices for systems that handle distributed generation, interactive loads, interactive metering, grid-intelligent micro inverters such as those used in solar panels, and the integration of plug-in electric and hybrid vehicles with the grid.

The broad range of the society's interests also includes the development of efficient devices, the application of circuit theory and design techniques, and the development of analytical tools for efficient electronic conversion, control, and conditioning of electric power.

Research is published in the society's two journals: *IEEE Transactions on Power Electronics* and *IEEE Power Electronics Letters*.

IEEE Reliability Society

http://www.ieee.org/portal/site/relsoc

The society is committed to making sure the smart grid runs reliably. The grid faces several reliability issues, including having to integrate diverse energy sources such as coal, nuclear, and wind; trustworthy metering, to say nothing of trustworthy logging, control, and billing; and ensuring that the grid's growth and modification are not disruptive to its customers. Research is presented at seven society-sponsored conferences and published in *IEEE Transactions on Reliability* and the *IEEE Reliability Society Newsletter*.

IEEE Society on Social Implications of Technology

http://www.ieeessit.org

The society holds workshops on the smart grid's social implications. In addition, SSIT develops articles that deal with social issues related to the grid for its *IEEE Technology and Society Magazine*. The society, along with other IEEE societies, participates in the IEEE P2030 standards working group, which focuses on developing guidelines for smart-grid interoperability. And it sponsors the annual International Symposium on Technology and Society.

Smart-Grid eLearning Courses

Seven tutorials are part of the IEEE eLearning Library's Smart Grid 101 series, sponsored by the IEEE Power & Energy Society.

NIST Smart Grid Conceptual Model
By Erich W. Gunther

Explains the seven-level domain model developed by the National Institute of Standards and Technology (NIST), including how electrical and communication interfaces connect the seven domains. The domains cover transmission, bulk generation, distribution, customers, operations, markets, and service providers.

The "Smarter" Grid—What Is It?
By Mark McGranaghan

Reviews the present state of smart-grid applications, including how they drive infrastructure requirements. The course also covers the challenges of deploying the smart grid, grid R&D, and how a smart grid would work. It also explains how industries are cooperating to modernize the grid.

Smart Devices for the Smart Grid
By Erich W. Gunther

Monitoring critical points of the smart grid is key to knowing what's going on and ensuring that the grid is working. This tutorial deals with the monitoring equipment and how it's used to generate useful data around the network, including its use at substations and transformers. The course also covers how to monitor so as to improve services to the customer.

Cyber Security for the Smart Grid
By Kevin Brown

Provides an overview of security principles and how to apply them. It also describes the security efforts being developed by such organizations as NIST and the Open Smart Grid group of the UCA International Users Group.

Distribution Automation—An Enabling Technology for the Smart Grid
By G. Larry Clark

An overview of distribution automation and how it's applied to the smart grid. This tutorial describes the components of distribution automation: supervisory control and data acquisition; the multiple-address-system communications infrastructure; and technologies applied to distribution lines, switches, and network protector relays. It also outlines the benefits of distribution automation and integrated distribution-management systems.

Smart Grid Integration
By Wayne Longcore

Describes the issues involved with integrating smart grid elements into a utility's operations. There's a lot to learn about the next phase of integration, including how to handle the big jump in data that results from monitoring so much more than before.

Standards for Smart Grid
By Erich W. Gunther

Describes a smart-grid standards framework and the challenges associated with developing it. The tutorial also provides an overview of smart-grid network communications and takes a close look at a utility's control center, transmission system, wide area networks, and distribution and field area networks. It also offers recommendations for dealing with market, regulatory, and other external forces.

For more information on these and other IEEE eLearning Library courses, visit http://ieee-elearning.org.

Wanda Reder
Grid Guru

Lighting the way to a smarter grid

BY SUSAN KARLIN

WHEN SENIOR MEMBER Wanda Reder became the 2008–2009 president of the IEEE Power & Energy Society (PES), she set her sights on modernizing its image and creating a gateway for IEEE's work on the smart grid.

The results were the IEEE Smart Grid Portal (http://smartgrid.ieee.org), which launched this year, and the first IEEE PES Conference on Innovative Smart Grid Technologies, coming up in January in Gaithersburg, Md.

The Smart Grid Portal offers publications, standards, tutorials, news, and information on conferences. The site is aimed at manufacturers, policymakers, educators, government leaders, researchers, and others involved in the power and energy, IT, and communications industries.

"We needed a way to bring the 38 IEEE societies together so we could leverage our areas of expertise, communicate with each other, and then go to those affecting the smart-grid marketplace with one voice," says Reder, who since 2004 has served as vice president of power systems services at S&C Electric Co., in Chicago. S&C is a global manufacturer of power equipment and services. In September, she was appointed to the U.S. Department of Energy's Electricity Advisory Committee, which will define strategies for modernizing the power grid.

As chair of the new IEEE Smart Grid group, her job is to coordinate IEEE societies' sometimes disparate agendas and find a common goal. The IEEE Smart Grid group "is a virtual network to help people in their various organizations work together across traditional silos without creating additional overhead," she says.

The initiative aims to go beyond the portal in disseminating information and promoting cohesiveness within the industry with an e-newsletter, a LinkedIn community, more international conferences to establish a greater global presence, a cross-disciplinary smart-grid reference, and standards activities. This includes approving the IEEE P2030 Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation With the Electric Power System and End-Use Applications and Loads.

IEEE is the right organization to tackle the challenges, Reder says: "There isn't a piece of smart-grid technology in which IEEE doesn't have some kind of expertise. We're working on such things as power systems, consumer electronics, communications, computers, instruments and measurement, photovoltaics, and standards. This broad base of technical expertise, coupled with our global membership, gives us a big leg up on any other technical organization dealing with smart-grid technology.

"We want to be the place for one-stop smart-grid shopping," she adds.

MOLDING THE MATRIX

Reder, who grew up in South Dakota, majored in engineering at South Dakota State University, in Brookings. She got her first taste of power engineering during a summer job at the National Rural Electric Cooperative Association, in Arlington, Va.

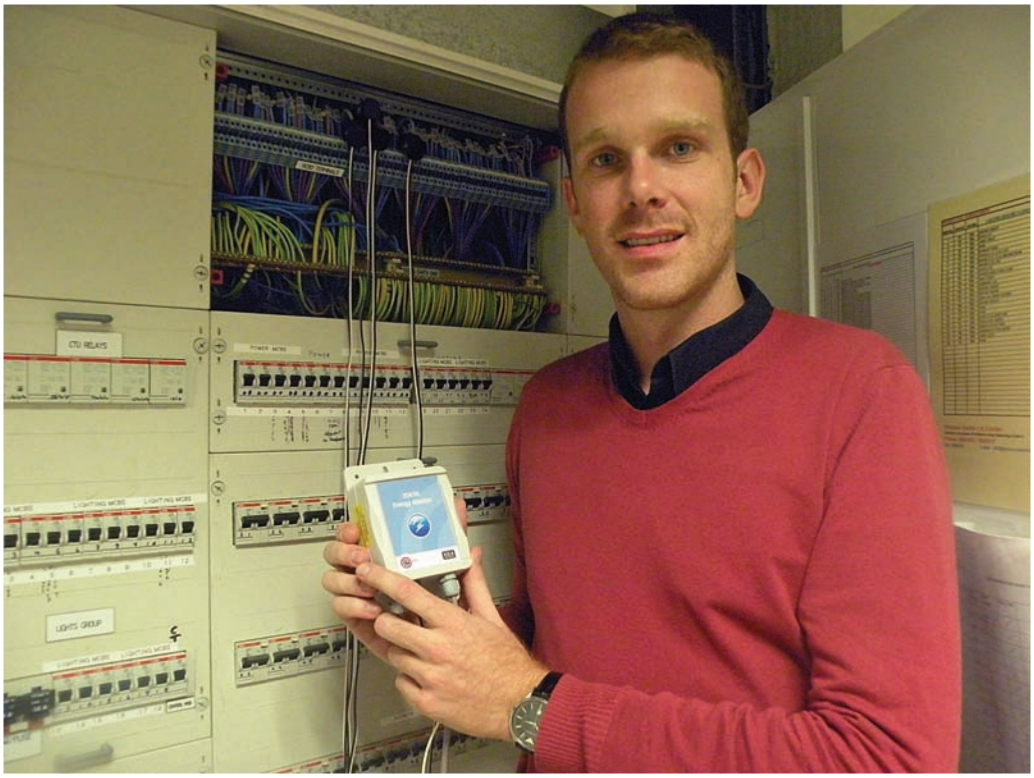
In the decade following her 1986 graduation, Reder held several engineering and managerial positions for Northern States Power (NSP), in Minneapolis. Concurrently, she earned an MBA in 1990 from the University of St. Thomas, in St. Paul. At NSP, she developed and implemented a system to manage the electricity used by water heaters and air conditioners, led the automated-meter-reading charge, and identified long-term grid requirements to accommodate increasing electrical needs. Usually, she was the lone female engineer on her team.

It was this work and the challenge of shaping a more efficient energy system that piqued her interest in smart-grid technology. In 1997, she was promoted to president and CEO of an NSP subsidiary, Ultra Power Technologies, in nearby Brooklyn Park, which tested underground cable. In 2000, she left to become vice president of Davies Consulting, in Chevy Chase, Md., establishing its energy-consulting branch.

The next year, Reder joined the utility conglomerate Exelon Corp., in Oakbrook Terrace, Ill., overseeing engineering, system planning, standards, and asset management. A year later, she was elected to the board of the IEEE Power Engineering Society, which was soon to be renamed. When she was elected president in 2008, she organized a rebranding effort, beginning with the name change, and focused on promoting forward-thinking and environmentally conscious aspects of power and energy to attract younger engineers and more women.

She established the Power and Energy Engineering Workforce Collaborative to find ways to develop more smart-grid engineers, anticipating an upcoming talent drain [see p. 7].

"In the power industry, you're looking at roughly a 50 percent attrition rate for engineers in the United States in the next five years, because many are expected to retire," Reder says. "It's critical that we attract the best and brightest into an educational system geared to prepare engineers to design, operate, and maintain today's electrical infrastructure well into the future. The demand for this talent is increasing while power engineering professors are retiring at a rapid rate. We have work to do!" ■



Anthony Schoofs with an electricity monitor he clamps to a meter's wires to measure the power consumed by various areas of a building. The monitor then sends data wirelessly to a controller.

ALEX SINTONI

Students Take On Smart-Grid Challenges

BY ANNA BOGDANOWICZ

WITH REPORTS of power engineers soon retiring in record numbers [see p. 7], many IEEE student members seem ready to stand in their places and tackle the building of the smart grid. When *The Institute* asked to be contacted by students working on smart-grid projects, we got dozens of responses from around the world. Here are three representative projects.

ENERGY MANAGEMENT

Craig Carlson was intrigued when he first learned of the smart grid. A graduate student in the School of Electrical and Information Engineering at the University of the Witwatersrand, in Johannesburg, Carlson was inspired by the need to improve South Africa's electric grid because of the increasing number of regional blackouts.

"Researching the smart grid was like delving into the depths of the unknown because it's so different from our current grid structure, which is more than 100 years old," Carlson says. "I started off with grand ideas of designing an entire system by myself—which proved to be quite absurd!"

For his dissertation, Carlson decided to focus on increasing the efficiency of power delivery to mitigate the effects of peak demand. He realized this could be achieved with load forecasting, which predicts how much power will be used in a specific area over a certain time. "If you know how much power an area needs, you can plan to get that power there most efficiently," he says.

To predict the load, Carlson developed a fuzzy logic algorithm using the MATLAB language. The algorithm depends on analyzing the power used over the same period the week before. For example, if the algorithm is to predict the amount of power that will be used on Monday, Carlson needs to find out how much was used the previous Monday. Next, he checks the weather because, naturally, it can have a great effect. He incorporates temperature into the algorithm, particularly the maximum temperature ever recorded for the upcoming date and the high temperature being predicted by weather forecasters. The algorithm then takes the data and computes what the load is likely to be.

Carlson is now working to fine-tune the algorithm, and he plans to enhance it by factoring in the effects of renewable energy sources.

MANAGING USAGE

Anthony Schoofs, a Ph.D. candidate at the Clarity Centre for Sensor Web Technologies—a partnership of University College, Dublin; Dublin City University; and Tyndall National Institute, Cork—is developing a pattern-recognition system that uses data from smart meters to determine how much power household appliances use. The local utility could use the information to provide its consumers with, for example, the cost of running a home's five most power-hungry machines.

"Such a system could pinpoint when the appliances use the most energy and help detect aging appliances that should be replaced with more efficient ones," Schoofs says. Consumers could also decide to reduce their electricity bills by using the appliances only during off-peak hours.

Schoofs has tested his prototype at the Clarity Centre and in several Dublin houses. He has come across one big obstacle: Most buildings don't have smart meters.

"We have been using other methods to measure a building's power load, such as clamping electricity monitors to a meter's wires to create makeshift smart meters," he says. "Electricity monitors typically embed current transformer sensors that are clamped around live wires to measure current, power, and phase difference between them so that the electrical parameters of a given load can be measured and sent to a PC-class controller for further use. Unfortunately, these monitors don't come cheap. It will be much easier to test our system once smart meters are rolled out."

PEAK-LOAD CHALLENGE

Ph.D. candidate Renke Huang led a team of classmates at the Georgia Tech School of Electrical and Computer Engineering in a General Electric Co.–sponsored competition designed to generate more research on the smart grid. Teams of students were asked to develop solutions to one of three smart-grid challenges: reducing peak load, improving the reliability of power-distribution systems, or minimizing power losses. "GE decided to continue to sponsor the project for the next year, since all the teams performed quite well," Huang says.

His team tackled the peak-load challenge. The goal was to reduce the power distribution system's peak use by 30 percent between 4 p.m. and 9 p.m. without affecting customers. This is the period when people tend to use the most electricity at home. Huang and his team designed a monitoring system to analyze peak use. It employs load-forecasting techniques to predict when peak load will occur and optimization algorithms that can then be applied to flatten, or reduce, the peak load. The algorithms determine the best times, with respect to the utility bill, for customers to use certain appliances, or when to connect energy-storage devices such as high-capacity batteries and plug-in hybrid electric vehicles—which can put energy back into the grid—to reduce peak energy usage.

Although his work was part of a competition, Huang says it's not about winning but about the thrill of discovery. "If our work can help get full control of such a complex system as the grid, I will feel like a treasure seeker who has just found something invaluable." ■

Eric Forsyth

Sailing the Open Seas

IN THE 46 years that IEEE Life Fellow Eric Forsyth has been sailing, he has circumnavigated the globe twice, churned through the dangerous waters of Cape Horn four times and the Arctic and Antarctic oceans three times, and cruised through the Panama Canal, Baltic Sea, and waters of the Far East.

Since retiring in 1995 as chair of the accelerator development department at Brookhaven National Laboratory, in Upton, N.Y., he says he has spent more time on water than on land.

Forsyth was profiled in *Cruising World, Yachting,* and *Latitude 38* magazines. He received the Cruising Club of America's 2000 Blue Water Medal for an 11-month, 37 000-kilometer voyage to Antarctica and South Africa. He chronicles his adventures at http://www.yachtfiona.com and http://www.greenoceanrace.com.

"Traveling by boat is not the same as being a tourist," Forsyth says. "You arrive at a crummy dock instead of a nice hotel, and you have to arrange to get fuel and parts to repair your boat, which usually needs maintenance after a few weeks at sea. Most docks are in the scruffy parts of town. All of this gives you a different sense of what a country is like."

PASSION
Sailing

PROFESSION
Electrical engineer, retired

HOMETOWN
Brookhaven, N.Y.

Forsyth usually sails with crew members, but he sometimes sails solo—which once nearly cost him his life. On a trip from Bermuda to New York, his mast collapsed in a strong wind some 550 km off Long Island. "That was a very bad night," he recalls. "I was alone and had just enough fuel to get home to Long Island without sails."

The British-born Forsyth started sailing shortly after he moved to the United States to work at Brookhaven National Laboratory in 1960. Upton is on Long Island, which offered numerous sailing clubs. Forsyth joined one and within four years had graduated from 5- to 7-meter vessels. Soon he was part of a crew that took a 14-meter boat on a trip to England in 33 days. After that, he mainly cruised up and down the East Coast during holidays and vacations on his 11-meter boat.

In 1975, he bought the 13-meter bare hull of his current boat, *Fiona*, and spent the next eight years completing it. "It was tremendous therapy," he says with a laugh. "I'd come home from work and vent my frustrations on a piece of wood."

Since retiring, he has spent an average of eight months a year at sea. Sailing costs him about US $40 000 per year.

"It's not a cheap hobby," he says, "but you only pass through this vale of tears once."—*Susan Karlin*

Tim Kopacz

Flying Saucers

TAKE A FRISBEE, add some bowling alley footwork, mix in some golf strategy, and you've got disc golf.

Three or four times a week, you can find IEEE Member Tim Kopacz, a senior project engineer at American Transmission Co. in De Pere, Wis., indulging his passion. He has been playing disc golf since 1998, in college, and he has competed in 25 amateur tournaments since 2003. Kopacz even turned his hobby into a family affair: He and his wife played the game on their honeymoon, and they play it now with their children when they're on vacation.

PASSION
Disc golf

PROFESSION
Utility engineer

HOMETOWN
Kewaunee, Wis.

The game, first formalized in the 1970s, is played on grounds that are about a third the size of a golf course. The goal is to land a flying disc in targets—typically 18 baskets on a course—in as few throws as possible. Discs come in various shapes, sizes, and plastics, enabling different flight behaviors. Unlike traditional golf courses, disc golf courses use the natural terrain. So a typical course requires maneuvering discs around trees or over streams. Players attach ribbons to discs to find them in snow, and glow sticks to see them at night.

"I like the complexity of disc shapes and flights," Kopacz says. "You can get different results by the way you throw different types of discs, or by changing the angle of your release or the power of your throw. I got hooked after watching the pattern of the disc's flight through the trees."

The sport is relatively inexpensive. It costs nothing to use most courses, and each player needs only one disc, which runs about US $11. Most players have an arsenal of a dozen or so specialized discs; Kopacz owns about 400. "I always have to check out the latest technology," he says.

He enjoys the active nature of the sport, he adds. "It's almost like bowling in that you need to take approach steps before the end of the tee pad, where you throw the disc," he says. "The number of steps and angle at which you release the disc change the throw."

Kopacz has leveraged his technical skills to another aspect of disc golf: course design. He designed a free course in his hometown that he has run since 2004. "I built the course with a group of friends," he explains. "My project engineering background came in handy in preparing a proposal that outlined construction, equipment, and maintenance costs." This year he helped design a course in Iron River, Mich. —*S.K.*

If you have an interesting hobby you'd like to share, e-mail the editors: institute@ieee.org.

TOP: ERIC FORSYTH; BOTTOM: ERIN KOPACZ

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Nominations are being sought for 2012 IEEE medals, awards, recognitions, and prize papers. The deadline for the IEEE Board of Directors to receive nominations is 1 July 2011.

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