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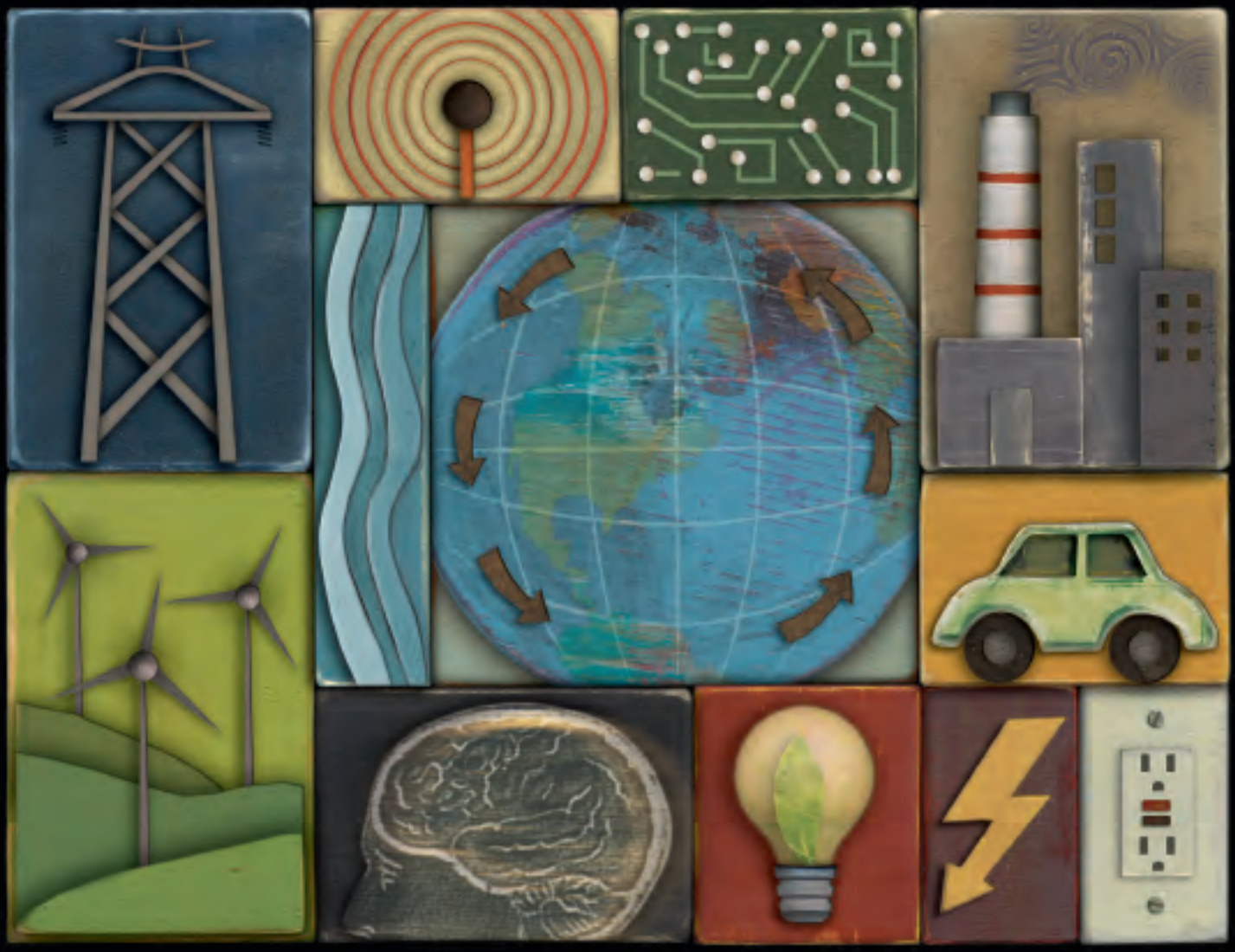

Highlights from **2007**

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Insights from the IIT Department of Electrical and Computer Engineering

Volume 2 — The Alumni Issue

ECE's Energy and Sustainability Efforts



Grainger Foundation Gives $5 Million to ECE Power Engineering Program

The electrical power engineering programs at Illinois Institute of Technology continue to expand their facilities and enrollment thanks to ongoing support from The Grainger Foundation of Lake Forest, Ill. The ECE department recently received a $5 million gift from the foundation to help inspire students in the United States to become interested in electrical power engineering. The generous donation also will allow the ECE department to continue to attract well-qualified students into power engineering professions.

The Grainger Foundation has supported power initiatives including scholarship funding and facility development at the university for more than two decades. Scholarships funded by past Grainger gifts have resulted in more than double the number of students dedicating their engineering focus to issues of power and sustainability.

David W. Grainger, president of the foundation, visited IIT Main Campus for the third time in April to tour The Grainger Foundation Laboratories, which serve as a focal point of the program. While visiting, he talked with current and past ECE students about how the laboratories and programs have affected their education, and what they aspire to achieve in their future engineering projects.

"IIT's work in power engineering is important for the future," Grainger says. "Students who understand the impact of power engineering will be able to understand and provide solutions in what is becoming an increasingly complex world of energy and sustainability."

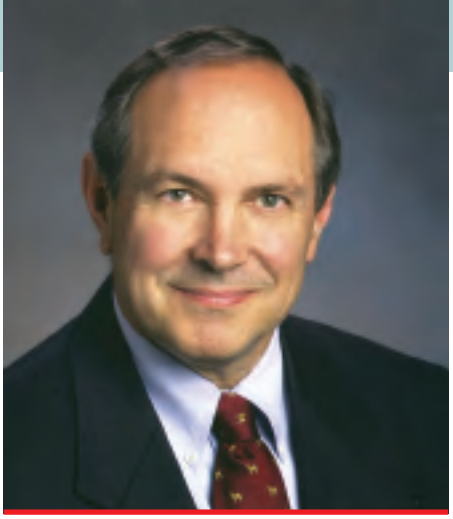
One of the most notable ECE additions, which houses The Grainger Foundation Laboratories, is the Electric Power and Power Electronics Center (EPPEC), established in 2004. The mission of EPPEC is to make significant educational, research, and practical contributions to the fields of electric power security, power electronics, energy efficiency, renewable energy, motor drives, and vehicular power systems. In the past three years, EPPEC has been a venue for more than 50 undergraduate, graduate, and faculty projects.

"EPPEC has one of the finest power programs with a unique integrated education, research, and leadership approach," says Ali Emadi, professor and EPPEC director. "The ongoing support of The Grainger Foundation has allowed us to establish the best power electronics, motor drives, and power systems teaching labs in the country. The new gift allows us to maintain these excellent laboratories and benefit so many more students. It will also help EPPEC attract the best and brightest to study power engineering at IIT because of the prestigious Grainger Scholarships."

"The most endearing part of The Grainger Foundation's support is that it is entirely focused on benefiting ECE students," says Mohammad Shahidehpour, Bodine Professor and chair of the Department of Electrical and Computer Engineering. "The foundation's support will help prepare our future engineers with the best education, so they are able to step in and help fill the shoes of a largely retiring workforce over the next 10 years."

The Grainger Foundation was established in 1949 by Mr. and Mrs. William Wallace Grainger, and has provided substantial support over the years to a wide range of organizations, including museums and educational, health care, and human services institutions. William W. Grainger is the founder of W. W. Grainger, Inc., North America's leading distributor of maintenance, repair, and operating supplies and components.

> "Students who understand the impact of power engineering will be able to understand and provide solutions in what is becoming an increasingly complex world of energy and sustainability."



Kurt Yeager
on Perfect Power Prototypes and IIT

Kurt Yeager *joined the Galvin Electricity Initiative, an effort to perfect the electric power system, shortly after it was launched by former Motorola chief Bob Galvin. As leader of the initiative, Yeager is working with electricity experts, innovators, and entrepreneurs to design and build prototypes of a smart, efficient electric power system. ECE Chair Mohammad Shahidehpour is working with the initiative to make IIT one of the first Perfect Power prototypes in the United States. Read on to learn more about the project and what it means for IIT and the future of power in the United States.*

For people who are not familiar with the project, briefly explain the Galvin Electricity Initiative's definition of "perfect" power and how the organization hopes to change the future of energy production, transmission, and distribution?

The goal of Perfect Power as established by the Galvin Electricity Initiative is to achieve an electricity system that never fails, under all conditions, to meet every consumer's expectations for service confidence, quality, convenience, and choice. This commitment to absolute quality from the consumer's perspective will always produce the lowest-cost result. For example, the unreliability of the United States electricity supply system today costs the nation and its citizens at least $100 billion dollars a year in lost productivity and avoidable product and service costs.

The fundamental limit-breaking innovation in achieving Perfect Power is the digital control and automation of all power circuits coupled with real-time telecommunications. The resulting capability provides an intelligent, instantaneously self-correcting and optimizing power system that can incorporate distributed and renewable energy generation plus storage resources as cost-effective capacity and reliability assets. This smart grid will also enable consumers to take full advantage of advanced net metering and demand response opportunities to significantly improve electricity service efficiency and reduce cost.

The basic philosophy of the Galvin Electricity Initiative is to increase electricity system intelligence, independence, and flexibility for optimal energy use and management in the least complex system configuration. To this end, the initiative is focusing its efforts on the implementation of local microgrids incorporating these breakthrough technology innovations to best advantage. These microgrids effectively act as intelligent, quality enhancing, consumer service capillaries on the existing bulk electricity distribution arteries. This approach reflects several realities: first, the most confident and sustainable engine for quality improvement is enabling innovative, self-organizing entrepreneurs to commercially engage in the electricity enterprise. Second, the quickest path to challenging the performance status quo and demonstrating quality transformation is to target the transformative innovations on the consumer's interface with the bulk power system. Third, this approach initially circumvents the relatively intractable, rigidly regulated bulk electricity infrastructure while utilizing it to best advantage as the primary energy source for the microgrids.

How will the Perfect Power system relate to global energy issues such as global warming, non-renewable energy sources, energy and fuel prices, reliability, sustainability, and security?

The Perfect Power system is designed to provide a comprehensive electricity-based platform for addressing the array of global energy issues. It does so by resolving the major limitations in today's analog, electromechanically controlled bulk power grid. This revolution, based on creating an intelligent power system, fundamentally increases efficiency, thus reducing the need for fossil fuels and the resulting CO_2 emissions. This smart system can also incorporate much larger quantities of inherently intermittent, renewable solar-based energy without degrading the reliability of the power system, as is the case with today's power system unless large quantities of expensive backup and storage power are also installed.

Over the course of the last hundred years, electricity has enabled the footprint of mankind on the planet to increase 100 fold—population has tripled and economic output has increased by more than a factor of 30. When put in the context of man's history on the planet, this "acceleration" is astounding. To put it in perspective, it is as if you accelerated your car from 0 to 60 mph in 10 seconds, and then a massive energy source took hold of the car and accelerated it to 6,000 mph in a hundredth of a second. Electricity is this energy source, and while it has produced tremendous good over the past century, it has also inevitably created side effects that must be resolved if we are to achieve a sustainable world—namely: population, poverty, and pollution. Electricity is also the unique energy solution to these immediate challenges if we transform the obsolete generation, delivery, and end-use technology on which our electricity supply system continues to depend. The Galvin Electricity Initiative's goal is to catalyze this urgent transformation.

What are your personal goals for the Perfect Power system in five, 15, and 30 years?

My personal goals for the Perfect Power system are, within five years, to have successfully demonstrated the benefits of Perfect Power over a variety of situations such as the IIT Main Campus. Within 15 years, I would like to see Perfect Power microgrids bringing the benefits of smart electricity service to consumers across the country, and within 30 years, to see the entire U.S. electric power system transformed into a Perfect Power national "Energy Net."

Why is Illinois Institute of Technology's Main Campus in Chicago the ideal place to begin a Perfect Power prototype?

Main Campus is an ideal place to begin a Perfect Power prototype because it provides a variety of consumer power quantity and quality demands from student residences to laboratories, and it is large enough to integrate and demonstrate the full scope of cutting-edge innovative Perfect Power technologies. It is also part of a large urban power system where the economic, reliability, and efficiency benefits to the community of smart buildings, demand response, and grid support can be demonstrated. This will be a win-win-win for the university, the utility (Commonwealth Edison), and the citizens of Chicago.

What are some of the additional projects the Galvin Electricity Initiative is beginning throughout the country?

The Galvin Electricity Initiative is also applying its results in cooperation with entrepreneurial technology developers and large real estate and building owners to create perfect power microgrids for office buildings, hospitals, and whole communities. As is the case at IIT, most of these results can also be retrofitted to existing infrastructures. A design study is also being completed for the new Mesa del Sol community development in Albuquerque, N.M. This is a community that will encompass high-end commercial and industrial organizations as well as thousands of homes, all incorporating photovoltaic solar power and the ultimate in ultra-efficient sustainable resource utilization technology.

You are currently writing a book about the state of the United States power system and how the Galvin Electricity Initiative plans to address its deficiencies. What issues will you draw attention to in the book?

The book, *The Path to Perfect Power,* is intended to broadly raise the public's awareness of the deficiencies and vulnerabilities of today's electric power system, and the opportunities for innovative technology to resolve these deficiencies. Today, our nation's electricity system is the equivalent of the black rotary-dial telephone that was the communication standard of 30 years ago. Today's digital economy and society cannot tolerate this obsolete performance standard. We need the electricity equivalent of the Internet with the flexibility of cell phones. The technology is there to make it happen, and IIT can show the way.

IIT, Argonne, and Korea Power Exchange Develop Joint Degree Program

Illinois Institute of Technology recently signed an agreement with the United States Department of Energy's Argonne National Laboratory and the Korea Power Exchange (KPX) to establish a joint professional master's degree program in the study of electricity markets. The hands-on training and research opportunities provided by the Department of Electrical and Computer Engineering (ECE) and Argonne will help KPX's employees better provide a stable electricity supply to the largest competitive market in Asia.

As part of the agreement, KPX will send members of its technical staff to Chicago every two years to enroll in the power engineering program at IIT. KPX staff will take courses from the Master of Electricity Markets curriculum while conducting applied research at Argonne in exchange for credit toward their degree. Students will learn to address concerns including global warming, renewable energy resources, blackout mitigation, security, and planning for future electricity systems. The first class of KPX staff members enrolled at IIT this fall.

"This agreement showcases what IIT does best, integrating applied forward-looking research with formal education to meet the needs of people committed to a brighter world future," says Mohammad Shahidehpour, Bodine Professor and chair of the ECE department. "By working together to advance the education of power engineers in this country and in others, we are helping to build the knowledge and stability of a worldwide community and its power systems."

"Given the recent upheavals in global energy markets, the trend toward electricity restructuring—and a generally renewed focus on energy, electricity, and environmental issues—it is our hope that this agreement will strengthen our joint research activities in these areas that are so vital to our countries and the world, expand our successful collaboration with KPX and IIT for the benefit of all three institutions, and establish a Trans-Pacific partnership for years to come," says Al Sattelberger, Argonne associate laboratory director for physical sciences.

The Korea Power Exchange was founded in April 2001 as part of the newly introduced electricity market following the Korean government's electricity industry restructuring plan. With responsibility for electricity market and system operation in Korea, KPX operates Asia's largest competitive electricity market and the second largest power grid in the region.

Argonne National Laboratory conducts basic and applied scientific research across several disciplines, ranging from high-energy physics to climatology and biotechnology. Since 1990, Argonne has worked with more than 600 companies and numerous federal agencies to help advance America's scientific leadership and to prepare the nation for the future.

Paul McCoy (EE '72) is president and co-founder of Trans-Elect, the first independent electric transmission company in North America. Organized in 1999, the company is comprised of experienced utility, finance, regulatory, legal, and management veterans that accumulated ownership of and managed more than 12,600 miles of transmission assets either through acquisitions or building new transmission. Trans-Elect is committed to making America's electric transmission grid more reliable by developing, building, or purchasing transmission systems and operating those systems efficiently to expand capacity and lower costs.

From the South Side of Chicago to the Top of the Grid

An Interview with High Voltage Visionary, **Paul McCoy**

Let's start with the basics. What inspired you to become an engineer?

I have always been fascinated with the physical world. As a college student, I was equally attracted to both physics and engineering.

You went to high school at De La Salle Institute, across the street from IIT. Were you born and raised in Chicago?

Yes. I grew up on the near South Side, about a block away from the new McCormick Place–West Hall.

How did you end up at IIT?

I consider myself lucky to have attended both De La Salle and IIT. I chose IIT because of my desire to study in the sciences or engineering, although at the time the engineering track was less well defined in my mind. I think I may have been the only De La Salle graduate to major in electrical engineering at any university.

Everyone at IIT refers to you as a "self-made man" who truly knows the meaning of hard work. Describe how you got started as an electrical engineer and how you worked your way up in the industry.

I'm flattered at being termed a "self-made man." I never thought of it that way as I started out. I did both attend IIT and hold what was a full-time job (at least 40 hours a week) for the last two years of my studies, and still was able to graduate as one of the top several students in the EE program. Scholarship money was difficult to come by at the time. What I did, I think, many did at the time.

I chose to go with Commonwealth Edison when I graduated, since it afforded an opportunity to work with a "growth" company. At the time, growth of electrical energy demand in the Chicago area was at a 7 percent rate, compounded, per year. A new engineer had an opportunity to advance rapidly in the company at that time. I made the conscious decision to move from engineering work to engineering and operations management about seven years after I had started my career. I don't regret it. I also chose to take project assignments considered difficult at the time. The risk of failure was certainly higher than normal, but the opportunity to gain experiences no one else had was invaluable, and serves me well to this day.

Trans-Elect has dedicated itself to improving reliability by investing in grids in areas across North America that need relief from transmission deficiency. How do you believe your company can continue to enhance the United States power system and ultimately raise the standard of what constitutes reliable energy?

The U.S electrical system is at a true crossroads. People have said for the last 10 years that the system is being asked to do things it wasn't designed to do, such as support large-scale wholesale power markets. While that is true, we are at an inflection point that will make what folks have talked and worried about for 10 years seem small in comparison. The emergence of large-scale renewable energy developments, plus a renewal of interest in nuclear power, require a fairly fundamental change in how we plan the grid of the future.

I believe that the need for transmission investment will approach $9 billion per year within three years or so (from its low point of $2.5 billion in the late '90s), and that companies like Trans-Elect will play a role. For example, while we owned and managed the transmission system formerly owned by Consumers Power in Michigan, we had launched a multi-year program of technological investment to bring the system protection, control, communication, and data management systems to a twenty-first century level.

www.trans-elect.com

Trans-Elect plans to develop new transmission projects for independent power producers including wind, coal, and hydro/pump storage. Do you envision cleaner energy sources such as wind and hydro to be a major part of future electricity systems in the U.S.? If so, how do you believe they should be integrated?

I think renewables will be a major part of the energy equation going forward. Right now, much of the renewable development is driven by the various states mandating that a portion of the total energy consumed in that state be supplied by renewables as a matter of public policy to reduce the growth of carbon emissions. However, wind in particular is already, or is poised to soon become, cost competitive on an absolute basis with other generation technologies. Various studies have shown that integration of wind up to a level of 10 percent of energy consumed is not much of a problem, and that 15 percent and higher penetrations are possible in portions of the system that are well interconnected. Europe is studying penetration levels of 30 percent! The key is a strong grid, as most good wind resources are located where people don't live. I think you will see serious commitments to major high-voltage direct current transmission lines as well as additional construction of 765kV and 500kV AC lines where those make sense.

What do you consider to be your greatest achievement to date?

In some ways, I don't think I have accomplished my "greatest achievement" yet. I don't look at any one thing I have done as being the "greatest," but think that a real engineer measures accomplishments in a way that views success as leaving things a little better than you found them. Engineers rarely work alone, and almost never can take credit for a "greatest achievement" on their own. In the sense that I am most proud of something, it would be the generation of engineering and operations leaders that I helped to nurture who followed me. Many of them hold leadership positions in major companies now.

You have been in the industry for a total of 35 years. Do you see yourself working forever, or are you thinking about retiring someday?

An old saying goes "find something you truly love to do as your life's work, and you'll never work a day in your life." While that wisdom gets tested throughout a career, I count myself as interested in my career now as the day I started. With a resurgence of interest in applying new technology to the grid, I find I get more requests than ever to comment on, assist, or lead efforts in that regard. I consider the period we are entering to be a new golden age of transmission technology applications, project development, and construction, and wouldn't miss it.

If with the snap of your fingers, you could change one thing about the industry you have dedicated your life to, what would it be?

I would have the grid structured much more like the independent transmission companies that exist in the United Kingdom, the Scandinavian countries, and several other spots in the world. The U.S. system is far too fragmented, making planning difficult and denying ultimate customers from significant economies of scale.

Since the 1980s, universities have seen a decline in domestic students interested in math, science, and engineering. To combat this, IIT has begun several initiatives to educate younger generations early on about the exciting possibilities these areas have to offer. How do you believe we can enhance our efforts to spark domestic students' interests in engineering, and more specifically, power engineering?

Those with a bent toward any of the engineering disciplines need an opportunity to engage with people who are doing actual engineering work, whether design, commissioning, or trouble/failure analysis related. They also need to see that engineering can be as much of a stepping stone in one's life as, say, a business or law degree is viewed. I would also suggest that the cultivation of an interest in engineering needs to start earlier in life. I know of other universities that are moving "interest" programs down to junior-high school, and lower, levels. Right now, we are at a cyclical high in the demand for engineers, especially in power, and IIT should be capitalizing on this.

Any advice for recent grads just starting their careers?

I now am fairly far afield from what I was doing (which was highly technical individual contributor work) when I started my career. But the decision-making and overall analysis skills I developed in the first 10 years of my professional life continue to guide me today, and provide a powerful reference point from which to view my professional world. If you are presented with an opportunity to take an assignment that requires you to "live with" the outcomes of your decisions, take it. The discipline in decision making that it brings will serve you well no matter where your career takes you.

Photo by Mindy Sherman

McCoy gave a lecture on technology and integration of renewable energy sources from a high-voltage transmission and electricity market perspective at IIT Main Campus in October. For more details, visit **www.ece.iit.edu.**