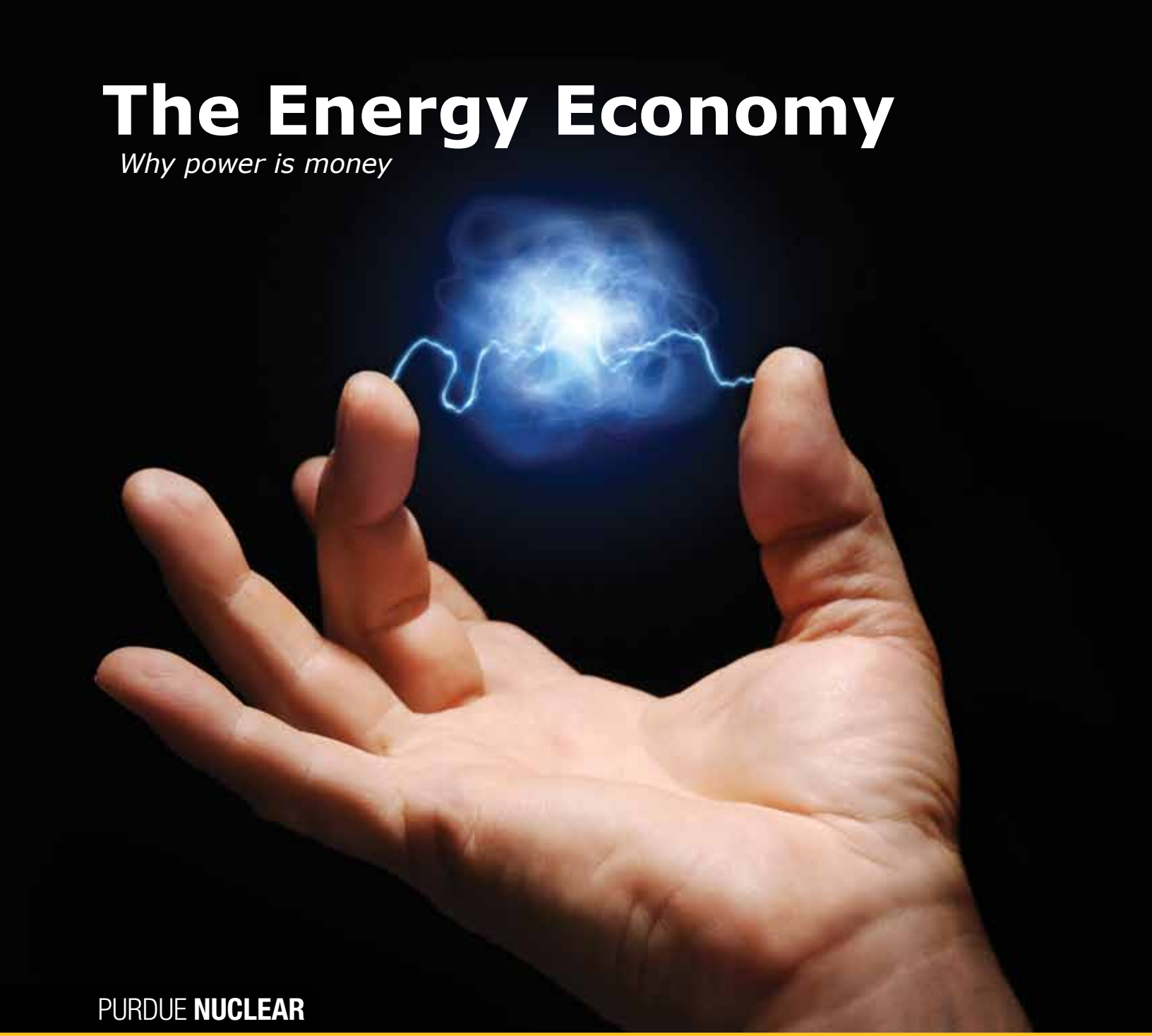
The Energy Economy

Why power is money



PURDUE **NUCLEAR**

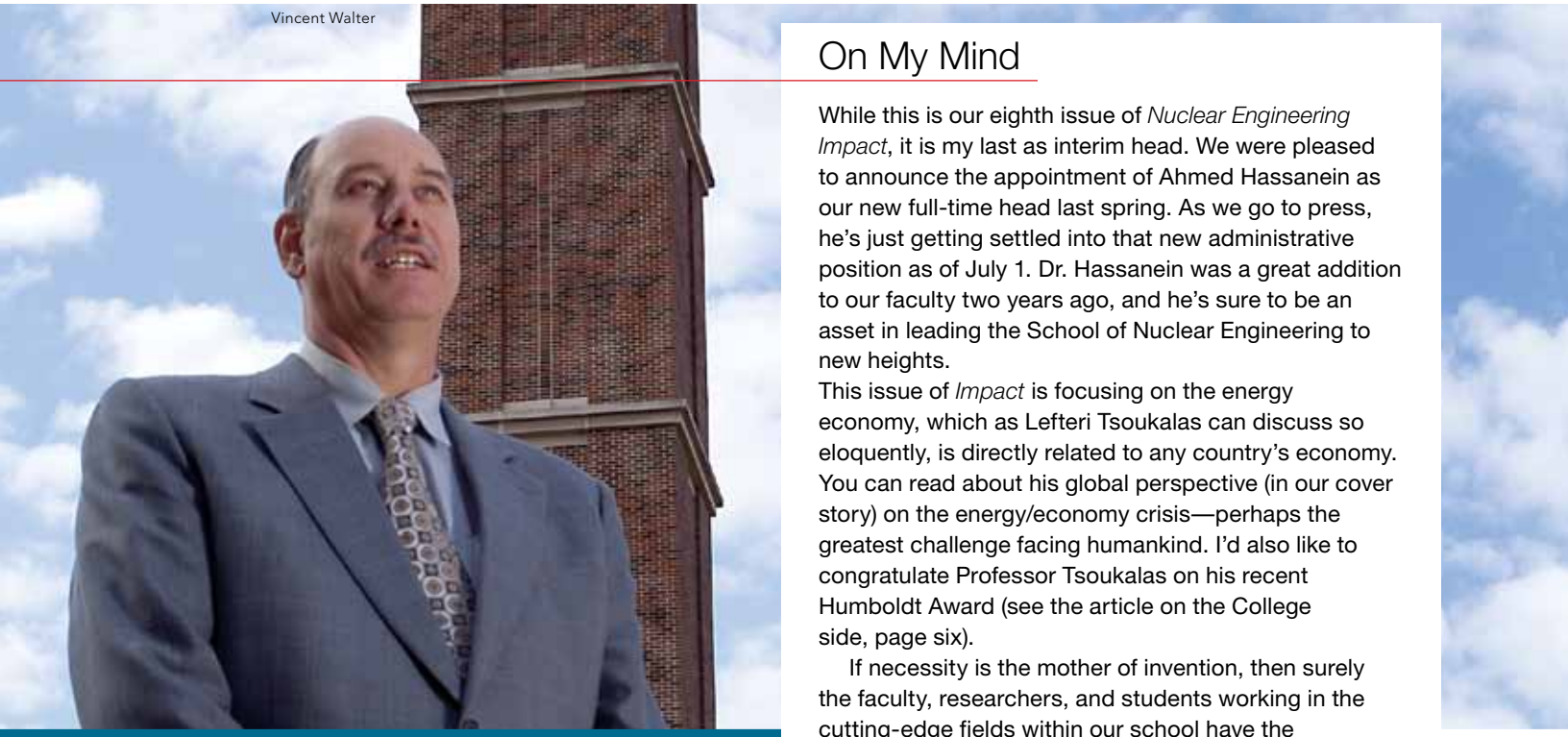
ENGINEERING IMPACT

FALL 2009

Fusion Future
Where do we glow from here?

American Nuclear Society
Great student success in Florida

Newly Named Head
Hassanein to lead school



Vincent Walter

About the Cover

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Electricity is difficult to store, but Internet technologies tied to the power grid can help us stretch electricity. In our cover story, Lefteri Tsoukalas, professor of nuclear energy, shares his vision on how to make that happen.

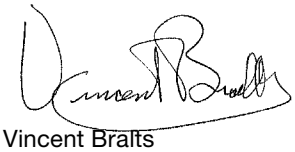
On My Mind

While this is our eighth issue of *Nuclear Engineering Impact*, it is my last as interim head. We were pleased to announce the appointment of Ahmed Hassanein as our new full-time head last spring. As we go to press, he's just getting settled into that new administrative position as of July 1. Dr. Hassanein was a great addition to our faculty two years ago, and he's sure to be an asset in leading the School of Nuclear Engineering to new heights.

This issue of *Impact* is focusing on the energy economy, which as Lefteri Tsoukalas can discuss so eloquently, is directly related to any country's economy. You can read about his global perspective (in our cover story) on the energy/economy crisis—perhaps the greatest challenge facing humankind. I'd also like to congratulate Professor Tsoukalas on his recent Humboldt Award (see the article on the College side, page six).

If necessity is the mother of invention, then surely the faculty, researchers, and students working in the cutting-edge fields within our school have the opportunity to capitalize on these grand challenges. Students presenting at the annual American Nuclear Society's convention in April fared very well, explaining the possibilities of what is achievable in the field of nuclear energy. We detail their collective success in our "Up Close: Students" feature. You can also see how a named professorship—courtesy of Paul Wattelet (PhD '67) and his wife—can further the research efforts of someone like Dr. Hassanein. Ralph Patterson (BSNE '76), of the Lawrence Livermore National Laboratory, offers his perspective on the future of hybrid fission-fusion power. And let's not forget the hard work of Sivanandan Harilal, a research assistant professor of nuclear engineering, whose efforts are detailed in the "Up Close: Faculty" article.

I'll leave on this personal note. The Purdue School of Nuclear Engineering has seen some ups and downs in recent years, yet remains one of the top producers of nuclear engineers in the country, while working closely with industry to help bring about a nuclear renaissance. I appreciate all the faculty, students, and staff I've had the pleasure to work with in my few years here, and wish them all much continued success.



Vincent Bralts
Interim Head, School of Nuclear Engineering

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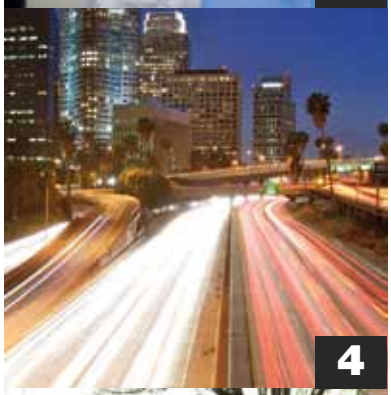

PURDUE UNIVERSITY
COLLEGE OF ENGINEERING

School of Nuclear Engineering

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Global Challenges, Fusion Futures, and New Beginnings

Spring and summer news within Nuclear Engineering

NSF Director Speaks Back at Purdue

Arden Bement Jr., director of the National Science Foundation (NSF) and the former head of nuclear engineering, returned to Purdue in March. He was the featured speaker for the inaugural Moshe M. Barash Distinguished Lectureship for Manufacturing Engineering, which is named for the late Purdue professor emeritus. Bement's talk, titled "In the Barash Tradition: Imagining the Shape of Things to Come," was about the role of research and innovation in addressing future global challenges ranging from energy security to climate change. The lectureship was sponsored by Purdue's School of Industrial Engineering.


Arden Bement Jr.

Bement, the former David A. Ross Distinguished Professor of Nuclear Engineering and head of the School of Nuclear Engineering at Purdue, also held appointments in materials engineering and electrical and computer engineering, as well as a courtesy appointment in the Krannert School of Management. He joined the Purdue faculty in 1992 after a 39-year career in industry, government and academia.

Bement became NSF director in 2004 and had previously been named director of the National Institute of Standards and Technology in November 2001. As NSF director, he oversees a budget of more than $6 billion that supports the research and education of roughly 200,000 scientists, engineers, educators, and students across the United States.

Professor Allain Goes to Washington

In June, Jean Paul Allain, assistant professor of nuclear engineering, was invited to participate in an extremely important national committee that will set the national agenda for nuclear fusion research for decades to come. Through the Department of Energy (DOE), the Office of Fusion Science is developing a strategic plan for U.S. fusion research in the next 25 years. The panel's work culminated in a Washington, D.C., gathering to compile the report, which was subsequently sent to the U.S. Congress in August.


Jean Paul Allain

Allain was one of about 75 scientists considered leaders in their respective fields, but one of the few less than 40 years of age. One of the more challenging issues examined is the role that materials will play in the future of fusion science.

Allain, who has a courtesy appointment in materials engineering, describes his research as a "cross between nanotechnology, nuclear engineering, and materials." With three different grants from the DOE in the last year, Allain is sure to play a pivotal role in helping shape the fusion future.


Vincent Walter

Ashley Lauren Brooks (left) and Kellie Reece

Staff News

Kellie Reece was promoted to administrative assistant to the head in March, and Ashley Lauren Brooks began as the school's new academic program manager in May. Brooks will be responsible for assisting students throughout their undergraduate and graduate careers by participating in recruitment, graduation and everything in between. Says the new hire, "I am excited to be a part of the students' experience here at Purdue and hope to be a beneficial resource for anyone involved in our program." ■ **William Meiners and Emil Venere**

Working in the Fourth State

What matters to a new assistant research professor in nuclear engineering


Vincent Walter

Sivanandan Harilal

Scientists theorize that the visible universe is composed of more than 99 percent plasma, the fourth state of matter after the triumvirate of solid, liquid, and gas. But one new research assistant professor in nuclear engineering, Sivanandan Harilal, is 100 percent focused on understanding the basic science of plasma and finding ways to make plasmas work for the world outside the laboratory.

Harilal has worked all over the globe himself. He received his degree in physics from Cochin University in Cochin, India, in 1998, and became the Alexander Humboldt fellow at Ruhr Universitat in Bochum, Germany, where he continued his pursuit of plasma. He came to the United States via the University of California, San Diego and later as a visiting scientist at Argonne National Laboratory.

Harilal even worked a short while in the world of industry, developing X-ray and extreme ultraviolet (EUV) sources from laser-produced plasmas as chief scientist at Hyperion Scientific in Madison, Wisconsin. He came to Purdue in January, drawn to "a well-known university where academic and research environments are excellent."

In the laboratory, nuclear engineers like Harilal create plasma using intense lasers. "Our focus at Purdue," Harilal explains, "is to utilize this laser-produced plasma for practical applications."

One such use for laser-produced plasma is EUV lithography. As current optical lithographic technology for creating semiconductor chips approaches its physical limit, it will soon become impossible to create computers that are any faster or more cost-competitive. Manufacturers of semiconductor chips are hoping to implement EUV lithography by the year 2012, which will require the development of a reliable high-power light source of just the right wavelength (13.5 nm). The answer, Harilal believes, lies in plasma.

Harilal is also working on a plasma application for the medical industry. Biomedical researchers and cell biologists stand to benefit from a new kind of imaging called water window transmission X-ray microscopy (WW-TXM). A microscope operating in the so-called water window wavelength range (2.3-4.4 nm) provides high resolution and large depth of focus, enabling valuable three-dimensional imaging. Microscopy at this level uses a strong natural contrast between water and carbon-rich tissues such as proteins and lipids. Harilal aims to develop a patentable table-top WW-TXM microscope using laser-produced plasma as a safe and reliable light source.

Keeping the population safe from the threat of nuclear terrorism is another of Harilal's concerns, so he and his colleagues are working on laser-induced breakdown spectroscopy (LIBS). "[The Department of] Homeland Security likes this technology," explains Harilal, noting that current applications of gamma rays and alpha-particles provide insufficient screening modalities.

"Unfortunately, we've got to be thinking about nuclear bombs in a bag," he says. The LIBS technique uses a single pulse of energy directed at the material in question, and the light emitted from the plasma plume is collected and analyzed with a spectrograph. "We will create a LIBS database of quantitative information for nuclear materials," proposes Harilal. "The expected outcome of the project is a highly sensitive LIBS sensor capable of detecting traces of radioactive materials."

Although relatively new to Purdue, Harilal is already feeling at home. He likes his new colleagues, whom he describes succinctly as "really cool," and he is happy with the small-town feel of West Lafayette. "The winters are better than in Madison, too," he points out. So is the academic environment; his laboratory research keeps him plugged into many practical advances in industry, science, and technology.

"I am also expanding my research fields to colliding plasmas, plasma diagnostics, and surface and interfacial science," he says.

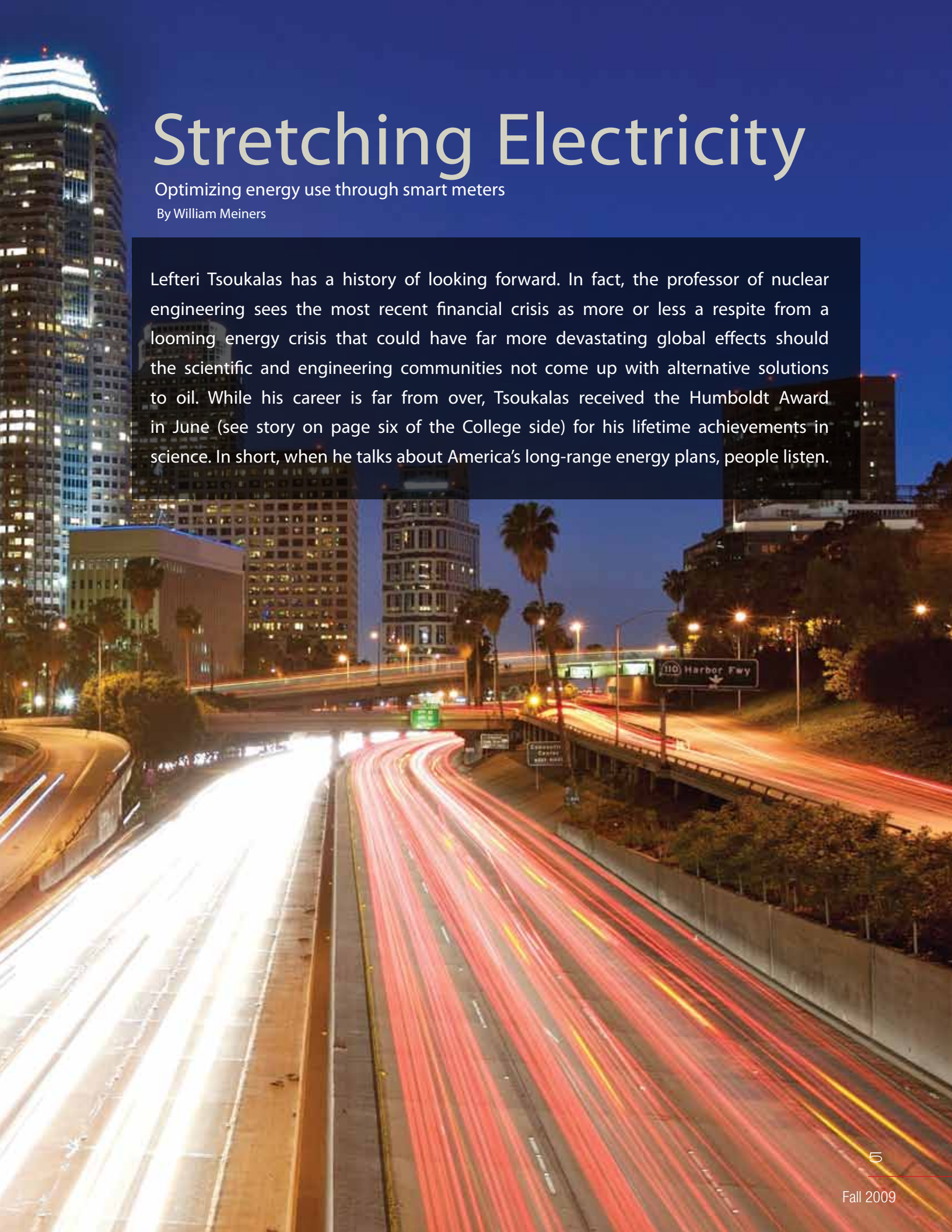
It seems for this researcher, Purdue is not only a comfortable place to work. It is also a good place to grow. ■ **Gina Vozenilek**

Stretching Electricity

Optimizing energy use through smart meters

By William Meiners

Lefteri Tsoukalas has a history of looking forward. In fact, the professor of nuclear engineering sees the most recent financial crisis as more or less a respite from a looming energy crisis that could have far more devastating global effects should the scientific and engineering communities not come up with alternative solutions to oil. While his career is far from over, Tsoukalas received the Humboldt Award in June (see story on page six of the College side) for his lifetime achievements in science. In short, when he talks about America's long-range energy plans, people listen.



"Energy is the lifeblood of modern civilization," Tsoukalas says. "Since the early the 1900s, the collateral for economic growth has been the ability to grow the energy supply. Over the last couple of decades, though, we've really started to see the limits of that growth."

"Electricity goes out at the speed of light, and you cannot easily store it. But we showed how aligning the grid with Internet technologies and built-in efficiencies could compensate for the lack of storage."

The problem with energy policies, from Tsoukalas' perspective, is their apparent shortsightedness. Even nuclear power has to be viewed in terms of its long-term benefits. With China wanting to build 50 nuclear power reactors by 2025 and another 100 by mid-century, Tsoukalas believes the Chinese will build the nuclear industry.

In the meantime—with a big chunk of the stimulus money going to energy initiatives—Tsoukalas sees the focus shifting to renewable sources (wind and solar) and much-needed attention to the power grid. "The last administration looked at energy from a transportation point of view," he says, "looking to make advances with biofuels and hydrogen."

Now, Tsoukalas says, we simply need to do more with less energy. Since the mid-1990s, his research group has demonstrated how to bring information technology to the power grid.

"Electricity goes out at the speed of light, and you cannot easily store it," he says. "But we showed how aligning the grid with Internet technologies and built-in efficiencies could compensate for the lack of storage. Everything that plugs into a wall can have its own IP address, could be on the Internet, and have its own energy management strategy."

These "smart appliances" could be programmed not to run at peak energy hours. "So you could program your Jacuzzi not to heat up at noon on a hot Tuesday, or not to use your washer if the price of electricity jumps to more than 20 cents per kilowatt hour," Tsoukalas says. "The goal is to reduce peak usages, stabilize the electricity we use, and thereby do more with less."

Collaborative investigations

Just as the energy solution will come from a variety of sources, the technological breakthroughs will come as a result of cross-disciplinary, collaborative efforts. Tsoukalas has been working with researchers and students in Purdue's Division of Construction Engineering and Management on what will become the challenges of building nuclear power plants in this country.

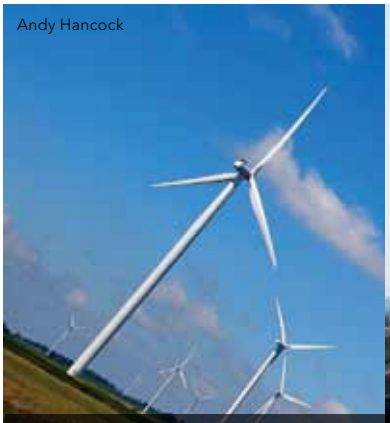
"the focus is shifting to renewable sources (wind and solar) and much-needed attention to the power grid.

And those collaborative efforts go far beyond the West Lafayette campus.

Two colleagues at the University of Illinois—Alejandro Dominguez-Garcia, assistant professor of electrical and computer engineering, and George Gross, professor of electrical and computer engineering—can attest to the creativity and team-building skills that Tsoukalas brings to any collaboration. Gross, who has worked with Tsoukalas for more than a dozen years, describes his Purdue colleague as a "deep thinker who looks at a broad scope of issues."

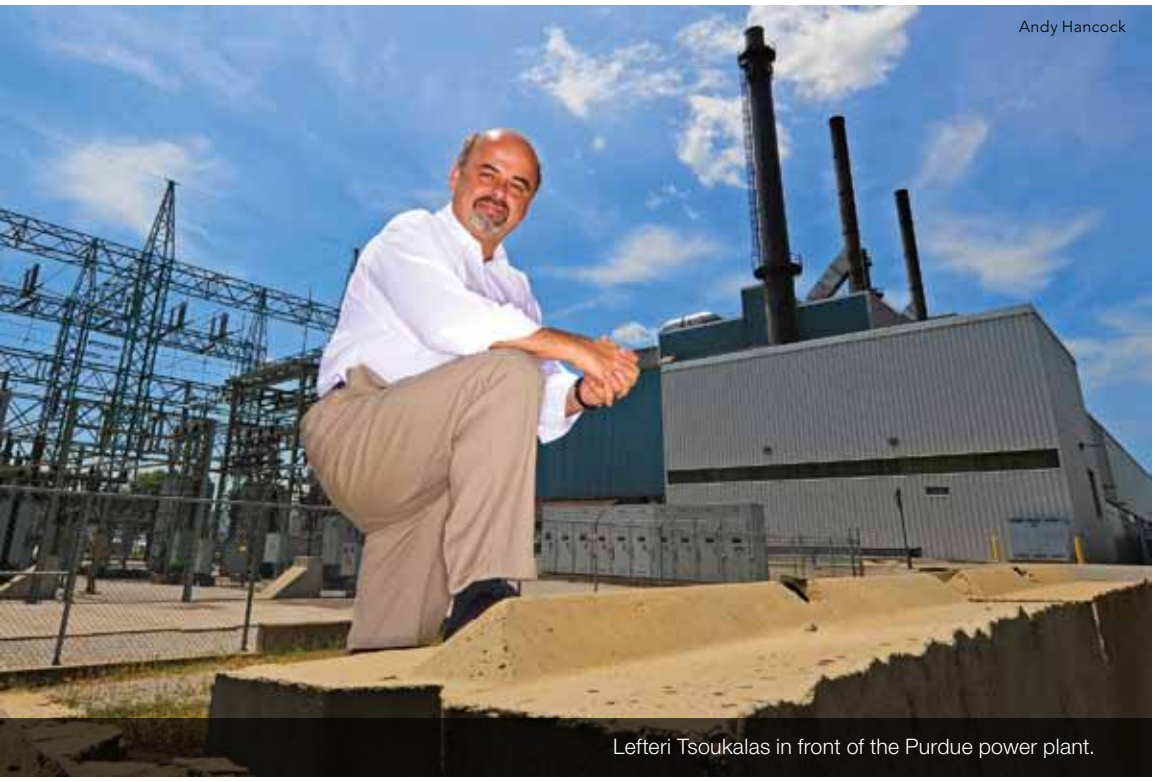
Gross and Tsoukalas are usually looking at energy in terms of its symbiotic relationships. How, for example, can improvements in hydro utilization make an energy difference? When it comes to their collaborative efforts on smart meters, Gross suggests, "We're looking on the demand side, not just the supply side. We're looking to make sure that consumers have active participation in how they use electricity."

This may not be as difficult as it sounds, Gross reasons. It's unlikely that every home would have an active energy manager, but smart appliances would allow them that option.


Andy Hancock


Vince Walter

Benton County Wind Farm (left) and Lefteri Tsoukalas and Richard Schwartz (right) near the solar panels atop the Knoy Hall of Technology.



Andy Hancock

Lefteri Tsoukalas in front of the Purdue power plant.

"The notion of having a smart meter communicating with appliances will bring about some effective deployment of this strategy," Gross says. "If a meter goes into every home or business and sends messages to a refrigerator to delay cycles to take advantage of cheaper electricity, you can have major repercussions in terms of shifting the loads."

Gross believes that within 10 years' time, these smart meters—along with increased consumer knowledge—will be effectively stretching energy and electricity. Test measurements over the next year or two could help predict the long-term success of such a program.

"We have to have a fair system, so every human being has access to the benefits of modernity—to healthcare, education, and good environmental quality. And there are tremendous margins for improvement there."

Human and technological engagement

Tsoukalas concurs on the role of the consumer. "We have to engineer an improved technology for human engagement," he says. Smart appliances and energy credits can get people thinking about their energy usage without asking them to overhaul their lifestyles. But the importance of avoiding an energy crisis calls for an all-hands-on-board approach—and not just from the science and engineering communities.

The energy question is a "show-stopper for the developing world," Tsoukalas says. "They know people are living better than they are and have the freedom of mobility. And they want to have that, too. The increasing problem becomes the lack of resources.

"We have to have a fair system, so every human being has access to the benefits of modernity—to healthcare, education, and good environmental quality. And there are tremendous margins for improvement there," Tsoukalas says.

So with 5.5 billion of the earth's 6.6 billion clamoring for those modern benefits, there will be much energy spent on the energy question. While Tsoukalas knows and heartily defends the benefits of nuclear energy, he knows it's not for everyone. "For countries that have infrastructure, it makes sense," says Tsoukalas. "But we have to be very careful, and because of this, we don't have the means to grow the industry quickly."

While Tsoukalas took his family to Germany in June to pick up his lifetime achievement award, he will likely spend the rest of his career thinking about how to maximize these energy mixes, and no doubt raising more questions. Where does nuclear energy fit into a solar economy? Will there be a hydrogen economy? Or does it all just fit under the heading of an energy economy?

In the meantime, Tsoukalas hopes that connecting the Internet with the power grid and continuous technological headway in the areas of wind and solar will be the beginning of the long learning curve in solving the most pressing problem of our time. ■

Hybrid Fusion-Fission Power for Sustainable Energy Future

Nuclear engineering alumnus shares vision for post-ignition fusion development

Ralph Peterson (BSNE '79)

Nuclear fusion holds a promise to deliver the ultimate solution to the humanity's energy needs. With the practical, economically feasible scheme to produce fusion energy in large quantities, an inexhaustible energy source would become available. Nuclear fusion exhibits many of the attractive features of renewable energy sources, without many of their shortcomings.

Nuclear fusion is carbon-free, produces only short-lived nuclear waste, relies on cheap, abundant fuel (hydrogen and lithium), and is characterized by extremely high-energy density. Thus it potentially enables compact solutions for future increasing terrestrial and extraterrestrial energy needs. The mainstream fusion research is focused on two alternative methods for production of fusion energy in large quantities, with net energy gain: magnetic confinement and inertial confinement. Recently, both methods have received much attention. The premier inertial confinement fusion experiment is coming online in spring 2009, and the premier magnetic fusion experiment, now under construction, expects its first experimental results around 2020.

As the project manager of the National Ignition Facility (NIF), the world's premier inertial confinement fusion project, I was responsible for overseeing the construction of one of the largest and most challenging scientific experiments to date—the size of three football fields. Recently completed and dedicated, NIF is now embarking on the National Ignition Campaign, in which controlled release of nuclear power from fusion is expected to result for the first time in ignition and net energy gain.

Activation of NIF is an unprecedented opportunity for fusion research, both in its scale and its expectations. As the first fusion experiment expected to reach ignition, NIF hopes to bring fusion energy to market within this generation. While the ignition on NIF will not immediately change the energy playing field, it will likely have significant long-term impact once the scientific basis for ignition is established experimentally.

As early as in the 1950s, scientists contemplated the possibility of a transition from fission to fusion economy that would utilize the hybrid energy systems based on both technologies. The team at Lawrence Livermore National Laboratory (LLNL) recently brought this idea forward again, but in an expanded form particularly well-suited for laser fusion. As originally proposed, in hybrid fission-fusion systems fast neutrons produced by the fusion component of the reactor can be used to increase the energy production by the use of a fissionable blanket surrounding the reactor. The hybrid fusion-fission reactor relaxes the stringent requirements on the efficiency of its fusion component and represents a highly efficient breeder for fission reactor fuel: A mid-size hybrid fusion-fission reactor could produce fissile material for fission reactors at a rate up to tens of times greater than conventional fission breeder reactors.

The LLNL concept, termed LIFE (laser inertial fusion engine), offers additional capabilities, which could address many of the challenges of the current fission nuclear fuel cycle. Specifically, the LIFE concept looks to use the spent nuclear fuel from fission reactors and weapons-grade plutonium in the fission blanket. This approach can dramatically improve the burnup of fission fuels, by as much as a factor of 100. Thus the possibility exists to reduce the rate of production of nuclear waste by a factor of 100, eliminate the stockpiles of weapons-grade plutonium, and pursue the utilization of cheap and abundant fuels: hydrogen and natural uranium or thorium.

The fusion ignition, likely to be demonstrated on NIF in the next several years, will be a momentous event in fusion research, one that will again shift public attention to this pathway to energy production with nearly unlimited potential. Envisioned as the stepping stone from the fission economy to fusion economy, the LIFE program's central advantage will be the advanced hybrid fuel cycle, resulting in minimal nuclear waste production and the minimization of the current stockpiles of spent nuclear fuel. ■

This column was compiled from Ralph Peterson's presentation in a spring 2009 visit to Purdue.

Looking Forward, Giving Back

Boilermaker couple endows professorship in School of Nuclear Engineering


Vince Walter

Paul and Madeline Wattelet

In these hard economic times, a large gift like the one made by Paul Wattelet and his wife, Madeline, of Oak Brook, Illinois, seems especially generous. The endowment is a statement of their connectedness to—and through—Purdue. It was at their mutual alma mater that the couple met, he while attaining his doctorate in nuclear engineering, she while studying for her master's in mathematics. Their gift provides funds for the Paul L. Wattelet Chair in Nuclear Engineering.

But it's not all romantic nostalgia that urged the Wattelets to support the school in this significant way. They are giving back. "My success in nuclear engineering is a result of my time at Purdue," says Wattelet.

After he received his doctorate in 1967, he set off for Pittsburgh and a job with Westinghouse Electric, where he helped design nuclear reactors. Then he returned to the Midwest, joining Sargent & Lundy in Chicago in 1972, where he turned his efforts to the design of nuclear power plants. He eventually rose to the position of chairman, president, and CEO, and retired in 2004. Wattelet was selected as a Purdue Distinguished Engineering Alumnus in 2002, and he served as a member of the Engineering Visiting Committee and of the Engineering Alumni Association Board at Purdue.

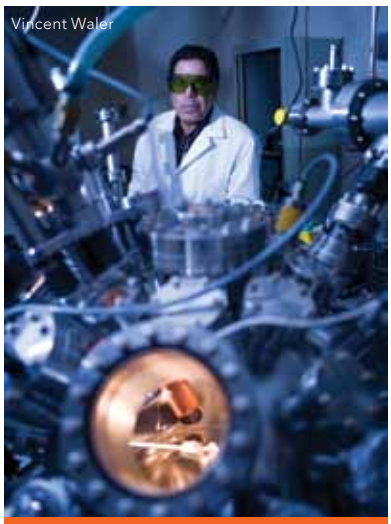
With this endowment, Wattelet and his wife are looking forward. "I'm a diehard nuclear power person," Wattelet asserts. "It appears now after 25 or 30 years of hiatus, nuclear power plants are starting to come back. I see Purdue playing a big role in providing students to the field."

Wattelet notes that even while he was in the industry, there was a shortage of nuclear engineers. He thinks that nuclear power will become a significant part of a new global energy portfolio, driving even greater demand for people with nuclear engineering degrees.

Wattelet is proud to have come from the Purdue nuclear engineering program, recognizing it as a cornerstone of nuclear engineering education in this country. "It's one of the real success stories in the field," he says. "Purdue hung in there when departments at other universities dissolved."

And now the program stands to gain even greater strength from the new professorship he and his wife have made possible.

Stepping up to that challenge will be Ahmed Hassanein, the Paul L. Wattelet Professor of Nuclear Engineering. Before coming to Purdue in 2007, Hassanein was a senior scientist and group leader at the U.S. Department of Energy's Argonne National Laboratory. He has more than 25 years in research and development in the fields of nuclear engineering and materials science. Hassanein is grateful for the financial boost. He says the funds will help the department in big ways and small, from exploring new ideas in nuclear engineering to supporting travel grants for graduate students so they can present their research at conferences.


Vincent Waler

Ahmed Hassanein in his lab

Along with the named professorship, Hassanein was made head of the School of Nuclear Engineering. He sees his new administerial role as complementary to his role as a researcher. He juggled these two professional functions at Argonne and found that "both strengthened each other." As head of nuclear engineering, he will be charged with bringing new research concepts to the school and also will work to assemble the best team of faculty to make that research flourish.

Hassanein seeks to augment the faculty in several key areas: nanotechnology, advanced computational physics with supercomputer applications, reactor physics, and nuclear fusion. He says he "wants to make Purdue's nuclear engineering school among the top in the nation."

The gift from the Wattelets goes a long way toward making that happen. ■ **Gina Vozenilek**

Student Success at ANS

Two Purdue undergrads, in two completely different ways, showcase Purdue's nuclear prowess

Vincent Walter

Baker's dozen: (from left) Jason Young, Lenka Kollar, Sheila Bolbolan, Bryan Heim, Abbey Donahue, Shanjie Xiao, Alex Bakken, Jeff Webster, Thomas Grimes, Michael Foxe, Rachel Crisp, Miltiadis Alamaniotis, and Manuel Sztejnberg.

Speaking with Abbey Jean Donahue (BSNE '09), recent graduate and outgoing president of the Purdue chapter of the American Nuclear Society (ANS), one gets an immediate sense of how far she's come during her years in West Lafayette. From an incoming first-year student leaning toward biomedical engineering or aeronautics and astronautics to her current position—in June she began her career as a neutronics engineer at Areva's American headquarters in Lynchburg, Virginia—Donahue's trajectory through Purdue exemplifies how getting involved and taking on responsibility can shape the course of one's life.

"I joined ANS sophomore year, and went to my first Nuke Week as a junior, which was what really inspired me to run for ANS chapter president as a senior," she relates.

And while her responsibilities as president were myriad—from coordinating Nuke Week to leading Volunteer Day and bringing in industry representatives to talk about professional opportunities for Purdue graduates, organizing Purdue's role in the annual ANS conference at the University of Florida was definitely her most daunting task.

"We had 17 student presenters this year, which was the second most of any university at the conference, and 13 of them presented," Donahue says. "Basically my job was to coordinate who was presenting what research in what category, and then make all the travel arrangements, from airfare to hotel reservations, make sure we had the funding to cover it all, and then make sure we all got down there." And that was all before she even arrived in Gainesville.

"At the conference itself, all the chapter presidents in attendance hold an executive meeting and discuss ways in which we can keep our organization relevant and helpful to our members." Donahue says.

She also represented Purdue's fair booth, answering questions about graduate programs and handing out information.

"We had several presentation winners this year, which made us look really good as a nuclear engineering program," Donahue sums up. "It was a great note to go out on."

For one of those winners, Purdue rising senior Brian Heim, this was his first ANS Conference, and it, too, will be a memorable one.

"I've been doing research for about a year and a half now in the Radiation Surface Science and Engineering Laboratory (RSSEL), and my advisor, Professor Jean Paul Allain, worked with me to get my conference presentation together," Heim relates. "Specifically, the talk I gave was on control studies of lithiated graphite surfaces and their implication on hydrogen retention in the National Spherical Torus Experiment, which is housed at the Princeton Plasma Physics Laboratory. It's based on plasma-facing components and materials."

Translation? "Basically, one of the main roadblocks on fusion technology is that the materials we're working with can't withstand the high fluxes of ions or the high heat produced by the process. So we're trying to develop new materials that can both withstand those environments and improve plasma performance, working toward steady-state fusion."


Vincent Walter

Professor Jean Paul Allain in his lab

And for that, Heim won the best presentation in the nuclear materials group. And what's more, the Idaho National Laboratory invited him and fellow presenter Lenka Kollar (also from the RSSEL group) to give a colloquium on the topic in July. Aside from his own presentation, Heim kept busy during his days at the conference.

"I definitely made sure to attend all the presentations in the nuclear materials group, and checked out the job fair where a lot of the national labs had booths set up," he says. "And I looked a bit at some industry applications, but mostly focused on the research side of things."

Heim is applying to graduate school at Purdue to keep pursuing his research endeavors. "Overall, the conference was a great way to see firsthand the nuclear world, both in research and in industry," he says. "Anyone interested in seriously pursuing nuclear engineering should definitely consider going." ■ **Patrick Kelly**

About ANS

According to its Web site, the American Nuclear Society (ANS) is a not-for-profit, international, scientific and educational organization. It was established by a group of individuals who recognized the need to unify the professional activities within the diverse fields of nuclear science and technology. December 11, 1954, marks the Society's historic beginning at the National Academy of Sciences in Washington, D.C. ANS has since developed a multifarious membership composed of approximately 11,000 engineers, scientists, administrators, and educators representing 1,600 plus corporations, educational institutions, and government agencies. It is governed by four officers and a board of directors elected by the membership.

Purpose:

The core purpose of ANS is to promote the awareness and understanding of the application of nuclear science and technology.

Vision:

ANS will be the recognized credible advocate for advancing and promoting nuclear science and technology.

aperture

Researchers have uncovered evidence suggesting that factors other than genes could cause obesity. A team led by researcher Ji-Xin Cheng, assistant professor in the Weldon School of Biomedical Engineering and Department of Chemistry, found that genetically identical cells store widely differing amounts of fat depending on subtle variations in how cells process insulin. In this image, insulin (green) is present in cells with no fat storage and absent in cells with fat storage at two days after insulin addition. This observation indicates faster insulin processing rates in cells with fat storage. Fluorophore-labeled insulin (green) is visualized with fluorescence imaging, and fat is visualized with coherent anti-Stokes Raman scattering—or CARS—imaging (red/white).