

EQad News

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IN THE
SERVICE
OF ALL NATIONS



PRINCETON

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Note on alumni class years

EQuad News follows a Princeton University convention in noting the year of graduation for alumni: A person's name followed by an apostrophe and class year indicates an undergraduate degree; an asterisk followed by a class year indicates a graduate degree, either master's or doctoral.

ENGINEERING IN THE SERVICE OF SOCIETY

Woodrow Wilson, former president of this University and nation, rarely strayed far in his writing and speaking from the subject of service. His 1896 speech, "Princeton in the Nation's Service," provided a guiding principle to this day, and in 1913 he famously reminded students at Swarthmore that, "You are here to enrich the world, and you impoverish yourself if you forget the errand."

That ethic of service underscores one of my favorite Wilson quotes. In honoring George Goethals for his leadership in constructing the Panama Canal, Wilson said, "the magic of the engineer is that he can change the face of nature and show the work of his hands, and that it is in some deep sense creative in character."

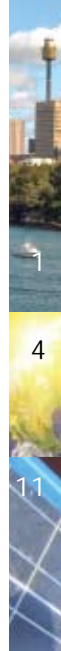
For Wilson, prerequisites for both service and creativity were the pursuit of not only deep thought in a chosen field but also a broad liberal arts education. He was fascinated by

"this complex interdependence and interrelation of all the processes which prepare the mind for effectual service: this necessity that the merchant and the financier should have travelled minds, the engineer a knowledge of books and men..." [Princeton inaugural, 1902]

And so, we have one of the driving tenets of Princeton Engineering: The role of an engineer is to use science in the service of society, from developing sustainable energy to improving global health. Yet the major problems facing the world cannot be solved by technology alone—each demands knowledge and collaborations that cross boundaries. And each requires the creative minds of men and women with varied backgrounds and perspectives.

This magazine can only touch on the innumerable ways Princeton engineers are bringing these ideals to life every day. Please visit us online at www.princeton.edu/engineering or in person to find out more.

H. Vincent Poor *77
Dean and Michael Henry Strater
University Professor of Electrical
Engineering



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An article in the Summer 2010 edition about a breakthrough in quantum materials science incorrectly stated the position of researcher Chen Huang; he is a graduate student.

INTERNSHIPS

ENCOURAGE SERVICE

These internships were supported by the Eugene Wong '55 Fund for Engineering and Policy, administered by Princeton's Keller Center.

**ALTHOUGH TECHNOLOGY
MAKES A DIFFERENCE, IT IS
ONLY SUSTAINABLE WITH THE
APPROPRIATE POLICY IN PLACE.**

—EDEN FULL



STEPHEN TUOZZOLO '12
**International Water Management
Institute in Accra, Ghana**

I worked on the Ghana Dams Dialogue, which promotes a more sustainable dam development process. This is done by bringing together stakeholders for meetings and discussions; for instance, a relocated village sends a representative to a meeting with representatives from the various power authorities, ministries and other decision-makers. Such meetings serve to improve relations between these groups and lead to a fair resettlement and compensation process. Working with the Ghana Dams Dialogue gave me the opportunity to view dam development through social, political, environmental and economic lenses. The opportunity to visit traditional communities that will be resettled in the near future was incredible.



EDEN FULL '13
**Solar For All, a joint initiative of Ashoka
and the Canopus Foundation**

My primary responsibility was to assist in developing an understanding for how policy in developing countries has to change to improve the accessibility of solar technology. I focused on one particular research project involving the company Calisolar, which holds patents for a process for purifying metallurgical grade silicon into 15-percent-efficiency solar wafers. I conducted extensive background research on the technology, wrote reports and then prepared a final proposal for a collaboration with Calisolar. Following this internship, I conducted research with Professor Wole Soboyejo at Princeton, concluding with a trip to Mpala, Kenya, where I helped two villages install their first solar-powered battery charging stations. This summer helped me understand that although technology makes a difference, it is only sustainable with the appropriate policy in place.

HARLAN YU,
graduate student

U.S. Department of Labor,
Washington, D.C.

I spent the spring and summer working on open government issues. The White House last December instructed each agency to establish a plan to increase its efforts in transparency, participation and collaboration. I helped to develop and write the labor department's plan—which

was due at the end of my first week—and spent the remainder of my time implementing it. I focused on our transparency initiative, and in particular, on identifying high-value documents and datasets that could be published online in the most useful way possible. I also worked col-

laboratively with the White House Office of Science and Technology Policy to increase public participation across the entire executive branch, among other projects. This was my first experience working in the federal government and it was a very positive one.

PRINCETON NAMED CYBERSECURITY HUB BY NATIONAL SECURITY AGENCIES



Photo by Frank Wojciechowski

For her graduate research, electrical engineering student Maddie Lu is developing a device (seen here) to prevent wireless signals from interfering with each other. Princeton's recent designation as a national cybersecurity center is intended to encourage such information assurance research and attract talented scientists to national security service.

by Chris Emery

Maddie Lu returned to Princeton University as a graduate engineering student this fall to finish what she started as an undergraduate: building a communications device to help safeguard U.S. soldiers in the battlefield.

Her goal is for the device to prevent wireless communications systems used by the military, police and other first-responders from interfering with one another when they are most needed.

"I learned about this project as an undergraduate, and after we got the principles of the device worked out, I thought it was fascinating," said Lu, who graduated in 2009 with a degree in electrical engineering.

The federal government announced last summer that Princeton will have special status as a hub for cybersecurity research, opening the door to more research such as Lu's, which uses engineering expertise to solve national security problems. Universities with this status are designated a National Center of Academic Excellence in Information Assurance Research. The program is administered by the National Security Agency (NSA) and the Department of Homeland Security.

The program allows Princeton faculty and students to apply to federal agencies for special fellowships, scholarships, internships and research funding related to information assurance, the practice of protecting sensitive national security data.

The Princeton program will be administered by the University's Center for Networks Science and Applications.

Princeton is one of seven U.S. universities accepted into the research program for the 2010-15 term, bringing the total number of centers to 47. The other newly accepted universities are Kansas State University, Purdue University, the University of Memphis, the University of Connecticut, Virginia Tech and West Virginia University.

"The National Security Agency and the Department of Homeland Security are looking for smart American citizens to help address the technical challenges of national security," said Paul Prucnal, a professor of electrical engineering who spearheaded Princeton's involvement in the program. "This gives faculty and students here an opportunity to pursue funding from NSA and DHS and will open doors for students who want to pursue careers in national security."

In addition to research funding and fellowships, the designation allows Princeton students to apply for the Department of Defense Information Assurance Scholarship Program and the Federal Cyber Service Scholarship for Service Program.

The programs provide scholarships to rising juniors and seniors and graduate students. Those selected for the program receive funding for tuition, books and other education costs and a stipend to cover room and board.

Lu participates in a similar NSA program, which supports her research in exchange for her serving as an intern at the security agency for two summers.

"It frees me from having to work as a teaching or research assistant, so I can focus on building this device," she said. "I have to spend summers working for NSA, but that seems pretty interesting." **E**

PRINCETON ENGINEERS BRING TECHNICAL EXPERTISE TO GOVERNMENT SERVICE

by Chris Emery

In his first year out of Princeton, Michael Konialian helped the U.S. State Department advance international cooperation to address climate change and reduce the risk of dangerous materials from nuclear reactors falling into the hands of terrorists.

"It has opened my eyes to the sheer amount of meaningful work done by the government," said Konialian, who graduated from Princeton with a degree in mechanical and aerospace engineering in 2009. "It also helped me understand how all the pieces fit together, whether it's mitigating climate change or enhancing nuclear security."

Konialian is the second Princeton engineering graduate to participate in the Scholars in the Nation's Service Initiative, a program that combines government service with graduate studies at Princeton's Woodrow Wilson School of Public and International Affairs.

Participants in the program complete a government internship between their junior and senior years at Princeton. After graduation they serve in the U.S. government for two years before returning to Princeton to complete a two-year master in public affairs program in the Wilson School.

Ishani Sud, the first engineering graduate to participate in the program, has returned for her graduate studies after two years of working as a technology analyst in Washington, D.C. She found that her training as an engineer put her in demand during her stint in government service.

"They really needed me to get to work right away," she said. "There are so many problems that are going to need to be

tackled. The government needs people who understand technology to develop many of the solutions."

Konialian started his two years of service working for the U.S. State Department in the United Kingdom where he worked to enhance cooperation between the United States and the United Kingdom on alternative energy development and analyzed the U.K. government's climate change policies.

He worked closely with British scientists and government officials to develop connections between U.S. universities and government agencies and their counterparts in the United Kingdom. He focused on efforts to develop technologies that capture carbon emissions from burning fossil fuels and store that excess carbon underground, thus preventing it from entering the atmosphere.

His second post is with the State Department Office of Nuclear Energy, Safety and Security in Washington, D.C., where he focuses on policies intended to prevent terrorists from obtaining highly enriched uranium and radioactive sources used in civilian nuclear plants.

"Basically, the office works to prevent the bad guys from getting access to nuclear materials," he said. "We are able to produce civil power and medical isotopes using low-enriched uranium now, which greatly reduces the proliferation risk of highly enriched uranium.



We know what economic and policy mechanisms are needed and have the technological platform, but we have to get everyone working together to make it all work."

When he returns to Princeton, Konialian plans to focus his graduate

studies on issues at the intersection of science and international relations. "The program has enabled me to focus on the topics that interested me most," he said, "and given me great latitude to pick the type of work I want to be doing." **E**

Michael Konialian, seen above in the U.S. State Department diplomatic lobby in Washington, D.C., has worked for the State Department as part of his participation in Princeton's Scholars in the Nation's Service Initiative.

As part of the Scholars in the Nation's Service Initiative, Ishani Sud conducted research on an American military base in Okinawa, Japan, during a summer internship prior to her senior year at Princeton. Below, she is seen on the deck of the USS Kitty Hawk off the coast of Australia.



FTC APPOINTS PRINCETON COMPUTER SCIENTIST **FELTEN** AS CHIEF TECHNOLOGIST



During Felten's leave of absence, Margaret Martonosi, also a professor of computer science in Princeton's School of Engineering and Applied Science, will serve as the acting director of CITP. The center is a joint venture of the engineering school and the Woodrow Wilson School of Public and International Affairs, where Felten also holds a faculty appointment.

Felten is the lead contributor to Freedom to Tinker, an influential technology blog hosted by CITP. In announcing Felten's appointment, the trade commission noted his expertise in computer security and privacy relating to consumer products, technology law and policy, Internet software, intellectual property policy and the use of technology to improve government.

"Ed is extraordinarily respected in the technology community, and his background and knowledge make him an outstanding choice to serve as the agency's first chief technologist," said FTC Chairman Jon Leibowitz.

"He's going to add unparalleled expertise on high-technology markets and computer security," Leibowitz added. "And he also will provide invaluable input into the recommendations we'll be making soon for online privacy, as well as the enforcement actions we'll soon bring to protect consumer privacy. We're thrilled to have him on board."

Felten has advised the trade commission on Internet privacy and safety issues related to children and on the recent proposal to create a "Do-Not-Track" registry that would allow consumers to opt out of having their Internet activities collected by businesses. He has served as a policy consultant for the agency since August.

—CE

GAST SERVES AS U.S. SCIENCE ENVOY

The Obama administration has appointed Princeton engineering alumna Alice Gast as one of three State Department envoys charged with promoting U.S. global engagement in science and technology.

According to the State Department, she will use this role to "deepen existing ties and foster new relationships with foreign counterparts and gain insights from other nations about potential areas of collaboration."

Gast, who has been president of Lehigh University since 2006, earned her Ph.D. in chemical engineering from Princeton in 1984.

"I have always felt that science diplomacy is an extremely fruitful way to build relationships between countries and people," Gast said. "It is exciting to see our government taking a leading role in such an approach and I am pleased to be a part of it."

The Science Envoy program, announced by President Obama in Cairo in June 2009, has the goal of creating global collaboration on developing new sources of energy, creating green jobs, digitizing records, providing clean water and growing new crops.



Photo courtesy of Alice Gast

Photo by Jamie Rose

The U.S. Federal Trade Commission (FTC) has named Edward Felten, a Princeton professor of computer science and public affairs, as the agency's first chief technologist to help guide government policy in an era when technology has a growing influence on businesses and consumers.

Felten is the founding director of the Center for Information Technology Policy (CITP), a Princeton research center that explores the connection between technology, government policy and the social sciences. He will take a leave of absence from the University for his one-year appointment to the trade commission position, which will begin in January.

Felten will advise the agency on evolving technology-related issues of consumer protection, such as online privacy and cybersecurity, and antitrust matters, including tech-industry mergers and anticompetitive behavior.

"The trade commission is heavily involved with issues that touch on technology," Felten said. "Much of my research and the work of CITP focuses on issues of consumer protection and competitiveness. This is a chance for me to apply what I've been studying and see the policy-making process from the inside."

Storm chaser: Augustine keeps up pressure on competitiveness

“Rising Above the Gathering Storm,” the 2005 report issued by a National Academy of Sciences committee led by alumnus **Norman Augustine**, made a powerful impression with its stark analysis of science and technology education and funding in the United States.

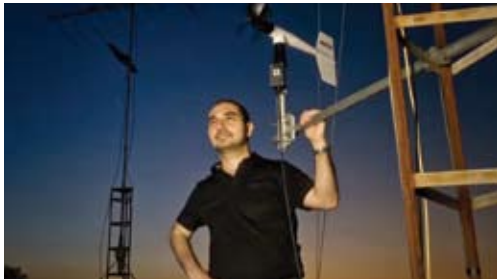
The report inspired the America Competes Act, federal legislation that included a range of provisions, such as increased funding targets for research. It also provided some of the basis for stimulus package spending aimed at science and technology. However, in a five-year follow-up, the committee, again led by Augustine, found that the ability of the U.S. to compete for quality jobs has continued to deteriorate.

The committee’s new report, issued in September, has a new subtitle that reflects Augustine’s wry manner: “Rising Above the Gathering Storm, Revisited: Rapidly Approaching a Category 5.” In interviews, Augustine called for more sustained investments with long-term horizons. “By focusing so much on short-term bursts of spending, we’re not paying enough attention to core problems like quality of teaching and the need for scientific research investments that could pay huge dividends in the long term,” Augustine told *The New York Times*. “We’re in a marathon, not a sprint.”

Augustine earned his bachelor’s and master’s degrees in aeronautical engineering from Princeton in 1957 and 1959 and went on to become chief executive officer and chairman of Lockheed Martin Corp. —SS



Photo by Frank Wojciechowski



Videos feature Princeton engineers

Elie Bou-Zeid, an assistant professor of civil and environmental engineering, is creating a wireless sensor network across campus to map the microclimate of Princeton. Bou-Zeid aims to better understand how local built environments can influence climate on a global scale.

Edgar Choueiri '91, professor of mechanical and aerospace engineering, is a leading expert in deep space propulsion but has a burgeoning interest in acoustics and how the brain locates the sources of sounds in space. He invented a technique for creating true 3D sound, which is demonstrated in the video.

Ed Weng '10 and fellow students shot footage as they field-tested Weng’s “unplugged water pump”—powered by a bamboo bicycle—in Kenya. Weng developed the pump, which was part of his senior thesis work, to provide clean drinking water to remote areas. (At left, Weng worked with Princeton engineering graduate student **Ismail Yakub** while in Kenya.)



Photo of Elie Bou-Zeid (top) by Volker Stieger; photo of Edgar Choueiri (left) by Frank Wojciechowski, and photo of Ed Weng (right) is courtesy of Ed Weng.

Watch these videos and many others at www.princeton.edu/engineering/video.

Engineering ethics courses emphasize responsibility



“It’s not just for their time as graduate students; it’s training for a profession,” said Gmachl, noting that the University and society put a lot of resources into graduate education. “What we ask in return is their honest work and their good judgment to solve societal problems. It’s a big responsibility and it’s important to live up to it.”

Jay Benziger, professor of chemical and biological engineering, taught “Ethics and Technology: Engineer-

ing in the Real World,” which drew 29 undergraduates, including a number from outside the engineering school. The course focuses less on research misconduct and more on the decisions and tradeoffs engineers face in developing technologies for market.

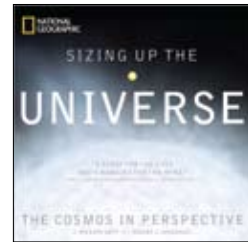
Case studies in the course range from safety failures in the auto industry to the unintended consequences of innovations such as freon, the ozone-depleting refrigerant.

“Technology shapes our society and political institutions in ways we don’t get to vote on,” Benziger said. He cited the invention of ever-larger farm equipment that increased yields and helped drive a shift toward corporate mega-farms.

“I’m trying to raise these issues for students. I don’t have all the answers,” Benziger said. “But as an engineer you really do have an ethical responsibility because your work really impacts society, whether you know it or not.” —SS

Putting the universe in perspective

Robert Vanderbei, professor and chair of operations research and financial engineering, has taken on a big topic: the universe. Working with Richard Gott, professor of astrophysical sciences, Vanderbei has co-written *Sizing Up the Universe*, a 240-page, picture-packed book published by National Geographic.



Tying together an image of an astronaut’s footprint on the moon with the last echoes of the big bang itself, the book takes an engaging approach to helping readers comprehend the vast range of sizes that exist in the universe.

Vanderbei, whose background is in applied mathematics, transitioned his research about 10 years ago into helping develop space-based systems that could directly capture images of planets circling stars other than our own. He also pursues a hobby of astrophotography, and many of his images are featured in the book.



Photo by Frank Wojciechowski

Photo of Claire Gmachl by Frank Wojciechowski

No longer just the province of the humanities, the study of ethics is taking on a greater role in engineering. In the fall 2010 semester, two courses—one graduate, one undergraduate—introduced students to the complex professional and societal implications of conducting research and bringing new technologies to market.

Claire Gmachl, professor of electrical engineering, taught “Responsible Conduct in Research: A Course on Ethics in Engineering,” a new half-semester course required of all engineering graduate students. In addition to providing a brief background in moral philosophy, the course covers topics such as research misconduct, credit and authorship in publications, student-adviser relationships, collaborations, and the wider societal implications of engineering decisions.

Responding to both Princeton University and federal agency requirements, Gmachl volunteered to teach the course for engineers and worked with the Keller Center to plan and develop the content.



Lynn Loo, an expert in flexible plastic electronics, received considerable media attention as a featured presenter at the summer meeting of the World Economic Forum in Tianjin, China.

Loo is featured presenter at world economic meeting

Princeton engineer **Lynn Loo** *01, who researches plastic electronics, was one of five early-career scientists who spoke in September at the World Economic Forum's "Annual Meeting of the New Champions" in China, otherwise known as Summer Davos.

Plastic electronics is a young and growing field that can potentially change the quality of human life in many ways, from greener sources of energy to better health monitoring, according to Loo, an associate professor of chemical and biological engineering.

"Imagine electronic wallpaper that changes patterns from green stripes to pink polka dots at a click of a switch," said Loo. "Imagine tinted windows that can also generate power during the day. Imagine disposable sensors that would change color if the water source is contaminated, or yet, think of smart plastic patches that can monitor your health and deliver medication when you're sick. The possibilities are endless."

Loo explains her work in more detail in a video that also features beautiful images of her materials and lab:

www.princeton.edu/engineering/video.

Undergrads win hydrogen production contest

True to its name, the homemaker's hydrogen generator featured a reactor vessel from Walmart and a whole lot of caulk.

The student-made device also produced enough clean-burning hydrogen fuel to win first place in an international competition sponsored by the International Association for Hydrogen Energy (IAHE). The all-undergraduate team put about \$600 worth of materials into its device, which used a solar panel to produce electricity that split water into hydrogen and oxygen.

"We realized we couldn't compete with the scientific literature in terms of time, resources and knowledge," said **Katherine Song**, a senior majoring in electrical engineering, and co-captain of the 10-student team. "We took a low-level approach that anyone could understand."

The project started in the fall of 2009 when seniors **Jane Yang** and **Yin Liang**, both chemical and biological engineering majors, started a Princeton student chap-

ter of the IAHE with Professor **Jay Benziger** as the club's adviser. With the contest as the club's first venture, the students worked through the winter, hitting numerous roadblocks, including an inexplicable lack of hydrogen.

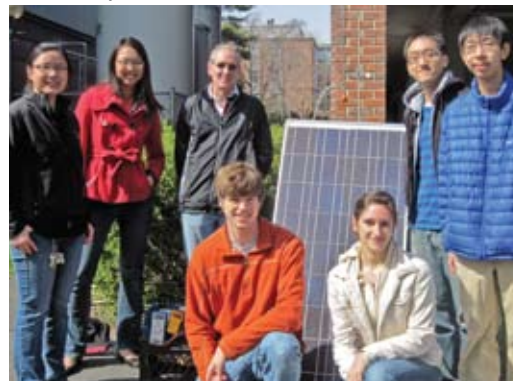
"One day I just went nuts with the caulk," said Song. The problem, which turned out to be many tiny leaks, was solved.

The students' write-up of their results, titled "A portable hydrogen generator for the homemaker," is due to be published in the International Journal of Hydrogen Energy. Their win also allows them to send five students to the World Hydrogen Energy Conference in Toronto in June 2012.

The project received support from the Kurtz Fund for Innovation in Engineering Education.

For more details on the group and to see a video explaining its submission, visit www.princeton.edu/~iahe. —SS

Photo courtesy of IAHE Princeton



Professor Jay Benziger (rear center) served as adviser to an undergraduate team that won an international hydrogen energy competition. Members of the 10-student team posing with their device are, from left: Yin Liang, Jane Yang, Alex Tait, Nicole Businelli, Leo Shaw and Michael Zhu.



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