Research at the Interface of Energy, Environment and Infrastructure

Learn more on page 3
Dear Friends,

I hope that this newsletter finds you well. It has been another exciting year for the department in terms of achievements and recognition for our students and faculty and new departmental initiatives. While the economic times have continued to be a challenge, the department continues to thrive, which I hope will be conveyed in this issue of our newsletter.

The highlighted theme of this newsletter is our research activities related to the interface between energy, the environment and infrastructure. We have a number of faculty members working at the interface between energy production and water. Kelvin Gregory has received a great deal of good publicity for the research he is doing related to treating and reusing the water during gas drilling. We also have a number of faculty members exploring how to make our buildings more energy efficient by capturing and using information collected from the facility. In addition, we have recently hired two new faculty members at this interface.

Mario Berges was hired to teach and do research in the energy infrastructure systems area and Thanasis Karamalidis was hired to do research in the area of environmental implications of energy production.

We have a number of excellent pieces of news to report since the last newsletter. We have had two additional faculty get elected into the National Academy of Engineering: Jacobo Bielak (2010) and Chris Hendrickson (2011). They join Dave Dzombak as active CEE faculty who are NAE members; this is tremendously good news for CEE, CIT and CMU. The following faculty were also recognized with national awards for their work: Lucio Soibelman received the ASCE Computing in Civil Engineering Award, and Dave Dzombak was selected as the 2010 AEESP Distinguished Lecturer. Three CEE faculty members also received significant local or university recognition: Dave Dzombak was made a University Professor, the university’s highest honor for a faculty member; and Irving Oppenheim and Burcu Akinci have been named the ASCE Pittsburgh Chapter Professors of the Year for 2010 and 2011.

In addition to all these awards, I am also very pleased to announce that IBM (with help from alumnus Wayne Balta (CE ’82)) and the State of Pennsylvania helped to establish the IBM Smarter Infrastructure Lab at Carnegie Mellon, to be housed in CEE. Construction is underway and in late spring, we will have an excellent 1000 sq. ft. facility housing a state of the art computing cloud from IBM, teleconference facility and a 3D immersive visualization environment (called a CAVE). This new facility will greatly assist the research being conducted in the AIS Program in CEE.

A number of alumni also received awards at our Alumni Brunch held this past November: Paul Rizzo (CE ’63, ’64, ’66) received the CEE Distinguished Alumnus Award; Seth Perlman (CE ’78, ’79) received the Outstanding Alumni Service Award; and Liz Higgins Durika (CEE ’03) received the CEE Recent Alumnus Award. Three alumni received university honors during Homecoming ’10 as well: David Williams (CE ’64) received an Alumni Distinguished Service Award; John Kovacs (CE ’93)—Alumni Service Award; and Dick Gray (CE ’56) received an Alumni Achievement Award. Our CEE students have also won a number of awards during this past year and they are listed in the student section of the newsletter. For example, Asli Akcamete won the John and Claire Bertucci Fellowship and Gabby Briffa won a GAI Scholarship.

We sincerely thank those alumni that have continued to support the department (alumni donors are acknowledged later in this newsletter). Without such support, we would find it difficult to continue to provide the world class educational environment we strive to maintain at Carnegie Mellon.
Managing Flowback Water from Shale Gas Development

Hydraulic fracturing is the cornerstone technology which has enabled the economical recovery of natural gas from deep shale formations such as the Marcellus shale in Pennsylvania. It involves the introduction of fracturing fluid with high enough pressure to fracture the shale formation and increase its permeability for economical recovery of gas, both in terms of quantity and rate. A single well hydrofracture in the Marcellus may require two to five million gallons of fracturing fluid, some of which returns to the surface as flowback water. The flowback water contains high concentrations of total dissolved solids from the deep geologic formation and is potentially harmful to the environment. Once brought to the surface, flowback must be managed in accordance with environmental regulations.

Kelvin Gregory, assistant professor of civil and environmental engineering, and University of Pittsburgh engineering professors Radisav Vidic and Eric Beckman are working together under a grant from the Department of Energy to develop a holistic approach for the treatment of flowback water, which uses Acid Mine Drainage water to remove toxic metals from the water, enabling the reuse of hydrofracturing fluids. The reuse of these fluids is expected to minimize the environmental risk posed by flowback water, and reduce the amount of freshwater needed for hydraulic fracturing.

Alternative Sources of Water for Power Plant Cooling Systems

An increase in demand for electricity means an increase in water needed for cooling. The cooling of power plants accounts for 41% of all freshwater withdrawal in the United States. Some areas of the U.S. have little or no freshwater available for use.

Partnering with the National Energy Technology Laboratory (NETL) and colleagues at the University of Pittsburgh, Dave Dzombak, Blenko University Professor of Environmental Engineering, post-doctoral associate Ming-Kai Hsieh, and PhD students Mahbub Choudhury and Ranjani Theregowda are examining alternatives to freshwater for use in cooling systems at electric power plants. The alternative sources being considered are lower quality waters available near locations of electric power production, including abandoned mine drainage, ash pond transport water, and treated municipal wastewater. The latter is receiving extra attention because it is available throughout the country.

Various approaches to preparing treated municipal wastewater for use in power plant cooling are being explored. Different combinations of additional (tertiary) physical, chemical, and biological treatment processes are being considered, including nitrification for removal of ammonia, softening for removal of calcium and magnesium, phosphorus precipitation, filtration, and organic compound removal by adsorption on activated carbon. The residual biodegradable organic matter, ammonia-nitrogen, and phosphorus in conventionally-treated municipal wastewater may pose biofouling, scaling and corrosion issues for power plant cooling systems. Addition of chemical agents for inhibition of corrosion, scaling and biofouling in combination with the treatment approaches listed above is also being investigated.

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The economic, technical and social factors of each approach are being considered to determine the scenario with the lowest cost, and the associated environmental impact of such a scenario.

Additional information about the project is available at: http://cooling.ce.cmu.edu/

Self-Configuring HVAC Systems

Heating, Ventilating and Air Conditioning (HVAC) systems have become more technologically complex, yet maintenance and repair practices have continued to be conducted in a largely reactionary manner. HVAC systems account for 16% of the total energy consumption in the United States, and between 25% and 40% of the energy consumed by HVAC systems is wasted through system faults. A need exists for an automated approach that supports performance monitoring, assessment and configuration of HVAC systems. CEE Professors Burcu Akinci, Mario Berges and Jim Garrett, along with Architecture faculty member Omer Akin and CEE PhD student Xuesong Liu, are researching ways to create a unified framework within an HVAC system that would work within five independent and synergistic functionalities: self-recognition, self-monitoring, self-assessment, self-improvement and self-healing.

Behavior in an HVAC system is difficult to predict because different faults can share similar symptoms. A self-configuring system relies on an information model that aligns the required information to be exchanged to support each of the five functionalities. A reconfigurable HVAC system would be capable of automatically configuring its own components and responding to a changing environment by adapting its behavior. In addition to detecting and diagnosing problems, the system would identify opportunities to improve energy efficiency.

The research team is reviewing existing approaches for self-configuring systems and developing new ways to implement self-monitoring and self-awareness of HVAC systems. Working with the facility operations team from Carnegie Mellon University and the Cleveland Clinic, the team plans to test the unified framework and information models they develop, and document energy saved by using a self-configuring approach for the HVAC system. This work is being done as part of the newly established IBM Smarter Infrastructure Lab.

2005 Freshwater Withdrawals in the U.S.

Benchmarking Energy Consumption in Residential Buildings

What if supermarkets provided customers with a monthly bill with a total sum instead of itemized receipts? Customers would have no knowledge of where most of their food budgets were being spent. Was produce taking up more than its share? Dairy? Meat? But that’s how electricity billing is commonly handled – a lump sum each month with no information on which appliances cost more to run than others.

CEE Professors Mario Berges, Lucio Soibelman and Scott Matthews, along with Jose M.F. Moura of Electrical and Computer Engineering and Yuanwei Jin of the University of Maryland Eastern Shore, research ways to provide consumer feedback on appliance-level electricity consumption in a project funded by the National Science Foundation.

One solution is to place sensors on appliances throughout the house to measure electricity used by each, though that solution comes with high equipment and labor costs.

A less costly solution involves examining the main electricity feed and how appliances behave, how people move within their homes, and where electricity waste falls. By placing one sensor on the main electric feed and tracking residents’ activity within the building, energy consumption can be determined for individual appliances. This approach, known as non-intrusive load monitoring, has been a subject of research for over twenty years, though a commercial product has yet to be produced.

The research team has partnered with Blueroof Technologies, a non-profit corporation based in McKeensport, PA dedicated to developing state-of-the-art living facilities for senior citizens. These facilities will be designed to provide safe, healthy and independent living arrangements through the use of sensors, information technology, and computer hardware and software. The team will test their electric monitoring tools using several residential buildings in the Pittsburgh area, including those maintained by Blueroof Technologies. An additional partnership with Robert Bosch LLC, a leading global provider of consumer goods and building technology, will help with worldwide adoption and exposure needed for significant reductions in energy consumption.

A desired result of the research is to provide consumers with actionable information about their energy consumption. Though not exactly an itemized receipt, knowledge of appliance behavior in their homes would allow consumers to make thoughtful decisions about appliance purchase and use.

From reducing the environmental impact of fuel retrieval and energy production, to changing the way residential and business consumers consider their energy consumption, CEE researchers are committed to finding long-term solutions to the demand on energy resources.
Dzombak Named AEESP Distinguished Lecturer
David Dzombak, Walter J. Blenko, Sr. Professor of Environmental Engineering, has been named the Association of Environmental Engineering and Science Professors (AEESP) Distinguished Lecturer for the 2010-2011 academic year. He will present 18 lectures at universities around the U.S. during Fall 2010 and Spring 2011.

Garrett Named Thomas Lord Professor of Civil Engineering
Jim Garrett, Department Head of CEE, has been named the Thomas Lord Professor of Civil Engineering. Jim joined the CEE faculty in 1990, and served as Associate Dean for Academic Affairs for CIT from 2000 until 2006, when he became Department Head. He is also the Co-Director of the Center for Sensed Critical Infrastructure Research (CenSCIR). Jim earned his B.S. (1982), M.S. (1983) and Ph.D. (1986) in Civil Engineering at Carnegie Mellon.

Soibelman Receives 2010 ASCE Computing in Civil Engineering Award
Professor Lucio Soibelman has been named the recipient of the 2010 American Society of Civil Engineers Computing in Civil Engineering Award. This internationally competitive award was established to recognize outstanding achievements and contributions in the use of computers in the practice of civil engineering. Professor Soibelman received his award in recognition of his research in knowledge discovery from data in civil and environmental engineering application domains, such as construction engineering and water/wastewater infrastructure management.

Hendrickson and Bielak Elected to National Academy of Engineering
Chris T. Hendrickson, Duquesne Light Company Professor of Engineering and Co-Director of the Green Design Institute at Carnegie Mellon, has been newly elected to the National Academy of Engineering (NAE) for leadership and contributions in transportation and green design engineering. Jacobo Bielak, University Professor, was a member of the 2010 NAE electoral class, recognized for advancing knowledge and methods in earthquake engineering and in regional-scale seismic motion simulation. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Professors Hendrickson and Bielak join seven other current and former CEE faculty as NAE members: George Bugliarello, Elio D'Appolonia, Dave Dzombak, Steve Fenves, Lester Hoel, Dick Luthy and Red Whittaker.

Akinci and Oppenheim Honored by ASCE Pittsburgh Section
CEE faculty have been recognized as Professor of the Year by the American Society of Civil Engineers (ASCE) Pittsburgh Section. Professor Burcu Akinci, captured the honors for 2011. Irving Oppenheim, Professor of CEE and Architecture had been named the 2010 recipient. This award is given for outstanding teaching ability and significant contributions toward improving professional aspects of civil engineering education.
**IBM Smarter Infrastructure Lab at Carnegie Mellon**

IBM and Carnegie Mellon are creating a collaborative research lab at the university to undertake research and create technologies to help cities, governments, and industries worldwide develop smarter infrastructures. The new lab is part of the Pennsylvania Smart Infrastructure Incubator (PSII), a Commonwealth of Pennsylvania economic development initiative, supported by IBM and Bombardier to create an incubator for advanced infrastructure technology in partnership with industry and state. The IBM Smarter Infrastructure Lab at Carnegie Mellon, and will be located within the CEE Department. Wayne Balta (B.S. CE 1982), vice president of corporate environmental affairs and product safety at IBM, was part of the IBM team who helped to bring about the collaboration. Several CEE faculty will head labs within the PSII. Burcu Akinci is faculty director of the Infrastructure/Facilities Information Modeling Laboratory while Lucio Sobelman leads the Infrastructure/Facilities Information Analytics Laboratory. Irving Oppenheim succeeds Jim Garrett as the CEE faculty co-director for the Center for Sensed Critical Infrastructure Research (CenSCIR). Jim Garrett is now a faculty co-director of PSII.

**Berges, Ergan, Karamalidis and Christian Join CEE Faculty**

**CEE Welcomes Four New Faculty Members to our Department:**

Mario Beruges joins the department as Assistant Professor of Civil and Environmental Engineering. Professor Beruges’ research areas include infrastructure monitoring, building energy management, smart grid, machine learning for signal processing and sensor networks. He completed his Ph.D. studies at Carnegie Mellon in 2010 and received his M.S. in Civil and Environmental Engineering from Carnegie Mellon in 2007. He received his B.S. in Civil Engineering and a Graduate Certification in Construction Management from the Instituto Tecnologico de Santo Domingo (INTEC) in the Dominican Republic.

Semiha Ergan comes to CEE as a visiting assistant professor from the Middle East Technical University (METU), where she was an assistant professor. Professor Ergan received her Ph.D. in Computer Aided Civil Engineering from Carnegie Mellon and her M.S. and B.S. in Civil Engineering from METU.

Athanasios Karamalidis, Assistant Research Professor, has been working with Professor Dave Dzombak as a visiting scholar for the past two years. He conducts research in the area of remediation and treatment technologies for petroleum wastes or petroleum contaminated soils. Professor Karamalidis received his Ph.D. in Environmental Engineering and Science from the Democritus University of Thrace, Greece in 2006 and his B.Sc. in Chemistry from the University of Crete in 1998.

Sarah Christian returns to the department as an adjunct faculty member. Dr. Christian received her B.S. in Civil and Environmental Engineering from Carnegie Mellon in 2003, and completed her M.S. at Johns Hopkins University (2004) and her Ph.D. at Stanford University (2009). Dr. Christian’s teaching and research interests lie in the area of structural engineering.
The Department of Civil and Environmental Engineering would like to thank the following alumni, corporate partners, and friends who have made a gift to the department in the fiscal year ending June 30, 2010. We appreciate your support!
CEE Graduate Students Receive PhD Fellowships

CEE PhD Students Asli Akcamete, Megan Leitch and Stacey Louie have recently been awarded prestigious and competitive fellowships. Asli Akcamete received a Bertucci Graduate Fellowship, created through the generosity of alumni John and Claire Bertucci to provide merit scholarships to doctoral students in Engineering. Asli is co-advised by Professors Burcu Akinci and Jim Garrett. Megan Leitch and Stacey Louie each received a Prem Narain Srivastava Legacy Fellowship, created through the generosity of Ashima and Sandeep Saksena to provide merit scholarships to doctoral students in Engineering. Both Megan and Stacey are advised by Professor Greg Lowry.

Gabriella Briffa Named GAI Scholarship Winner

Gabriella Briffa, Class of 2011, has been named one of four recipients of the GAI Engineering & Environmental Science Scholarship, presented to juniors who perform well during their internship assignments. GAI is a 700-person, employee-owned, multi-discipline engineering and environmental consulting firm, serving clients worldwide in the energy, transportation, real estate, water, municipal, government, and industrial markets.

Leneve Ong Awarded Ellegood Strategic Doctoral Fellowship

Graduate student Leneve Ong is the recipient of the second Ellegood Strategic Doctoral Fellowship, established through the generosity of Michael (B.S. CE 1960) and Julia Ellegood. Leneve completed her undergraduate studies in Environmental Engineering Science with a concentration in Energy & Resources at the University of California, Berkeley.

CEE Student-Athletes Named to CoSIDA Academic All-District Team

CEE students Bryan Connelly (Class of 2013) and Mike Shedlosky (Class of 2011) were among five members of Carnegie Mellon’s football team who were named to the College Sports Information Directors of America (CoSIDA) Academic All-District Team this fall. To be nominated for the award, a student-athlete must be a starter or significant reserve and maintain a 3.3 GPA or better.

Whitney Ladzick Receives SMART Scholarship

CEE undergraduate Whitney Ladzick, Class of 2011, has been awarded a two-year Science, Mathematics & Research for Transformation (SMART) Scholarship, established by the Department of Defense to support undergraduate and graduate students pursuing degrees in Science, Technology, Engineering and Mathematics disciplines. The program aims to increase the number of civilian scientists and engineers working at Department of Defense laboratories.
Undergraduate Student Awards
H.A. Thomas, Sr. Scholarship Award
Jeffery Miller

The James P. Romualdi Civil & Environmental Engineering Award
Christopher Donlon

Graduate Student Awards
Outstanding Teaching Assistant Award
Asli Akcamete and Guizide Atasoy

Paul P. Christiano Distinguished Service Award
Ricardo Taborda

Mao Yisheng Outstanding Dissertation Award
Yunha Lee
**CEE Alumni Recognized at Homecoming**

CEE alumni were recognized at both the university and department level during Homecoming 2010.

The CEE Department presented alumni awards during the CEE Alumni Brunch, attended by over 60 alumni, faculty and staff. These awards recognize the dedication, support and contributions of CEE alumni.

**Awards Were Presented To:**
- **Paul Rizzo** (B.S. 1963, M.S. 1964, Ph.D. 1966) - Distinguished Alumnus Award
- **Seth Pearlman** (B.S. 1978, M.S. 1979) - Outstanding Alumnus Service Award
- **Elizabeth Higgins Durika** (B.S. 2003) - Recent Alumnus Award

The following CEE alumni received Carnegie Mellon Alumni Awards, which recognize alumni, students and faculty for their service to the university and its alumni for their achievements in their chosen professions.

- **David Williams** (B.S. CE 1964) - Alumni Distinguished Service Award
- **John Kovacs** (B.S. CE 1993) - Alumni Service Award
- **Richard Gray** (B.S. CE 1956) - Alumni Achievement Award
Alumni Reflections

JEFFREY R. PARENTI (B.S. CE 1995)

I remember the day I decided I wanted to be a civil engineer. It was in the CMU bookstore. But not when I was enrolled as a student. It was years earlier during a visit my family took to Pittsburgh. My dad, Ron Parenti (S’74) earned his PhD from the Physics department and brought me to campus in hopes, I’m sure, of continuing a family tradition. My grandfather, Clayton, took architecture classes Carnegie Tech.

I was flipping through the pages of the statics and structures books from the “12 Civil” shelves. I think I was in junior high. While the symbols in the equations were Greek to me, the diagrams and photos of bridge trusses were calling me. I’d found my college major.

This surprised no one at home. With the neighborhood’s largest Matchbox car collection, I had been interested in roads and bridges for years. I used huge sheets paper to draw cities of roads. I specialized in interchange design.

A few short years later I sat in my first CMU class, Introduction to Civil Engineering. I won my first design competition, a 30-inch-high tower of balsa, string, and glue that held 20 pounds. It was close, though. At 30 grams, it wobbled dangerously around its z-axis during testing. “Near torsional failure” was the comment on my lab report.

Aside from CEE core courses, there were others that have proven to be surprisingly valuable in my career: probability and statistics, economics, and especially technical writing. Imagine that: an English professor giving valuable instruction to an engineer.

Two CFA courses (playwriting and acting) strengthened my oral and written communication skills. I published an article in the Federal Highway Administration magazine Public Roads in 2006, and I have presented at nearly a dozen international conferences.

I also wrote a play about mentoring for a Boston Section of ASCE event on the subject of mentoring, humorously based on the TV show Judge Judy. That’s when I crossed over: in 2004 I published a short story in the anthology Fenway Fiction. Last year I started writing an opinion column for my local newspaper.

During the day I am the mild-mannered traffic engineer for the City of Cambridge, Massachusetts. While I strive to be among the best in the traffic business, I want my writing career to take off, too. Yes, I do fantasize about being the first P.E. ever to host Saturday Night Live. Can’t you picture a sketch where the character of Larry Cartwright is walking across a student-designed wooden bridge dressed like a cow!

JENNIFER LAWRENCE (B.S. CE 2009)

Since May of 2010, I have been living in Akhadesh, a small farming village nestled in between the slopes of Morocco’s Middle and High Atlas Mountains. It is my home for the next two years, as I serve as an Environmental Educator and Community Development Volunteer with the United States Peace Corps. The mission of this particular program is to assist people living in rural areas to raise their living standards, through the integration of a more responsible approach to the use and management of natural resources into their livelihood activities.

Thus far, I have been furthering this cause through the implementation of school and youth based educational projects, including murals and environmental discussion groups. In the upcoming months, I plan on facilitating a home toilet installation project. There is much work to be done here in Akhadesh, and I look forward to all the unique challenges I will be facing in the next two years.

CEE Alumni, share your reflections with us!
Send your story with a photo to francioni@cmu.edu.
In Memoriam: Professor George Bugliarello

We sadly announce the passing of Professor George Bugliarello, who was a member of our CEE faculty from 1959 to 1969; he taught fluid mechanics and established a graduate program in bio-engineering. The bioengineering program existed for nearly 30 years before the establishment of the current Biomedical Engineering Department. He served as Dean of the College of Engineering at the University of Illinois at Chicago from 1969-73. He then became the first president of Polytechnic Institute of New York (NYU-Poly), formed by the merger of Polytechnic Institute of Brooklyn and New York University’s School of Engineering and Science in 1973 and held that position for 21 years. Professor Bugliarello was a member and foreign secretary for the National Academy of Engineering and received an Honorary Degree from Carnegie Mellon. In addition to his wife, Dr. Bugliarello is survived by his sons, Nicholas and David.

Design and Construction 2010: Bill Brown Memorial Garden

The Design and Construction 2010 project, funded by the Mellon College of Science, was a memorial to Professor Bill Brown. Professor Brown was an award winning Biology faculty member who died unexpectedly in 2007. The project site, on the south side of Doherty Hall, was outside of the lecture hall where Professor Brown had taught many classes.

The design consisted of split-level seating areas with the footprints of each area assembled in pentagons and hexagons. The shape of each area defined a particular DNA molecule – a subtle homage to Professor Brown’s discipline. An art student created four sculptures inscribed with the words “Respect”, “Mentoring”, “Collaboration” and “Creativity”, chosen to describe Professor Brown’s role as an educator.

A curved retaining wall was created at the north end of the lower terrace. To make the lower area ADA compliant, the existing grade had to be increased 2.5 feet. The class installed forty-eight tons of compacted engineered fill over an 8 hour period — all shoveled, wheeled, placed and compacted entirely by hand.

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Carnegie Mellon University does not discriminate, and Carnegie Mellon University is required not to discriminate, in admission, employment, or administration of its programs or activities on the basis of race, color, national origin, sex, or handicap in violation of Title VI of the Civil Rights Act of 1964, Title IX of the Educational Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973 or other federal, state, or local laws or executive orders.

In addition, Carnegie Mellon University does not discriminate in admission, employment, or administration of its programs on the basis of religion, creed, ancestry, belief, age, veteran status, sexual orientation, or gender identity. Carnegie Mellon does not discriminate in violation of federal, state, or local laws or executive orders. However, in the judgment of the Carnegie Mellon Human Relations Commission, the Presidential Executive Order directing the Department of Defense to follow a policy of “Don’t ask, don’t tell, don’t pursue” excludes openly gay, lesbian, and bisexual students from receiving ROTC scholarships or serving in the military. Nevertheless, all ROTC classes at Carnegie Mellon University are available to all students. Inquiries concerning application of these statements should be directed to the provost, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-6684, or to the vice president for enrollment, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213, telephone 412-268-2056.

Carnegie Mellon University publishes an annual campus security report describing the University’s security, alcohol and drug, and sexual assault policies, and containing statistics about the number and type of crimes committed on the campus during the preceding three years. You can obtain a copy by contacting the Carnegie Mellon Police Department at 412-268-2323. The security report is also available online.