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Letter from the Director

In the past year, the faculty, research staff and students at the EMS Energy Institute have worked on a wide range of externally funded projects that dealt with various aspects of energy resources, conversion, utilization, energy systems, and environmental protection as well as alternative energy. Much like the ripple effect created when a pebble is dropped into a body of water, their research has implications far beyond Penn State, potentially shaping the future of energy worldwide.

Since becoming the director of the EMS Energy Institute in May 2007, I have witnessed the Institute continue to expand its reach each year. One measure of our impact is made obvious by the increase in refereed publications originating from Institute faculty as well as the large increase in Institute publications listed in the science citation index. I am pleased to report that annual science citations reached an all time high this past year of about 1,700 counts.

In addition to continuing our work with government agencies and industries in the United States and expanding the impact of our research, the Institute has been working on strengthening collaborative research efforts and enhancing international cooperation for faculty and students. With today's global energy challenges and environmental concerns, international cooperation is critical to solving many of the world's energy problems.

One such effort has been the development of the Joint Center for Energy Research (JCER), a research endeavor between Penn State and Dalian University of Technology (DUT) in China. This collaboration is part of the university-wide Global Engagement Node at Penn State. In March 2012, the third PSU-DUT Joint Energy Workshop was held in Dalian for faculty members from Penn State and DUT to share ongoing research and discuss future collaborations. Penn State President Rodney Erickson and Vice Provost Michael Adewumi participated in this event. Also this year the JCER released a report highlighting the Center's many accomplishments, including twenty-five refereed journal publications.

Looking to 2013, the Institute is excited to be the hosting organization for two major international conferences, the International Conference on Carbon Dioxide Utilization (ICCDU) in June and the International Conference on Coal Science and Technology (ICCST) in October. These conferences will have presentations from active researchers worldwide in clean alternative energy, and carbon dioxide conversion and utilization as well as sustainable development research.

As our faculty continue to bring in research grant awards and contracts, the Institute's funding has remained healthy even without congressionally-directed funds or stimulus funds. Additionally, the Institute staff deserves recognition. They are working as hard as ever, putting in extra time in support of the faculty and student research, including proposal submissions, research project management, as well as the Institute newsletter and website. I hope you will find the contents of this issue interesting. Please let us know if you have any suggestions or comments.

Dr. Chunshan Song
Director, EMS Energy Institute
Associate Director, PSIEE
Distinguished Professor of Fuel Science and Chemical Engineering



Research Briefs from Around the Institute

From exploring alternative energy sources to developing new technologies for the production, generation, and utilization of energy, the EMS Energy Institute is involved in almost every aspect of energy research. This section highlights the diversity of some of our ongoing projects.

Institute researcher's work focuses on the interface of energy and the environment in subsurface systems

Dr. Li Li, assistant professor, energy and mineral engineering, focuses her research on understanding the connections between multiple processes in natural, heterogeneous subsurfaces, including soils, sediments, aquifers, and reservoirs. In particular, she examines the simultaneous occurrence of (bio)geochemical reactions, transport, and flow processes with the goal of obtaining a mechanistic understanding of these processes as well as developing models to interpret, quantify, and predict the dynamics of multiphase flow and reactive transport processes in complex subsurface systems.

Li's research is at the interface of energy and environment and she currently has two projects that focus on environmental implications of energy resources important in today's energy climate. One project, on carbon sequestration, looks at how to prevent storage reservoirs from leaking. For the second project Li is studying environmentally friendly and cost-effective technologies for recovering heavy oil.

Geological carbon sequestration involves the long-term storage of carbon dioxide removed from the atmosphere to mitigate the effects of greenhouse gasses. The idea is to inject supercritical carbon dioxide captured from industrial operations into deep subsurface reservoirs to reduce carbon concentration in the atmosphere. One of the major concerns with carbon sequestration is the potential for the carbon dioxide to leak from the storage reservoir and seep into nearby groundwater. One cause of leaks can be chemical reactions that degrade wellbore casings and cement intended to trap the carbon dioxide. If the carbon dioxide reaches subsurface or surface water, it can have large environmental impacts on water quality; this is a specific concern for drinking water resources. Li's research, partially funded by the Department of Energy's National Energy Technology Laboratory (NETL), looks at the possibility and impacts of carbon dioxide leakage. Her group is studying property evolution of wellbore cement in abandoned wells during its interaction with carbon dioxide and brine. These interactions could potentially increase the possibility of carbon dioxide leakage. In addition, they are investigating potential water quality impacts if carbon dioxide does leak.

A second project funded by BP focuses on enhanced oil recovery, specifically using environmental friendly and cost-effective technologies to recover heavy oil. In particular, Li is studying bacteria-mediated biogeochemical reactions to produce chemicals such as biosurfactants, biopolymers, acids, and gases. These chemicals either change the properties of oil and gas or the properties of the reservoir to improve the heavy oil recovery process. For example, Li's group is currently working on using bacteria to produce biopolymers. These biopolymers can be used to selectively plug certain regions of an oil reservoir to change the relative magnitude of permeability. The goal is to increase sweeping efficiency from the original low permeability zones. In this work, Li's group is collaborating with research scientists from Lawrence Berkeley National Laboratory to integrate experimental observations with modeling predictive capabilities.

New CO₂ Molecular Basket Capture Technology could help meet DOE emission targets

The EMS Energy Institute is working on a project in conjunction with Research Triangle Institute (RTI) as part of a Department of Energy (DOE) program focused on lowering the cost of carbon capture technologies for coal-fired power plants.

Coal-fired power plants generate about half of the nation's electricity. Without new technologies aimed at capturing harmful gases from these plants, carbon dioxide levels in the atmosphere will continue to increase, which could have serious consequences for the environment. Carbon dioxide capture technologies, similar to a filter added to a new or existing plant, effectively remove potential greenhouse gasses from the atmosphere by isolating carbon dioxide from other gasses before the gasses leave the plant.

Current technologies designed to capture and compress carbon dioxide emissions from industrial sources require large amounts of energy, which means a power plant's net electricity output could be significantly reduced making widespread use of these technologies cost prohibitive.

By developing new materials, which can take the form of solvents, membranes, or sorbents, DOE's goal is to find a cost-effective, energy-efficient solution so plants can continue to use coal, an important domestic resource, while reducing environmental impacts.

The focus on the project with RTI is to develop an advanced, solid sorbent-based carbon dioxide capture system. The key to this process is a novel technology known as a Molecular Basket Sorbent (MBS), which researchers at the EMS Energy Institute have spent several years developing and improving. The idea of MBS development is to load carbon dioxide-attracting polymers onto high surface area nanoporous materials to increase the number of sorption sites on the sorbent and enhance the sorption/desorption rate.

EMS Energy Institute researchers are working to help develop a commercially viable MBS while reducing associated costs. The project, *Bench-Scale Development of an Advanced Solid Sorbent-based CO₂ Capture Process for Coal-fired Power Plants*, will specifically look to increase the carbon dioxide loading, reduce the cost compared to current MBS forms, promote the thermal, chemical, and cycling stability of the MBS, and make the sorbent fluidizable for use in a fluidized-bed system. Dr. Chunshan Song, Distinguished Professor of Fuel Science and director of the EMS Energy Institute, is the principal investigator on the project.

The carbon dioxide capture process developed through this project will have significant potential to meet DOE's target performance by removing at least 90 percent of carbon dioxide emissions from a plant without increasing the cost electricity produced by more than 35 percent.

Other partners on the project include Masdar, Süd-Chemie, Inc., and Foster Wheeler USA.

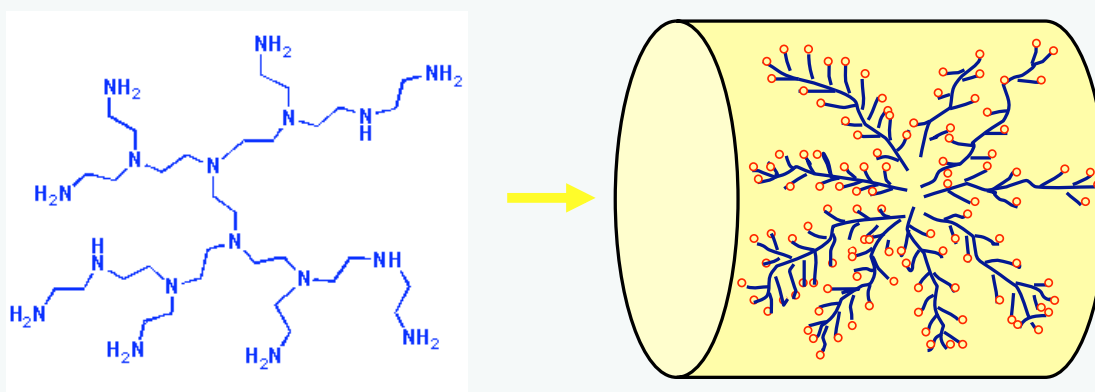
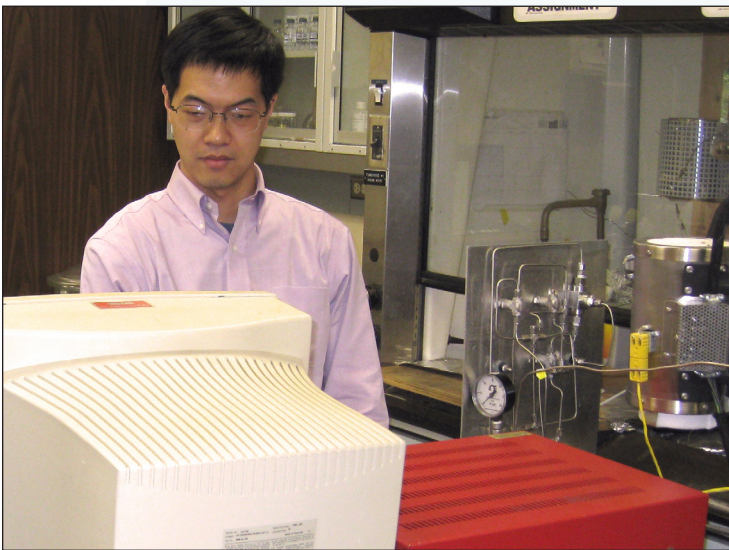


Image shows Molecular Basket Sorbent technology. Branched CO₂-attracting polymers provide a large amount of adsorption sites.

Exploring a new process for biomass-to-liquid fuels

Carbon dioxide emissions are causing concern, fossil fuel reservoirs are decreasing, oil prices are increasing, and alternative energy continues to gain momentum. So it's no surprise the use of biomass for liquid fuel production has received a great deal of attention recently in fundamental and applied research. Biomass is a renewable energy source and can include plant material, vegetation, or agricultural waste. Its benefits include the fact that as an energy source biomass is abundant, readily available, and almost carbon neutral. Dr. Xiaoxing Wang, research associate, EMS Energy Institute, is the principle investigator on two projects, one supported by the Department of Energy and the other supported by the Department of Defense, that explore a novel process for converting renewable biomass including woody and herbaceous materials to liquid hydrocarbon fuels such as gasoline and jet fuels. Dr. Wang's work focuses on converting biomass-derived light olefins to liquid fuels, which is one of the key steps in the proposed process for liquid fuel production from biomass.



The main objective in the conversion of light olefins to liquid fuels is to explore the feasibility of using the proposed new process and to develop a new type of catalyst for the production of liquid hydrocarbon fuels from light olefins derived from biomass at relatively mild reaction conditions. Since light olefins derived from biomass may contain some amount of carbon dioxide, carbon monoxide, and other impurities, a highly active and carbon-resistant catalyst will be necessary. In this research, novel metal loaded hierarchical meso-microporous zeolite catalysts are proposed and under development. Unlike the conventional zeolite-based catalysts, which are ineffective for processing large molecules that cannot diffuse inside the micropores, the designed meso-zeolite catalysts consist of a network of connected mesopores (2-50 nm, IUPAC) and micropores (< 2 nm, IUPAC) for olefin reaction and large molecules diffusion, thus the activity and selectivity can be improved and the coke formation will be mitigated. As part of the research effort, the research team is also seeking to make the conversion process more energy efficient, economical, and environmentally friendly.

EMS ENERGY INSTITUTE RESEARCH PROGRAMS

Descriptions of these programs and contact information for key researchers can be found at www.energy.psu.edu.

Carbon Materials Program

Program Director: Semih Eser

Coal Science & Technology Program

Program Co-directors: Jonathan Mathews and Sarma Pisupati

Clean Fuels & Catalysis Program

Program Director: Chunshan Song

Energy Economics Program

Program Director: Andrew Kleit

Electrochemical Technologies Program

Program Director: Serguei Lvov

Nanomaterials Program

Program Co-directors: Randy Vander Wal and Angela Lueking

Petroleum & Natural Gas Program

Program Director: Zuleima Karpyn

Stationary Power Program

Program Director: Bruce G. Miller

Sustainable Energy Program

Program Director: Joel Morrison

Transportation Program

Program Director: André Boehman

Oil from Sand

A new process to extract hydrocarbons, such as oil and bitumen, from sand and other mineral matter could make some energy resources cleaner.

Canada is now the largest supplier of oil to the United States, the size of its reserves second only to Saudi Arabia. About half of that oil is derived from Canadian tar sands, referred to as “the world’s dirtiest oil” because of the significant environmental impact associated with extracting and upgrading the bitumen.

There are estimated to be about 32 billion barrels of oil in tar sands in the western United States, mainly in Utah. However, because they are located in a desert region, a technology that does not need large quantities of water and does not produce wastewater is needed in order to extract the oil.

Hydraulic fracturing and other new technologies have opened the door to vast untapped gas and oil reserves in formations such as the Marcellus and Bakken shale. In drilling the wells to access these reservoirs, 300-1,200 tons of sand, shale, or other minerals mixed with oil are brought to the surface and dumped in landfills.

Background Image: Image of Alberta oil sands magnified 10x.

Developing a cleaner process

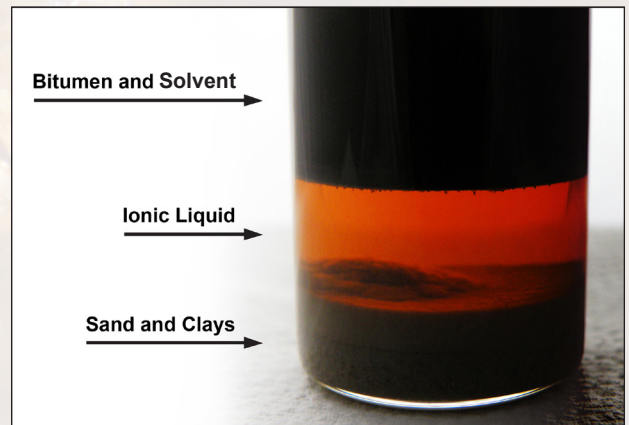
The separation and extraction of oil and bitumen from soil, sand, or other forms of mineral matter, are difficult processes and current technologies are much more energy and resource intensive than those for conventional oil wells. In addition, the disposal of waste products poses further problems. For example, the separation of bitumen from tar or oil sands requires large amounts of water that then becomes toxic to aquatic life, a major environmental and cost problem.

A team of researchers at Penn State, led by Dr. Paul Painter, professor of polymer science and engineering, has developed a novel method for separating hydrocarbons from mineral matter through the use of ionic liquids (ILs). ILs are similar to common table salt except they are liquids below 100°C (by comparison table salt, NaCl, melts at about 800°C). They have powerful solvent properties, outstanding chemical and thermal stability, a very low degree of flammability, and almost negligible vapor pressure.

Extracting hydrocarbons using ILs is simple and relatively inexpensive. The bitumen, solvent, and sand/clay mixture are separated into three distinct layers and each is easily recoverable. The separation process occurs at room temperature and requires very little water. As a result, minimal amounts of energy are used and the need to import large quantities of water for processing oil or tar sands is essentially eliminated.

Painter and his team, comprised of personnel from the EMS Energy Institute, including Bruce Miller, senior scientist; Aron Lupinsky, research assistant; Dr. Maria Sobkowiak, research associate; and Andrea Choperna, research assistant, are conducting laboratory- and demonstration-scale work. The team constructed a demonstration unit consisting of a 200-gallon mixing tank, two polyethylene tanks for gravity separation of coarse sand from liquids, and a coalescing unit to separate oil or diluted bitumen from the ILs. The ILs are then recirculated to the main tank for further separation. Researchers are now installing a centrifuge to accelerate and improve the oil/IL separation.

With this new method, researchers have completely recovered bitumen, even from low-grade tar sands, and crude oil from a sand/oil mixture. The resulting hydrocarbon is free of particle fines and shows no contamination from the ILs. Residual sands and clays



Top: Layers after separation process using ILs.

Middle and Bottom: Aron Lupinsky, research assistant, EMS Energy Institute, works with the demonstration unit.

are also very clean and can be returned to beaches, used in the remediation of environmental scars from mining, or processed into a value-added product.

Residual IL is removed from the sand using a water rinse. The water and ILs are separated with vacuum distillation and both are recycled. The toxic wastewater, currently stored in vast tailing ponds, becomes nonexistent and recycling the ILs yields significant savings, as much as 50 percent when compared to current technologies.

Reducing the impact of energy resources

One area where ILs can make a considerable impact is in the mining of oil sands where bitumen is either dug from open pit mines or, if too deep to be strip-mined, obtained using *in-situ* extraction methods, such as steam-assisted gravity drainage (SAGD). The bitumen is often contaminated with minerals, mainly clays, and these oil-contaminated waste solids are ultimately sent to landfills.

The United States was importing over 2 million barrels per day of crude oil from Canada in January 2011, according to the U.S. Energy Information Administration, and nearly all of that oil was produced by upgrading bitumen extracted from oil or tar sands. In addition, there are estimated to be about 32 billion barrels of oil in tar sands in the western United States, mainly in the desert region of Utah where there are no commercial scale operations.

Already, the research team has successfully separated oil from minerals in oily wastes from SAGD operations and materials from Canadian tailing ponds, resulting in increased oil recovery and the elimination of toxic tailing ponds, significantly lessening the impact of what is currently called “the World’s dirtiest oil.” Since ILs require very little water, they also make extracting oil in the Utah desert regions feasible.

In addition, ILs could improve the process for recovering heavy oil, which is found in about thirty countries, with the largest deposit in Venezuela. Instead of expensive thermal extraction methods such as steam injection, a new technique called cold heavy oil production with sand (CHOPS) can significantly increase well productivity. However, CHOPS involves the continuous production of sand along with oil, presenting separation and disposal problems. The research team has successfully recovered heavy oil from deposits within the United States.

ILs could also play an important role in reducing waste from natural gas drilling operations. While hydraulic fracturing in formations such as the Marcellus and Bakken shale has allowed the recent exploitation of previously inaccessible gas and oil reserves, tremendous amounts of waste drill cuttings, the sand, shale, or other minerals brought to the surface during drilling, must now be shipped to landfills. A typical horizontal Marcellus shale well produces 300-1200 tons of cuttings. Each drilling site or pad can contain eight to twelve wells. In addition to the expense, up to \$150 per ton, to dispose of these cuttings, they also contain large amounts of oil, which creates compaction problems for landfills.

ILs can be used to separate oil from contaminated cuttings. The recovered oil, which can be as much as 20 percent of the weight of the drill cuttings, can be recycled to drilling muds or used as a fuel, while the cleaned sand and soil can be used for land reclamation, soil amendments, easily compacted landfill cover, or as a starting material in making a value-added product, proppants (a material sent down with the fracking fluid to prop open cracks in the rock).

For more information contact Dr. Painter, painter@ems.psu.edu, or Mr. Miller, bgm3@psu.edu.

Other applications under investigation

Cleaning beach sand from the
Deepwater Horizon oil spill

Separating and recycling oil from roof
shingles, saving materials from landfills

Recovering oil from oil sands in Africa

Recovering oil from the desert in Kuwait,
where millions of barrels were spilled
during the first Gulf War

Recovering oil from sludge removed from
supertankers after an oil delivery

Recovering oil from refinery waste streams

Joint Center for Energy Research Workshop Held in Dalian, China

On March 21-23 Penn State and Dalian University of Technology held the third workshop for the Joint Center for Energy Research (JCER). The workshop was held in Dalian, China and was attended by over eighty faculty, students, and administrators from both universities.

The workshop consisted of presentations of current research endeavors by various faculty members as well as discussions around further collaborations. The group also toured Dalian University of Technology research laboratories.

Participants from Penn State included President Rodney Erickson; Vice Provost Dr. Michael Adewumi; Dr. Tom Richard, director, Penn State Institutes of Energy and the Environment; Dr. Chunshan Song, co-director, JCER and director, EMS Energy Institute; Dr. Yaw Yeboah, department head, Energy and Mineral Engineering; Dr. Bruce Logan, director, Engineering Energy and Environmental Institute; Dr. Michael Janik, associate professor, Chemical Engineering; Dr. Sarma Pisupati, associate professor, Energy and Mineral Engineering; Dr. Yongsheng Chen, assistant professor, Energy and Mineral Engineering; Dr. Zhen Lei, assistant professor, Energy and Mineral Engineering; and Dr. Jonathan Mathews, assistant professor, Energy and Mineral Engineering.



Top (from left to right): Penn State President Rodney Erickson, Dalian University of Technology President Jinping Ou, and Chunshan Song, co-director of JCER.
Bottom: Attendees at the JCER workshop.

Welcome

New Faculty & Staff

The EMS Energy Institute welcomes the following new members who have joined the Institute in the last year. Detailed profiles can be found at www.energy.psu.edu.



Danielle Harter
Staff Assistant
EMS Energy Institute

Danielle Harter is the assistant to the director of the EMS Energy Institute. She schedules meetings, meeting rooms, conference calls, and catering. She also handles travel arrangements and reimbursements for the director as well as other faculty and students. In addition, Harter processes research supply and equipment orders, makes fleet vehicle reservations, distributes visitor parking permits, and orders office supplies. She is in charge of all gas cylinder ordering.



Anastasia Shcherbakova
Assistant Professor
Energy Economics, Risk, and Policy

Dr. Anastasia Shcherbakova is an assistant professor in the John and Willie Leone Family Department of Energy and Mineral Engineering and she is a new affiliate in the EMS Energy Institute's Energy Economics Program. Dr. Shcherbakova earned her Ph.D. in public policy at the University of Chicago, where her doctoral dissertation explored financial outcomes of energy sector regulation in high risk nations. Dr. Shcherbakova specializes in energy economics, regulation of oil, gas, and electricity markets, and firm and financial market risk.



Hui-mei Yu
Visiting Scholar
EMS Energy Institute

Dr. Hui-Mei Yu is an associate professor at the Shanghai Institute of Ceramics, Chinese Academy of Sciences (SICCAS). She is currently a visiting scholar at the EMS Energy Institute. Dr. Yu's research focuses on the application of thermal analysis-mass spectrometry coupling techniques for characterization of materials, such as coals, nanocarbons, high temperature carbon dioxide sorbents, and TiO₂/InN. Her specific research interests include the characterization of advanced inorganic materials by thermal analysis combined with mass spectrometry techniques, phase transition behavior of ceramics and thermal analysis kinetics studies, and carbon dioxide capture and separation. Dr. Yu has two patents and has published more than twenty journal articles.

Recent Graduates Reflect on the Institute, Well Prepared for Future

Mark LaBarbera gained real-world experience working directly with industry



“Research at the EMS Energy Institute is exciting and engaging for any future engineer or scientist eager for hands-on experience with real-world fuel processing and analysis techniques.”

Mark LaBarbera ('12 EME), first learned about the EMS Energy Institute as an undergraduate. He was introduced to Bruce Miller, associate director, EMS Energy Institute, during his junior year at Penn State and was offered a summer position assisting Ronald Wasco, research assistant, EMS Energy Institute, with the preparation and analysis of fuels.

“The experience I gained as an undergraduate researcher for the EMS Energy Institute has been invaluable to my skill set as an engineer,” LaBarbera said.

He quickly proved his ability in the lab and was an integral part of several projects to analyze potential fuels sources such as coal-water slurries (a waste product of coal powder, water, and chemical stabilizes) and corn stover (the remnants of a corn plant after the ear is removed).

Possibly the project in which he was most involved was for a combined electricity and steam generation facility in western Pennsylvania. LaBarbera, alongside Wasco and Bradley Maben, research technologist, EMS Energy Institute, designed, installed, and began the initial operation of a coal-water slurry mercury capture system to reduce the power plant’s environmental impact. The team collaborated with the plant’s engineers throughout the entire process and, after completing the design, traveled to the facility for a week of on-site installation directly working on the burners. The team began the operation of the mercury capture system to ensure everything ran smoothly before transferring control back to the power plant engineers.

“Mark is a very hands-on engineer, eager to learn, and willing to take on new challenges. He was an excellent undergraduate student researcher, which carried over to his graduate study. I was most impressed with his independence in helping me formulate a coal-water slurry (CWS) for a major Canadian coal mining company,” Miller said.

LaBarbera came to Penn State from New Jersey. He initially attended Penn State Hazleton, transferring to University Park after his third semester. He studied chemical engineering with a fuel and energy engineering option, and interned at NOVA Chemicals outside of Pittsburgh, manufacturing polymers, his junior year. After completing his undergraduate degree, he decided to stay at Penn State and immediately began a graduate program. He was offered position with Dr. Serguei Lvov, professor of energy and mineral engineering, to continue a solid oxide fuel cell (SOFC) research project.

For his graduate work, LaBarbera designed, assembled, operated, and analyzed solid oxide fuel cells operating on a variety of alternative fuels. Initially, he used traditional analysis techniques, but with U.S. Department of Energy support, he was able to carry out state of the art impedance spectroscopy analysis of the fuel cells.

The results of the SOFC project opened the door for collaboration with another research group at the EMS Energy Institute, the fuel reformation research team, led by Dr.

Chunshan Song, Distinguished Professor of fuel science. Working together, the groups integrated a fuel reformer directly with a SOFC to analyze the performance of diesel reformat and anaerobic digester gas as fuels for SOFCs.

Finally, this work allowed researchers to study a novel anode designed to directly use solid hydrocarbon fuels (coal and biomass) in SOFCs. This technology, while in its early stages, could significantly increase the efficiency and substantially reduce the carbon footprint of electrical power generation.

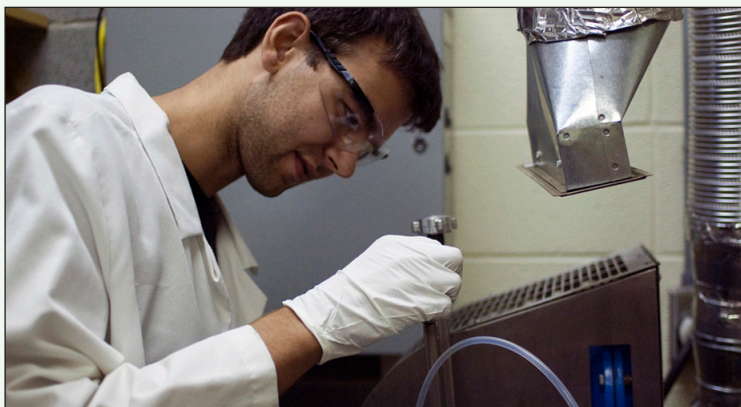
LaBarbera noted that his graduate and undergraduate research experiences were highly relevant to their respective industries, something that will prove valuable as he begins his job hunt for a position as a SOFC scientist/engineer in industry research and development.

“Research at the EMS Energy Institute is exciting and engaging for any future engineer or scientist eager for hands-on experience with real-world fuel processing and



analysis techniques,” LaBarbera said. He added that at the Institute he was personally responsible for and involved in every aspect of the project from initial proposal writing and planning to experimental analysis and reporting results directly to industrial partners.

Gregory Lilik took advantage of the many opportunities available through the EMS Energy Institute



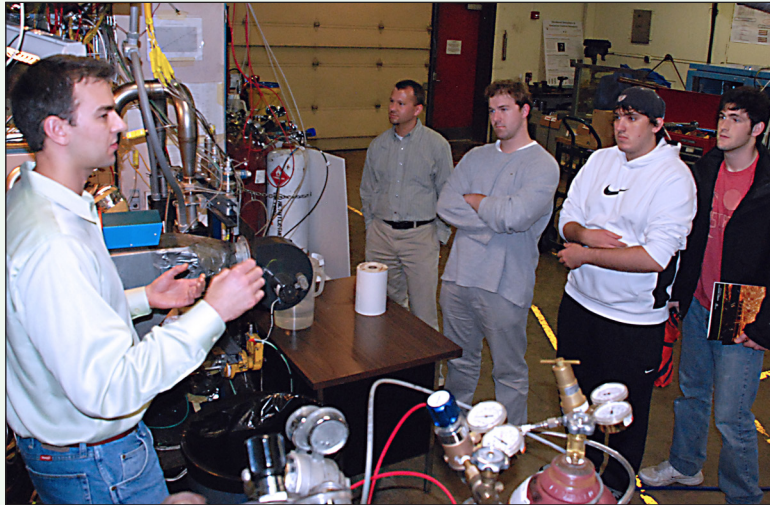
Gregory Lilik ('12 EME) came to Penn State as a graduate student in energy and geo-environmental engineering and began working with Dr. André Boehman, professor of fuel science, as a graduate research assistant in the diesel combustion and emissions lab at the EMS Energy Institute. After receiving his bachelor's degree in mechanical engineering from Widener University in Chester, Pennsylvania in 2005, he knew he wanted to focus his education and career on energy-related problems.

“The Energy Institute's multi-disciplinary approach to research and solving real world engineering problems made Penn State stand out among the other universities I interviewed,” Lilik said.

Lilik's master's work focused on hydrogen-assisted diesel combustion and resulted in several publications, including journal articles in *Energy and Fuels*, and the *International Journal of Hydrogen Energy* as well as a co-authored book chapter in *Synthesis Gas Combustion: Fundamentals and Applications*. In addition, his research experience was central to the Penn State hybrid electric vehicle team's fifth place win in the 2007 Challenge X competition. His team implemented hydrogen assistance to a diesel hybrid Chevy Equinox as part of the U.S. Department of Energy- and corporate-sponsored competition in which

student teams from seventeen universities compete to re-engineer a Chevrolet Equinox into a vehicle that is more fuel efficient and cleaner running while maintaining the vehicle's original utility.

After completing his master's degree, Lilik had the opportunity to work at the Oak Ridge National Laboratory in Tennessee as a post-master's researcher. While there, he maintained and conducted experiments on an engine test stand, but equally as important, he had the opportunity to work alongside and network with experts in fuel science while conducting his research.



“The Energy Institute’s multi-disciplinary approach to research and solving real world engineering problems made Penn State stand out among the other universities I interviewed.”

Lilik returned to Penn State to complete a doctorate degree in energy and mineral engineering with a fuel science option. After several years working as a research assistant in the combustion lab, he became an expert on the experimental setup of instrumentation and data acquisition systems so he began to take an active role in assisting other students at the Institute. Lilik explained that he was motivated to cooperate with his peers by offering his technical skills and any knowledge he gained from previous experiences. However, he added that he also continues to learn from the experiences of his peers and the faculty with whom he works.

Lilik’s doctoral research focused on fuel chemistry effects on advanced diesel combustion, specifically examining advanced combustion diesel operation using coal-based Fisher-Tropsch fuel. His research led to a method for reducing all major emissions while increasing combustion efficiency in a diesel engine, a development that produced a patent disclosure between Penn State and Conoco Phillips with Lilik as the lead inventor.

In 2011 Lilik and his advisor, Boehman, attended the Volvo Group Tech Show in Gothenburg, Sweden. The show gave Lilik the opportunity to network with industry professionals and help expand the relationship between Penn State and Volvo by discussing ongoing research with Volvo scientists.

“Greg Lilik has been a tremendous asset to the EMS Energy Institute through his scholarship, his work ethic,

and his willingness to help others in their research. His thesis is a significant and valuable contribution to the literature and generated an invention disclosure. We will be sorry to see Greg leave the EMS Energy Institute, but we are delighted that he is heading to a prestigious post-doctoral research position in the combustion research facility at Sandia National Laboratory, Livermore,” Boehman said.

In the summer of 2011, Lilik was accepted, along with four other students, to the Sandia National Laboratory’s summer institute in Livermore, California. The institute focused on combustion and while there Lilik worked with Sandia researcher Dr. Mark Musculus to examine measurement uncertainty with imaging detectors. Later that year he was invited to return to Sandia, and in early 2012 he presented a seminar based on his research to some of the world’s experts in combustion. Afterward, he was offered a post-doctoral appointment under Dr. Charles J. Mueller. Lilik will begin his appointment at Sandia National Laboratory in summer 2012.

“Research at the Energy Institute was a very fulfilling experience, mainly due to the opportunities that were available. The faculty and staff facilitate research and provide graduate students with many opportunities to publish and achieve. In particular, my advisor Dr. André Boehman has been an outstanding mentor, who saw my potential and guided me to reach it,” Lilik said.

Transportation research authority at the Institute heading to Michigan



After eighteen years with Penn State, Dr. André Boehman, professor in the John and Leone Family Department of Energy and Mineral Engineering and leading researcher in engines and fuel science, has accepted a position as a professor of mechanical engineering at the University of Michigan.

Although he'll be leaving the university in July, Boehman plans to continue to collaborate with Penn State on future projects.

Dr. Chunshan Song, director of the EMS Energy Institute, spoke highly of Boehman. "We will miss him at Penn State but we wish him all the best in his continued success at University of Michigan, and look forward to continuing our interaction and collaboration."

As director of the transportation program and manager of the diesel combustion and emissions laboratory (DCEL) at the EMS Energy Institute, Boehman's research revolves around alternative and reformulated fuels, and combustion and pollution control. Specifically his focus has been on alternative diesel fuels, diesel combustion, and diesel exhaust aftertreatment. Boehman was integral in setting up the DCEL, which is devoted to studies of fuel chemistry, combustion, and pollution control for diesel engines, and more generally for compression ignition combustion processes. Typically there are more than a dozen students, graduates, undergraduates, and lab assistants, involved in research at the DCEL.

Boehman has made many notable contributions with his work at Penn State, including his work with dimethyl ether (DME), a derivative of natural gas. Boehman is actively involved in the International DME Association and worked on engineering fuel systems with Volvo Trucks and Volvo Powertrain. In addition, he's currently working with Glenn O. Hawbaker, Inc. in a techno-economic evaluation of the use of natural gas in a "dual fuel" combustion process, which involves feeding both natural gas and diesel fuel simultaneously to the engine. In October 2002, he led a successful project with Air Products and Chemicals, Inc. and support from the U.S. Department of Energy National Energy Technology Laboratory to convert a Penn State shuttle bus to operate on a blend of DME and diesel fuel. This was the first vehicle in the world to use a DME-diesel blend and the first transit vehicle to carry passengers operating in whole or in part on DME.

Professor and Associate Dean Scaroni retires after thirty years with Penn State



Dr. Alan Scaroni, professor emeritus, energy and mineral engineering in the John and Willie Leone Family Department of Energy and Mineral Engineering, retired in February of this year after thirty years of service at Penn State. Most recently, Scaroni served as the associate dean for

graduate education and research in the College of Earth and Mineral Sciences, where he oversaw graduate activities for five academic departments and three research institutes.

Prior to his position as associate dean, Scaroni served as the department head for the Department of Energy and Geo-Environmental Engineering, now the Department of Energy and Mineral Engineering in the College of Earth and Mineral Sciences, from 1998 through 2003. The two years before, he was chair of the fuel science program in the College of Earth and Mineral Sciences. At that time, fuel science was one of four programs in the Department of Materials Science and Engineering.

In 1992 Scaroni became director of the Energy and Fuels Research Center, which was the base for the EMS Energy Institute – formally established in 1996. He led the Institute through June 1998 at which time he was appointed head of the new Department of Energy and Geo-environmental Engineering from the merger of the fuel science program with the Department of Mineral Engineering. He returned as interim director of EMS Energy Institute for one year, from June 2006 to May 2007. Under Scaroni's direction, the Institute supported over 130 faculty, staff, and students. It grew to encompass five distinctive research units: the carbon research center, the coal and organic petrology laboratories, the coal utilization center, the combustion laboratory, and the laboratory for hydrocarbon process chemistry, as well as an annual budget of \$4 million.

"Dr. Scaroni has made major contributions to the EMS Energy Institute, the Department of Energy and Mineral Engineering, the College of Earth and Mineral Sciences and Penn State as a whole," said Dr. Chunshan Song, current Director of the EMS Energy Institute and Distinguished Professor of Fuel Science and Chemical Engineering. "We will continue to benefit from his advice and we wish Dr. Scaroni all the best in his life after retirement from Penn State."

Read more at www.energy.psu.edu/news

Funding a Sustainable Future for PA

One of Pennsylvania's major champions of sustainable energy is managed from a small corner office on the east side of Penn State's Campus.

The West Penn Power Sustainable Energy Fund (WPPSEF), valued around \$22 million, has been steadily working to change the attitude toward energy and energy utilization in the twenty-three-county service area of West Penn Power.

The goal of the fund is to preserve and grow its initial monies in order to invest in sustainable energy projects around the Commonwealth. So far the WPPSEF has provided over 100 grants and funded more than 30 loans. Funding has been used to support the deployment of Pennsylvania's growing wind and solar energy infrastructure, to stimulate biomass projects in the state, to develop and support a broad array of energy efficiency programs, and to sponsor energy-related events. Joel Morrison, research associate at the EMS Energy Institute, has served as WPPSEF director since its inception in October 2000. The EMS Energy Institute is responsible for overall management of the Fund and works closely with the Economic Growth Connection (EGC) of Westmoreland, which serves as the Fund's corporate office. Together, the EMS Energy Institute, EGC, and the WPPSEF board of directors have grown the Fund and its activities during the last 12 years from \$11.4 million to over \$22 million. The Fund works very closely with West Penn Power to support utility programs.

Changing face of energy in PA

In 2000 there was only one operational wind farm in Pennsylvania, the Green Mountain Wind Farm in Garrett, PA. Now, just 12 years later, there are more than ten and, according to the American Wind Energy Association, they provide enough energy to power 180,000 homes. In addition, the use of solar energy is on the rise as photovoltaic systems are used in residential, commercial, and industrial applications. The WPPSEF has had a hand in many projects throughout the state that have contributed to the significant emergence of these and other renewable energy technologies over the last ten years.

One of several projects in which the WPPSEF was able to support the use of solar power, was the acquisition and installation of a photovoltaic system as part of the 2011 capital project to expand and renovate the Sis and Herman Dupre Science Pavilion at St. Vincent College in Latrobe, PA. The photovoltaic system, which is part of the 110,000 square foot LEED Gold-certified facility, reduces the building's carbon footprint as well as serves

as an educational tool to promote the use of clean energy technologies and to increase public awareness of the viability of alternate energy sources.

Bioenergy is yet another renewable energy source the WPPSEF has helped promote and fund. Biomass is an underutilized renewable energy source in Pennsylvania and the WPPSEF recognized a strategic initiative that can benefit Pennsylvania in a sustainable, environmentally responsible way. In early 2012 it provided an educational grant to help establish an industry-driven, non-profit association to advance the environmentally responsible use of biomass for clean heat, and combined heat and power applications.

The WPPSEF provided momentum for energy efficiency programs in Pennsylvania when, in 2007, it began to lay the foundation for a residential energy efficiency program designed to attract and establish the U.S. Environmental Protection Agency's (EPA) Home Performance with ENERGY STAR and ENERGY STAR qualified home programs in Pennsylvania. The WPPSEF became the state sponsor for the EPA's Home Performance program and won the EPA's 2009 and 2010 Special Recognition Awards for Excellence in Energy Efficiency. Home Performance built on one of the WPPSEF's existing energy efficiency financing programs – Keystone Home Energy Loan Program (Keystone HELP). In partnership with AFC Financing in Allentown, PA, the WPPSEF deployed Keystone HELP statewide and it became an immediate success when the PA Department of Treasury invested \$20 million of base funding. "The WPPSEF took a leadership role in developing a series of residential energy efficiency programs that are now highly leveraged by Pennsylvania electric utilities as part of their ACT 129 programs," Morrison said. "The WPPSEF is delighted to see its programs transition into the private sector and to flourish in a sustainable manner with private capital."

The WPPSEF has also worked to identify and support the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Level II energy audits. It is currently supporting an energy audit at the Kiski School campus in Saltsburg, PA and is working with Greensburg-based Excelsa Health to reduce the health system's energy use within its three hospitals, Frick Hospital, Latrobe Hospital, and Westmoreland Hospital. The WPPSEF is providing a grant to support Excelsa Health's energy reduction program and overall goal of reducing energy and water costs at these facilities by 10 percent. Savings would equate to an annual reduction of 1,600 metric tons of carbon dioxide from electric use,

508 metric tons of carbon dioxide from natural gas consumption, and 5.6 million gallons of water.

Currently, the WPPSEF is partnering with the Phipps Conservatory in Pittsburgh, PA to support the construction of the Conservatory's Center for Sustainable Landscapes. Morrison indicated that the center will meet the Living Building Challenge, a challenge issued by the Cascadia chapter of the U.S. Green Building Council, and exceed LEED Platinum certification requirements. The center will be a net zero energy high performance building while also being net zero in water consumption.

Energy Education and the Penn State connection

In addition to funding energy generation and efficiency projects, the WPPSEF also plays an important role in energy education at Penn State and throughout Pennsylvania. WPPSEF has worked closely with Penn State Public Broadcasting to produce two educational public broadcasts. *ENERGY@home* shows homeowners how to reduce energy use and save money, and *PA Energy* showcases Pennsylvania's emerging sustainable energy technologies. Both public broadcasts are available on a DVD format. In 2004 and 2006, WPPSEF worked with the EMS Energy Institute and the Bryce Jordan Center to plan and host a statewide sustainable energy expo. The Clean Energy Expos drew over 25,000 attendees.

Support for driving innovation in solar PV design and building integration has been an area of interest for both WPPSEF and Penn State. The WPPSEF provided a \$25,000 grant to Penn States' 2007 and 2009 solar home entries in the U.S. Solar Decathlon competition. The Solar Decathlon, a U.S. Department of Energy event, is a student competition to design, build, and operate the most attractive, effective, and energy-efficient solar-powered house. The students in the competition gain valuable education on the benefits of energy efficiency, renewable energy, and green building technologies.

In 2010, WPPSEF expanded its efforts to support energy efficiency by launching an industrial-scale energy efficiency program. WPPSEF provided a grant to Penn State's Pennsylvania Technical Assistance Program (PennTAP) to assist World Kitchen's Pyrex manufacturing plant to develop an energy savings program that conformed to the U.S. Department of Energy's Save Energy Now program. With the assistance of the WPPSEF, World Kitchen has begun to implement energy assessment recommendations such as upgrading the plant's compressed air system, which will save the plant over 4,500,000 kWh a year.

How electricity restructuring led to sustainable programs

The vision for WPPSEF was born out of the Electricity Generation Customer Choice and Competition Act, which Pennsylvania enacted in 1996 to restructure the electric industry. At that time, five Pennsylvania electric utilities established sustainable energy programs within their regions to promote renewable energy. On November 19, 1998, the PUC granted final approval to the West Penn restructuring plan, which included the provision to establish the WPPSEF to promote the adoption of clean energy technologies throughout its service region. In October 2000, the WPPSEF board of directors selected the EMS Energy Institute as the fund administrator. The WPPSEF is one of the five sustainable energy funds in operation today.



The Mill Run wind farm in Springfield Township.



Attendees and exhibitors at a Clean Energy Expos. GE brought the wind turbine seen in the background all the way from Texas for the event.



The Phipps Conservatory's Center for Sustainable Landscapes is under construction and expected to be completed this summer.

Exploring Unconventional Gas and Oil Resources

The nation's energy demands continue to rise each year and while oil and natural gas comprise over 60 percent of our energy portfolio, conventional resource deposits are becoming scarcer.

According to the Department of Energy's National Energy Technology Laboratory (NETL) our nation's demand for natural gas alone is expected to grow as much as 50 percent by 2025. In order to sustain that growth while reducing our reliance on imports, unconventional gas and oil resources are beginning to play a significant role in securing our energy future.

Unconventional resources typically span large areas of poorly understood geologic formations such as ultra-deep reservoirs, low-permeability formations, and environmentally sensitive areas. Currently the most substantial volume of unconventional natural resources can be found in the form of coal-bed methane, tight sands, gas shales, and oil shales.

Coal-bed methane is a form of natural gas found in coal seams, which can retain six times more gas than an equivalent volume of rock in a conventional formation. Tight sands are sandstone formations that are 'tight' or have very low permeability. Shale gas refers to natural gas trapped in shale layers of sedimentary rock formations. Oil shales are also recognized as a significant unconventional source of oil with major deposits in the United States and worldwide. Again, these unconventional formations have much lower permeability than the rocks that make up conventional reservoirs.

New technologies, improved petrophysical knowledge, and increased commodity prices make it more possible than ever to tap into these oil and gas reserves. However, sustainable recovery within unconventional formations depends on technological developments and a focused research effort.

In order to better explore issues with unconventional gas recovery, petroleum and

natural gas faculty at Penn State recently launched a research consortium dedicated to providing the framework for a collaborative research effort in this area. The Unconventional Natural Resources Consortium (UNRC) is housed in the EMS Energy Institute and co-directed by Dr. Luis F. Ayala H., associate professor, petroleum and natural gas engineering, and Dr. Russell T. Johns, professor, petroleum and natural gas engineering.

Begun in 2011, the UNRC is a research effort between industry and academia with the goal of providing support for cutting-edge research in the area of unconventional gas resource exploration and development. In addition, the consortium will provide invaluable experience for graduate students specializing in the area of petroleum and natural gas engineering. Students will have an opportunity to interact with industry representatives on research and the UNRC will help guarantee a well-trained future workforce for the hydrocarbon industry.

Penn State has identified natural gas engineering and unconventional gas research as a core endeavor and the importance of this research is apparent when we consider the vast amount of resources locked in these complex formations. For example, taking into account only the Marcellus and Utica shale formations, estimated recoverable gas reserves in Pennsylvania and the Appalachian Basin are some of the largest in the world.

The UNRC research projects will focus on the reservoir engineering areas of unconventional natural gas exploration and production technology, with an emphasis on shale gas, tight gas, and shale oil formations as well as closely related areas. In order to ensure the research remains highly relevant to industry, members are encouraged to provide research topics and data. The consortium will also provide practical analytical models and software for members to analyze unconventional plays.

For more information on UNRC visit www.energy.psu.edu/unrc.

Institute Organizing Two International Conferences in 2013

The EMS Energy Institute will play host to two large International conferences next year. The conferences are held biennially in various locations throughout the world. The Institute is excited to be the hosting organization as these conferences represent some of the most important events in their respective research areas.

International Conference on Carbon Dioxide Utilization

The twelfth International Conference on Carbon Dioxide Utilization (ICCDU), will be held from June 23-27, 2013, in Alexandria, VA. Dr. Chunshan Song, director of the EMS Energy Institute and Distinguished Professor of Fuel Science, is the conference chair and is responsible for all of the conference details along with an organizing committee and a local arrangement committee.

ICCDU, which began in 1991 in Nagoya, Japan, provides a multi-disciplinary forum on recent innovations in fundamental and applied aspects of carbon dioxide utilization. In 2013, the focus will be on carbon dioxide conversion and utilization for chemicals, fuels, and materials for sustainable development. The goal of the conference is to facilitate the advances in carbon dioxide research and bring together the academic and industrial communities for the exchange of ideas, concepts, and innovations. For more information on ICCDU, visit www.energy.psu.edu/ICCDU.

International Conference on Coal Science and Technology

Dr. Jonathan Mathews, assistant professor of energy and mineral engineering, and program director for the Institute's coal science and technology program, is chairing the 2013 International Conference on Coal Science and Technology (ICCS&T). The conference will be held September 29 through October 3, 2013, at the Penn Stater Hotel and Conference Center near the Penn State University Park Campus.

Next year marks the first time this conference will be held in Pennsylvania, which boasts a rich history in coal. More information on the conference will be available in the beginning of the year at www.iccst.info.



Chemicals • Fuels • Materials

International Conference
on Carbon Dioxide Utilization

June 23 - 27, 2013

Alexandria, VA

www.energy.psu.edu/ICCDU

The abstract deadline is December 15, 2012. Look for early registration and abstract submissions to open in November 2012. Sponsorship and exhibitor information will be available at that time as well.

Institute Researchers Part of Partnership to Improve Science Comprehension in Middle Schools

How do you explain to a middle school student the process of generating electricity from coal in a way that allows them to really understand the process and apply it to other energy systems?

A relatively new partnership at Penn State, Earth & Space Science Partnership (ESSP), is working on answering similar questions related to a variety of earth science topics and providing professional development opportunities for teachers from underserved school districts throughout Pennsylvania. The partnership, which is funded by a grant from the National Science Foundation, is exploring ways to engage students to deepen their understanding of science curriculum. Faculty and graduate students from the College of Education are partnering with members of the College of Earth and Mineral Sciences and the Eberly College of Science to develop workshops on energy, plate tectonics, and astronomy for summer 2012.

Two researchers from the EMS Energy Institute are part of the energy workshop team. Dr. Meredith Hill Bembenic, a postdoctoral scholar, and Dr. Caroline Burgess Clifford, senior research associate, are working to determine important energy topics and activities to represent those concepts. Stephanie Preston, a postdoctoral scholar, and Alice Flarend, a doctoral student, from the College of Education are helping to develop strategies to incorporate the science content in a middle school curriculum.

The workshop is geared towards helping science teachers in grades five through nine better incorporate energy-related science content into their classrooms. The goal is to help teachers understand what concepts are important to introduce to students and to guide the teachers through

strategies that will allow students to get the most out of their classes. The workshop also aims to emphasize energy literacy so teachers can further prepare their students to be scientifically informed about energy issues.

This workshop is based on the premise that students learn better in small groups and when they are actively participating in the learning process.

“It’s more oriented to students teaching each other,” Burgess Clifford said. Student’s need to interpret and discuss ideas, right or wrong, and make their own way to an answer in order to truly understand a concept. Researchers will work with teachers so they understand how to not only allow, but also facilitate this exploration rather than providing all the answers – intervening only when a student wanders too far off track.

“It is very challenging because we are thinking about [teaching] in a different way. We have to engage students differently,” Hill Bembenic said.

The ESSP workshops, which will be led by the same development group, will combine theoretical and practical understanding of scientific principles with hands-on activities that can be used in the classroom to illustrate scientific concepts. Workshop leaders will discuss appropriate levels of scientific understanding teachers can expect from students as well as ways to analyze student work for understanding.

For example, in the energy workshop, one activity might include the use a model of a steam plant to show the process of turning chemical energy into heat in order to turn a turbine to generate electricity. Once students understand the basic pieces of this process, the same process can be applied across a variety of energy systems, such as transportation systems and fuel cells.

During the workshop, researchers will lead the teachers through these types of activities and give them a chance to ask questions, much like their students. In addition, workshop leaders will focus on some of the foreseeable misunderstandings students could have about the concepts.

By creating an easy diagram to explain the energy transfer processes teachers will learn how to use this same technique with other forms of energy, such as hydro or wind energy. The goal is to break down complex concepts and stay away from using specifics like numbers. Instead the focus is on understanding the process.

Although energy is a new subject this year, ESSP started in 2011 and held several workshops last summer. As part of the project, researchers continue to follow teachers that attended those workshops and their students to understand how the process transfers to an actual classroom.

In addition to developing the energy workshop, Hill Bembenic is working as part of a team to evaluate student ideas about plate tectonics. She helped develop questions and interview students whose teachers were involved in the workshops last year about topics such as volcanoes, earthquakes, and mountain formation.

The goal is to determine if students are just regurgitating vocabulary or if they truly understand the concepts, Hill Bembenic explained. In addition, researchers are developing learning progressions to understand how students' ideas and explanations about plate tectonics concepts change over time. The researchers are identifying productive and unproductive ideas that may or may not be deeply rooted in science.

To illustrate what she means, Hill Bembenic paraphrased an exchange with a student in which the student explained that mountains were formed from layers of animal poop. Instead of immediately dismissing this response as incorrect, teachers are encouraged to build on the student's assumption to guide them to another idea that is closer to a correct explanation, i.e. mountains are made of layers of rock.

In order to work efficiently together, EMS and Education faculty had to first learn about each other's work. While Hill Bembenic and Burgess Clifford explained important energy processes to their counterparts, they had to grasp new education concepts. Although both researchers have experience teaching, implementing these strategies was difficult.

"It is very challenging because we are thinking about [teaching] in a different way. We have to engage students differently," Hill Bembenic said.

The five-day workshops will be held in July and August. For more information on the program visit www.essp.psu.edu. Tanya Furman, professor of geosciences, and assistant vice provost and associate dean for undergraduate education, and Scott McDonald, associate professor of science education are leading the ESSP project.



Photos of teachers in last year's climate workshop from www.paesta.psu.edu.



André Boehman named SAE International Fellow

Dr. André Boehman, professor of fuel science, was elected as a 2011 International Fellow by the Society of Automotive Engineers (SAE).

SAE Fellow membership is given in recognition of “outstanding engineering and scientific accomplishments by an individual that have resulted in meaningful advances in automotive, aerospace, and commercial-vehicle technology.” It is the highest grade of membership granted by SAE International.

Boehman was chosen for the honor based on his “outstanding accomplishments for promising research in alternative and reformulated fuels and engine combustion and emissions.” He, along with the other members of the 2011 class of SAE Fellows, were celebrated at the SAE 2012 World Congress and Exhibition in Detroit, Michigan, in April.

SAE International is a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive, and commercial-vehicle industries.



Student garners award at international conference

Enette Louw, graduate student in the John and Willie Leone Family Department of Energy and Mineral Engineering, was recognized at the 28th Annual International Pittsburgh Coal Conference on September 12 – 15, 2011.

Louw received the best poster award for her poster *Morphologies, X-ray Parameters, and Burnout Comparisons of Inertinite-Rich and Vitrinite-Rich South African Bituminous Coal Derived Chars.* *

The International Pittsburgh Coal Conference (PCC) is hosted by the University of Pittsburgh, Swanson School of Engineering. It is an outgrowth of a series of conferences spanning more than three decades, and dealing with coal utilization both in the United States and internationally.

*Louw, E.; Mitchell, G. D.; Mathews, J. P., *Morphologies, X-ray Parameters, and Burnout Comparisons of Inertinite-Rich and Vitrinite-Rich South African Bituminous Coal Derived Chars.* International Pittsburgh Coal Conference, 2011, Pittsburgh, PA.



Blumsack named Ryan Faculty Fellow

On July 1, 2011, Dr. Seth Blumsack, assistant professor of energy policy and economics in the John and Willie Leone Family Department of Energy and Mineral Engineering, was named a Ryan Faculty Fellow. The purpose of the fellowship is to provide supplementary funds to outstanding faculty members in the College of Earth and Mineral Sciences to assist them in continuing and furthering their contributions in teaching, research, and public service.

Chunshan Song recognized by the Catalysis Club of Philadelphia

The Catalysis Club of Philadelphia selected Dr. Chunshan Song, director of the EMS Energy Institute and Distinguished Professor of Fuel Science, as the recipient of the 2011 Excellence in Catalysis Award. He was recognized during the spring symposium in May 2011 for his accomplishments in the field of catalysis on sulfur removal from hydrocarbon mixtures and hydrocarbon conversion for energy oriented processes.

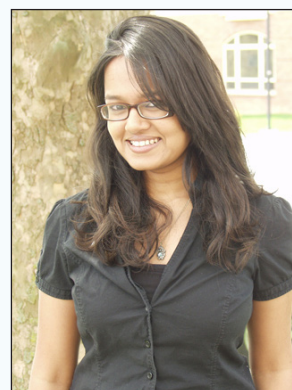
Each year the Catalysis Club of Philadelphia, a founding section of the North American Catalysis Society, recognizes an outstanding member of the catalysis community who has made significant contributions to the advancement of catalysis. As the 2011 recipient, Dr. Song presented an award lecture during the September 2011 meeting titled *Oxygen Enhanced Water Gas Shift Over Bimetallic Catalysts for More Efficient Hydrogen Production*.



Student receives first place in the SPE regional student paper contest

Riteja Dutta, a master's student in petroleum and natural gas engineering, won the 2012 Society of Petroleum Engineers (SPE) Rocky Mountain/Mid-Continent/Eastern Region student paper competition with her presentation, *Laboratory Study of Fracturing Fluid Migration due to Spontaneous Imbibition in Fracture Tight Formations*. The competition was held during the April 16 conference at Missouri University of Science and Technology.

SPE coordinates ten regional student paper contests at the undergraduate, master's and doctorate level. The winner in each region is invited to participate in the International Student Paper Contest, held during the Annual Technical Conference and Exhibition (ATCE). Dutta will represent Penn State during the 2012 ATCE, October 8-10, in San Antonio, TX.



Graduate Student Yu Noda takes first prize at student poster competition

Yu Noda, a graduate student in the Department of Energy and Mineral Engineering was awarded first prize for his poster, *Conversion of Lignocellulosic Biomass by Sequential Combination of Organic Acid and Base*, at the 2012 Bioenergy Symposium.

The Symposium was held on February 29 and this year's focus was Pathways to the Future – Short Rotation and Perennial Crops. The student poster competition was open to all graduate and undergraduate students who are currently working on research in the field of bioenergy and symposium attendees were asked to help judge the quality of the submitted posters.

Noda's poster was based on his doctoral work at the EMS Energy Institute and the Department of Energy and Mineral Engineering. His advisor is Dr. Chunshan Song and co-authors on the poster included Ungkana Wongsiriwan, Pattarapan Prassarakich, Yaw Yeboah, and Chunshan Song.





Bembenic and Clifford received R. A. Glenn Award for Best Paper

Meredith Hill Bembenic, a graduate student in the John and Willie Leone Family Department of Energy and Mineral Engineering, and Dr. Caroline Burgess Clifford, senior research associate, EMS Energy Institute, received the R. A. Glenn Award for best paper from the American Chemical Society (ACS) Fuel Chemistry Division. The award, which was for a technical paper given at the 2010 ACS National Meeting, *Examination of Hydrothermal Lignin Conversion using Carbon Monoxide*, was presented during the ACS Fall 2011 National Meeting.



The ACS Division of Fuel Chemistry, in cooperation with Bituminous Coal Research, Inc., established the R. A. Glenn award to recognize outstanding papers presented at division symposia. The award is based on the oral presentation, technical subject matter, and the quality of the preprint.



Faculty receive promotions

Zuleima Karpyn received a promotion to associate professor and tenure. Karpyn, petroleum and natural gas engineering, has research in the areas of reservoir characterization and multiphase transport phenomena in porous media, including applications in reservoir engineering, underground hydrology, and environmental remediation.



Dr. Sharon Falcone Miller received a promotion to senior research associate at the EMS Energy Institute. Dr. Miller has over twenty-five years of research experience in the field of fossil fuel and biomass utilization in combustion and gasification systems, analytical techniques for the characterization of the inorganic component of coal and biomass, ash and slag behavior, and their physical properties as well as trace element emissions.

Falcone Miller is also the Director of the Office of Student Development at the EMS Energy Institute, which promotes the participation of undergraduate students from a variety of disciplines in research experiences at the Institute.

2012 Department of Energy and Mineral Engineering student awards

Outstanding Graduate Teaching Assistants

Gun-Ho Kim
Thomas P. McGuire

Charles B. Darrow Award

Divya M. Chandra
Kyungsoo Kim

Frank and Lucy Rusinko Graduate Fellowship

Gregory K. Lilik
Aime H. Tchapda

Robert and Leslie Griffin Award

Gregory K. Lilik

Harry and Susan Kauffman Trustee Scholarship in the College of Earth and Mineral Sciences

Derek M. Hall

C. C. Wright Award

Meredith Hill Bembenic
Gregory K. Lilik

2012 Wilson Banquet and Awards Presentation

The College of Earth and Mineral Sciences held its 2011 Wilson Banquet and Awards Presentation April 29 to recognize student achievement, faculty mentoring, faculty commitments to service, and excellence in research and teaching.

Gladys Snyder Education Grants



Semih Eser, professor, John and Willie Leone Family Department of Energy and Mineral Engineering, received the Gladys Snyder Education Grant for *Incorporation of Aspen HYSYS Petroleum Refining Modeling Software to Teaching F SC 432, Petroleum Processing in Energy Engineering Curriculum.*



Randy Vander Wal, associate professor, John and Willie Leone Family Department of Energy and Mineral Engineering, received the Gladys Snyder Education Grant for *A Contemporary Energy Conversion e-Text.*



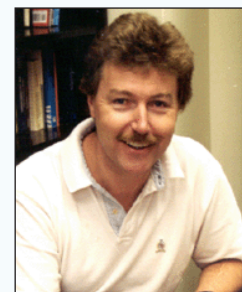
Paul F. Robertson Award for the EMS Breakthrough of the Year

Paul C. Painter, professor, polymer science, was recognized for developing an ionic liquid extraction system to separate hydrocarbons from soils and sands.



Faculty Mentoring Award

Sarma V. Piupati, associate professor, John and Willie Leone Family Department of Energy and Mineral Engineering.



25-Year Service Award

Derek Elsworth, professor, John and Willie Leone Family Department of Energy and Mineral Engineering was recognized for his commitment to service.

2011 EMS Energy Institute Celebration of Accomplishments

Several faculty, staff and students received awards last year for their achievements and service to the Institute during the EMS Energy Institute 2011 Celebration of Accomplishments banquet held in December. Below is a list of the awards presented and their recipients.

Research Achievement Award

Jointly: Damian Saffer, Associate Professor, and Chris Marone, Professor, Geosciences

For outstanding research accomplishments as reflected by high-impact research publications in refereed journals.

Administrative Staff Excellence Award

Kelly Rhoades, *Administrative Assistant, EMS Energy Institute*

For superior performance in supporting faculty, students, and research staff for research, service, and outreach at EMS Energy Institute.

Dedicated Employee Award

Shea Winton, *Writer/Editor, EMS Energy Institute*

For dedicated and excellent job performance at EMS Energy Institute.

Student Achievement Award

Gregory Lilik, *Graduate Student*

Jointly: Divya Chandra, Graduate Student, and Derek Hall and Andrew Weiner, Undergraduate Students

For superior performance in research by graduate or undergraduate students working at EMS Energy Institute, as evidenced by publication.

Student Service Award

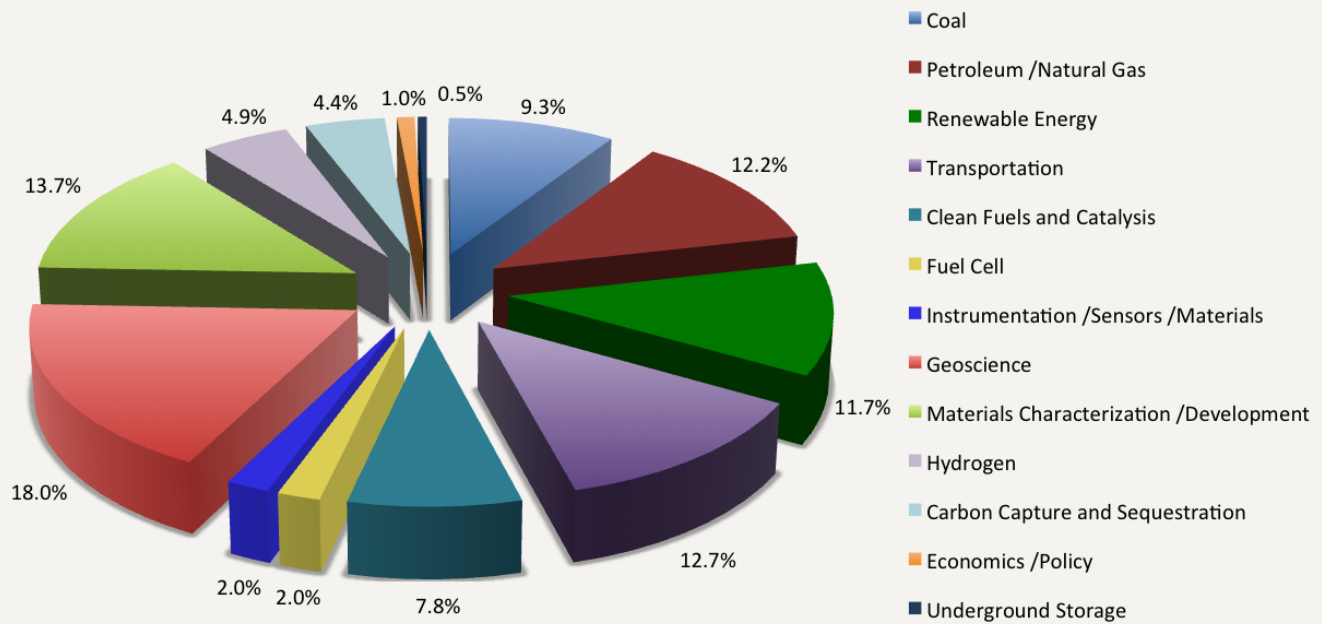
Yu Noda, *Graduate Student*

Jointly: Bhaskar Prabhakar and Greg Lilik, Graduate Students

For excellent service by graduate or undergraduate students to the research, service, and educational missions of the EMS Energy Institute.

Summary of Projects & Funding

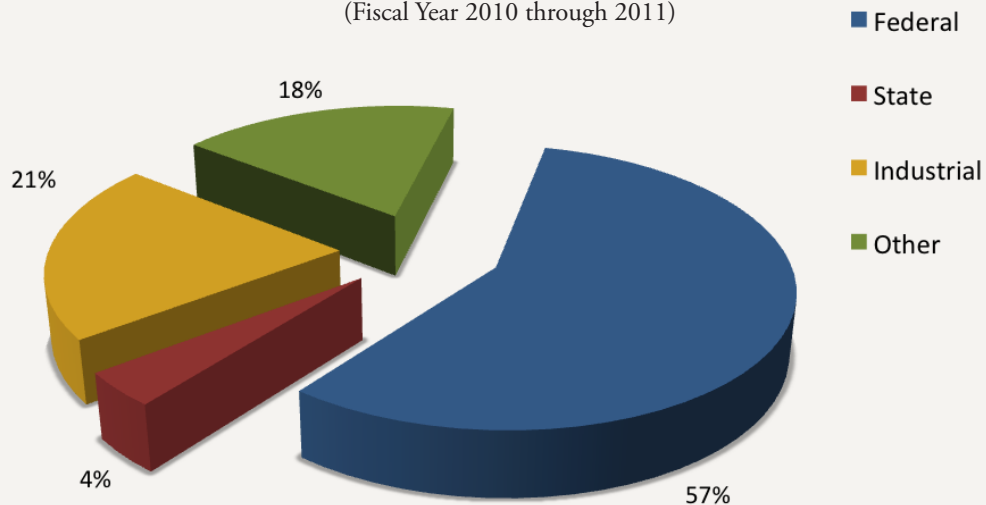
EMS Energy Institute Projects by Program Area
(Fiscal Year 2008 through 2011)



Total Projects 205

EMS Energy Institute Awards by Source

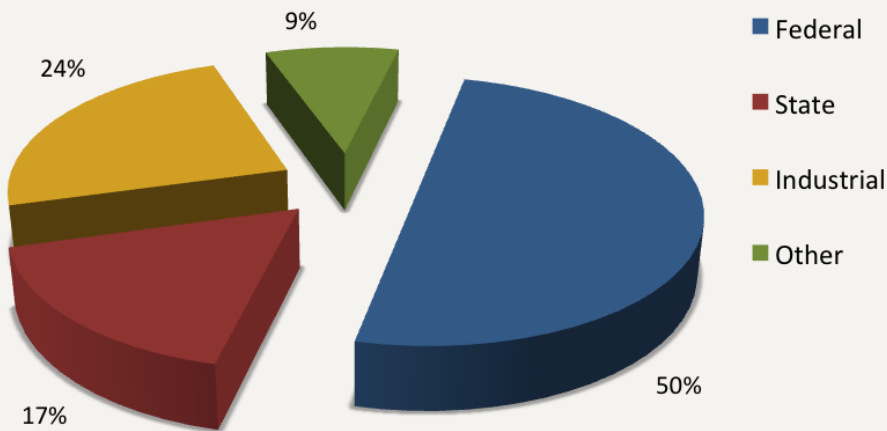
(Fiscal Year 2010 through 2011)



Total Awards 112

EMS Energy Institute Funding by Source

(Fiscal Year 2010 through 2011)



Total Funding \$6.5 million



EMS Energy Institute director and office staff (from left to right) Cindy Anders, Barbara Robuck, Director Chunshan Song, Elizabeth Wood, Shea Winton, Ron Nargi, Danielle Harter, Erin Rogers, Kelly Rhoades, Rebecca Eby.

For more news as well as information on our research, facilities,
and outreach programs, visit the EMS Energy Institute online.

www.energy.psu.edu