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2010



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Director's Message

It has been another exciting year here at UC Riverside's Center for Environmental Research and Technology, where we continue to expand our research program amid difficult economic times. In 2010, we welcomed several new faculty and staff including George Karavalakis now working in the Emissions and Fuels group, Rajeev Kumar in the biofuels area, and Sadrul Ula joining our solar and electric energy technology group. Over 60 undergraduates and nearly 55 graduate students participated in research at CE-CERT in 2010 — several who have won a variety of prestigious awards. I am hopeful that their time here is providing them with key real-world experience that you would not normally get from the classroom.

In addition to our personnel, I am very proud of our new infrastructure we added in 2010. In late June, we finished building our new heavy-duty dynamometer facility (pg. 17). We are now able to test buses and heavy-duty trucks across a wide range of driving conditions. We have also developed a new solar thermal storage research lab, where cutting-edge research is leading to increased energy storage efficiency and reduced costs (pg. 12). The transportation research system group has also put together a unique "ECO-ITS" vehicle which is being used for a variety of on-road experiments for quantifying potential fuel and emission savings (pg. 3). Many new research contracts and grants are now coming to CE-CERT because of our unique resources, as well as our very capable faculty, staff, and students.

This annual report highlights our research programs and many of the people involved. To explore a bit deeper, you can find more detailed information on our website, www.cert.ucr.edu, where we describe all of the latest activities here at our Center.



Matt Barth
CE-CERT Director



Transportation Systems Research

The transportation systems research group has significantly expanded its research in Eco-friendly Intelligent Transportation Systems (ECO-ITS) this past year. In general, ECO-ITS is focused on using advanced technologies to improve traffic operations and driving behavior to save fuel and reduce vehicle pollution. CE-CERT has been developing and implementing a variety of new applications for several years, making use of computer modeling tools and also using its ECO-ITS testbed vehicle (see pictures on page 3).

The functional heart of these ECO-ITS applications usually involve advanced algorithms – a tightly defined group of functions and expressions that turn multiple data inputs into useful results. Examples of these applications include an eco-routing navigation system, a freeway-based dynamic eco-driving system, an arterial-based dynamic eco-driving system, and an advanced driver alert system.

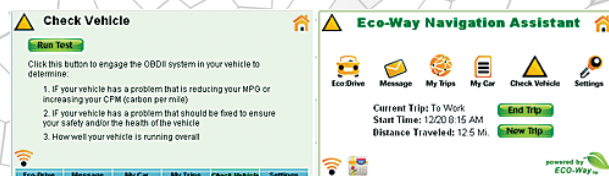
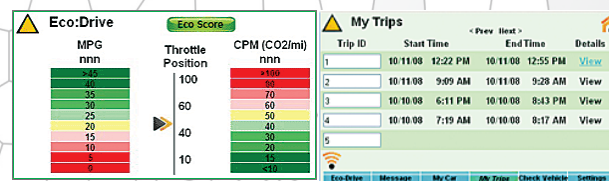
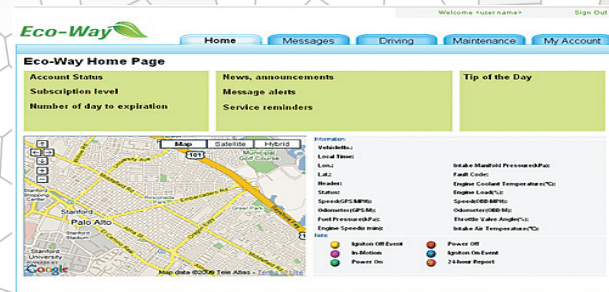
As part of the transportation group's ECO-ITS research program, many of the algorithms are being ported over to commercially available products (e.g., custom hardware and existing devices such as the iPhone and iPad), allowing motorists to choose the road to better fuel efficiency and lower emissions (i.e., eco-navigation).

As an example, Earthrise Technologies Inc. has licensed the provisionally patented, eco-friendly navigation system technology (EFNAV) developed at CE-CERT. This state-of-the-art routing technology raises the bar beyond standard GPS based navigation algorithms by incorporating more variables along with actual vehicle performance, thereby enabling much more robust and accurate results when choosing a route to travel on.

EFNAV takes into account three key factors when calculating eco-routes: traffic (real-time and historical), road gradient, and road type. By using these data along with tapping directly into a vehicle's data stream, EFNAV can deliver accurate and reinforcing feedback to a driver based on the eco-success of the route selection and driving style.

In addition to Eco-routing, Eco-driving has also been an area of recent research interest in the overall effort to reduce greenhouse gas emissions from motor vehicles.

The TSR group has carried out a pilot-study to show that eco-enabling technologies can affect driving behaviors and thereby improve fuel economy. The core of eco-driving technology is to provide



Earthrise partnered with the Transportation Systems Research Group in the development of an eco-driving system (above) which provides drivers with a variety of bio-feedback allowing active control of gasoline savings and pollution reduction. Earthrise purchased a license for the patent-pending technology.



UCR and UCB's eco-friendly navigation research for Audi was featured in a video available on You Tube.

drivers with a variety of real-time feedback to minimize fuel consumption while driving.

This study capitalized on the partnership with Earthrise, evaluating how an on-board eco-driving device that provides instantaneous fuel economy feedback affects driving behaviors, and consequently the fuel economy, of gasoline-engine vehicle drivers in the U.S. under real-world driving conditions.

Twenty Southern California drivers were profiled as to their driving behavior with and without “eco-driving” feedback. Forty percent of the participants said they were already practicing eco-driving techniques. After training and experience, eco-driving demonstrated fuel economy improvements of six percent on city streets and one percent on highways.

Subjects also reported that the active adoption of eco-driving principles would increase to 95 percent as gasoline prices rise to \$4.40 a gallon.

The next step is an expanded study, with the UC Berkeley Transportation Sustainability Research Center, that will establish a baseline for driving behavior by first covering the feedback displays to more precisely measure the change in driving behavior with data feedback. Studies in Europe and Japan suggest eco-driving could reduce fuel consumption by an average of 5 to 20 percent.

The eco-friendly navigation research is continuing, extending the practical and theoretical basis of the technology.

A major sponsor of the work, Audi, produced a seven minute video on the research at CE-CERT and Berkeley. Titled “Audi Clean Air – A Viable Planet Initiative,” featuring Matthew Barth, CE-CERT Director and Karl Hedrick, Director of Berkeley’s Vehicle Dynamics Laboratory.

Rapid advances in networking and computer processing power are allowing the researchers to build an integrated, dynamic database of regional traffic activity. This enables drivers to select not just the fastest route in time, or the shortest route in distance, but now also the least fuel consumed, or even the least pollution emitted.

“When this capability becomes part of Audi’s emissions reduction technology it can make a significant difference in how we drive,” Barth said. He noted that today transportation accounts for half of the energy we use and 29 percent of greenhouse gases produced by human activity.

Assisting Barth on the UCR team are Kanok Boriboonsomsin, Assistant Research Faculty, and Alex Vu, Junior Development Engineer.

Another major project completed in 2010 was Phase One of an effort to propose to the Federal Highway Administration the next generation of driver assistance systems (along with co-investigator Electrical Engineering Professor Jay Farrell). Global Position System/Inertial Navigation System (GPS/INS) technology already offers robust positioning capabilities, but additional enhancements may be possible.



Henry Chen (left) and Alex Vu work on the instrumenting of their group's ECO-ITS testbed vehicle.

Funded by FHWA's Exploratory Advanced Research Program, the group conducted a broad assessment of potential sensor and infrastructure technologies that might be economically combined to provide unprecedented real-time information about vehicle position on the road.

Existing driver assistance systems provide roadway information, route guidance, adaptive cruise control, lane keeping, and collision detection by employing GPS, digital maps, and relational, kinematic and radio navigation sensors.

If carrier signals from radio, television, and mobile phone transmissions could be integrated into positioning systems, it might be possible to work around GPS triangulation losses and improve precision of existing techniques. The group is investigating phase measurement algorithms which could make use of current carrier signals, or enhanced signals engineered for this purpose.

Inexpensive computer vision and radar technologies are also being studied for their ability to enhance GPS/INS features by tightly integrating their capabilities for higher resolution and robustness.

Positioning errors are common in all lane-level positioning strategies. For instance, GPS performs poorly or not at all whenever satellite signals are blocked. INS and encoders require regular assists or their accuracy begins to drift. Computer vision, laser ranging, or RADAR can be successful only if there are sufficient features that can be reliably detected and tracked within the driving environment.

The study concludes that only a fusion of sensors with complimentary features can truly provide reliable, all-weather, all-time-of-day, lane-level position determination. The benefits of such a technological fusion are obvious for driver assistance. However, the research also points to positive impacts on traffic congestion, mobility, energy/environmental conservation, and roadway safety.

Over the next two years, the group will develop and evaluate prototype positioning systems integrating on-board sensors with measurements from cooperative infrastructure signals. Although not yet cost-effective, the group will also evaluate the potential of LIDAR (Light Detection And Ranging), remote sensing technology that measures reflected laser light to measure distance to objects.

Another intelligent transportation project evaluated existing technology for individual vehicle tracking. The South Coast Air Quality Management District engaged the TSR group to investigate technologies that could be used to measure vehicle activity for highway tax purposes.

The current per gallon tax charge to collect federal highway taxes for the maintenance and expansion of our surface roads has led to a multi-billion dollar shortfall in our highway trust fund. One negative impact of improved fuel economy is that less tax money is collected.

The TSR group report concluded that there are several existing technologies that could be employed to measure vehicle miles travelled (VMT) for individual vehicles. Currently only estimates of VMT are available by using numerous measurement programs combined with demographic and transportation modeling.

The ability to measure and report each vehicle's VMT could enable the implementation of other fees, such as carbon emission fees associated with global climate change. The report reviewed the vehicle hardware, communication methods and protocols, and the data management techniques required for such a tracking system.

Legacy of CMEM Model Continues

The U.S. EPA released its official new mobile source inventory model MOVES (MOtor Vehicle Emissions Simulator) in early 2010 after nearly a decade of development. MOVES is a tool to help local and regional authorities meet clean air regulations, and its final shape owes something to the techniques and models that came before it. CE-CERT's 16-year-old Comprehensive Modal Emissions Model (CMEM), in particular, has played an influential role in the development of this technology.

Released in 1995, CMEM was one of the first traffic emissions models to account for variations in vehicle operation at a more fundamental level. The wide range of emission behaviors found under various driving conditions such as acceleration, deceleration, idling, steady-state cruising, and congestion makes in-use urban driving emissions difficult to estimate. Emissions under such conditions vary greatly and in such a way that "average speed" based emissions cannot easily express.

CMEM is distinct from most other models in at least two ways: it estimates emissions based on specific physical properties from each source vehicle; and it predicts second-by-second vehicle performance and emissions. One of the advantages of the CMEM model over conventional traffic emission models is that certain changes such as vehicle weight, aerodynamic characteristics, and additional accessory loads can be modeled without recalibration of vehicle categories.

The CMEM model has proven to be an exceptional research tool and was the basis for the simplified Physical Emission Rate Estimator (PERE) model which is part of EPA's new MOVES modeling suite. MOVES emission fac-

Of course the implications of vehicle specific data would be vast for highway designers, planners, researchers and many others who have no source of large scale aggregate data of vehicle activity, emission rates, or driving behavior.

The possible approaches outlined included simple integration of VIN and odometer readings with on-board diagnostics downloaded during infrequent “smog check” type inspections. More regular reporting could involve wireless communication approaches integrated with data collection during gasoline fill-ups. The most complex and costly approaches would involve minute-by-minute vehicle telematics systems such as those used in fleet-tracking systems.

at Home and Abroad

tors are based on Vehicle Specific Power (VSP), a quantity which generalizes many of the same physical principles characterized by the CMEM model.

PERE gives MOVES users the ability to expand EPA’s emissions data model with customized local data from actual physical measurements. “The model is essentially an effort to simplify, improve, and implement the Comprehensive Modal Emissions Model (CMEM) developed at the University of California, Riverside,” wrote Edward K. Nam, formerly of Ford Research and Advanced Engineering, in his Proof of Concept document.

According to Nam, the engineering advances over the past two decades in engine design, fuel formulation, control systems, and catalysts have made the use of generalized VSP calculations possible in the MOVES model. Modern vehicles simply perform more consistently at different speeds, loads and grades.

Over the years, the CMEM project has built an invaluable inventory of physical emission data for several hundred vehicles and traffic emission models for numerous automobile categories. As an open source model, CMEM has attracted more than a hundred registered users worldwide.

CMEM will continue as a research tool for those who have the need to view traffic emissions at the “microscopic” level. Researchers investigating transportation system design, intelligent transportation systems, emissions from traffic simulation models and many other areas where more precise localized measurements are essential will continue to need a physical model for fuel consumption estimation and pollutant emission prediction.

The TSR Group also completed a pilot-scale implementation of just such a fleet tracking system during 2010 for Caltrans. That agency operates a fleet of mixed-fuel capable, E-85 vehicles across the state, but it had no way to monitor how often ethanol, gasoline, or other fuels were being used.

Using CE-CERT’s experience in telematics, the group was successful in providing a tracking system at two Caltrans districts that allows tracking of fuels by managers at any time through an online reporting system.

The developed system includes on-board monitoring hardware that has telematics capabilities based on an open architecture and non-proprietary system that will allow maximum ease of integration and expansion of the Caltrans fleet and the addition of more intelligent transportation system applications. The final report also completed a full deployment plan to implement the technology throughout the department’s alternative fuel vehicle fleet.

ITS Expertise Lends Leadership to Sustainable Transportation Research

CE-CERT is part of a new major research program in Transportation Sustainability funded by the UC Office of the President as part of their Multi-Campus Research Program Initiative (MRPI).

Called “Sustainable Transport: Technology, Mobility, Infrastructure” this five-year, \$6.5 million research program is organized to address transportation issues in California in three major areas: vehicles and fuels, infrastructure investments and system management, and land use and mobility planning. The Transportation Sustainability Program includes researchers from more than 30 disciplines on six UC campuses – Berkeley, Davis, Irvine, Los Angeles, Riverside, and Santa Barbara.

This transportation sustainability program received the largest amount of funding of any MRPI. Together the research programs are intended to gather together the UC System’s formidable roster of experts to address many of the state’s pressing problems.

“Transportation accounts for a major part of the urban air pollution generated in California,” said Barth. “The movement of people and goods also accounts for the largest portion of greenhouse gases,” he added.

The state has mandated significant rollbacks in greenhouse gas emissions by 2020 as well as improvements in land-use and transportation practices. “The transportation technologies, policies, and strategies to meet those goals still need to be created,” Barth said. “This is a great opportunity to push that agenda forward.”

Sustainable Energy Research

Cellulose, a polysaccharide, is the most common organic compound on Earth. Plants also contain non-cellulosic polymers like hemicellulose, xylan, and pectins. As petroleum supplies are depleted, lignocellulosic biomass remains the most abundant source of organic carbon on Earth, but unlike petroleum, it is renewable. The availability and low cost of cellulosic feedstocks make them the only resource that can support large scale sustainable production of liquid fuels.

As leading specialists in cellulosic pretreatment, the fundamental goal of the cellulosic biomass processing (CBP) team is to understand the fundamentals of biomass conversion and develop new technologies to convert cellulosic biomass to ethanol and various hydrocarbons effectively and economically.

The group, as key pretreatment experts in the DOE funded BioEnergy Science Center (BESC), is addressing the engineering and fundamental challenges to allow the emergence of a non-food crop ethanol/hydrocarbon biofuel industry for production of transportation fuels. In the year 2010, the group has made great progress in advancing the fundamental understanding of how to economically break down plant materials into simple sugars.

A recent breakthrough in the CBP lab was the discovery that commercially available enzymes used to breakdown cellulose are strongly inhibited by compounds called xylooligomers which are produced during pretreatment and enzymatic hydrolysis in great amounts, depending upon feedstock, pretreatment technique employed, and enzyme loadings.

The USDA is funding research on continuous fermentation of cellulosic biomass, the most economical process for which almost no data exists. The work also helps meet the goals of the BioEnergy Science Center by lowering the biofuels/biochemical production cost.



Additional work in 2010 further quantified the inhibition effect of xylooligomers using various enzymes and suggesting ways to improve the production of simple sugars.

A fermentation laboratory was an important new addition to the cellulosic biofuel research effort at the Center. With the new lab, the group is working on improving ethanol production processes. Batch fermentation used by liquor distilleries tend to be labor intensive to run and suffer from low productivity. However, to be economically viable, a cellulosic ethanol industry must be able to reliably produce product 24 hours a day, seven days a week. Yet, the knowledge of continuous fermentations that could better meet this need is very limited and has mostly dealt with pure sugars or pure cellulose as a feedstock. Fermenting cellulosic biomass (i.e., agricultural residues, municipal solids waste, and forestry residue) in a continuous fashion presents new challenges to be economical that must be addressed by focused research.

During the first year of the three-year project funded by the U.S. Department of Agriculture, the group has identified instabilities in continuous processing not predicted from traditional findings in batch processing. These instabilities complicate the already ambitious goal of integrating the pretreatment hydrolysis of cellulosic biomass with enzymatic hydrolysis to sugars and fermentation of the sugars to ethanol. To be successful, the group will need to find methods of speeding up hydrolysis with multistage enzymatic treatment. In addition, they have set a goal of reducing the amount of costly enzymes needed beneath current experimental findings.

Charles Wyman's group is also working on two DARPA (Defense Advanced Research Projects Agency) projects (subcontracted through Logos Technologies and the University of Massachusetts, Amherst) which aim to produce hydrocarbons through aqueous processing of cellulosic biomass via catalytic and/or biological routes. One promising technique demonstrated how high octane gasoline can be derived from hydrolysis of maple wood. The highest yield of gasoline was produced through acid hydrolysis, adding oxalic acid to maple wood and heating to 160°C. The resulting fuel had an estimated octane rating of 96.5.

This process began by adding sulfuric acid, oxalic acid, or just hot water to the wood chips to produce an aqueous carbohydrate solution. Next a two-step catalytic process was used to achieve carbon yields of up to 57 percent. The first catalyst bed contained ruthenium and carbon (Ru/C) catalyst heated to 120°C. The second catalyst bed contained platinum and zirconium phosphate catalyst heated to 245°C. The results were published in Green Chemistry journal. Given the high cost of the catalysts used, perhaps the most important finding of this research was that the catalysts remained active and stable after 200 hours of on-stream testing. The group is also collaborating on another DARPA project to study the production of jet fuel from cellulosic feedstocks through fermentation routes.



Lignocellulose pretreatment, particularly research on continuous feed fermentation, requires a custom-designed, high-yield steam gun which can deliver 60 percent solid load processing at high pressure and 180-260 degrees Celsius.

Work is well underway on the Steam Hydrogasification Reaction (SHR) Process Development Unit (PDU) with the basic design by the sustainable energy research group and detailed design by Technip USA Inc., a provider of project management, engineering, and construction services for the oil and gas industry.

Fabrication is underway in the SHR lab where the goal will be to process 10 pounds per day to produce 4-5 gallons a day of synthetic diesel fuel with a carbon conversion rate of close to 70 percent.

According to Chan Seung Park, assistant research engineer, hydrogasification is not new; it has been around since the 1930s as a method of making methane gas from coal. CE-CERT's patented breakthrough was adding steam and high pressure to the process, making a slow carbon conversion reaction ten times faster.

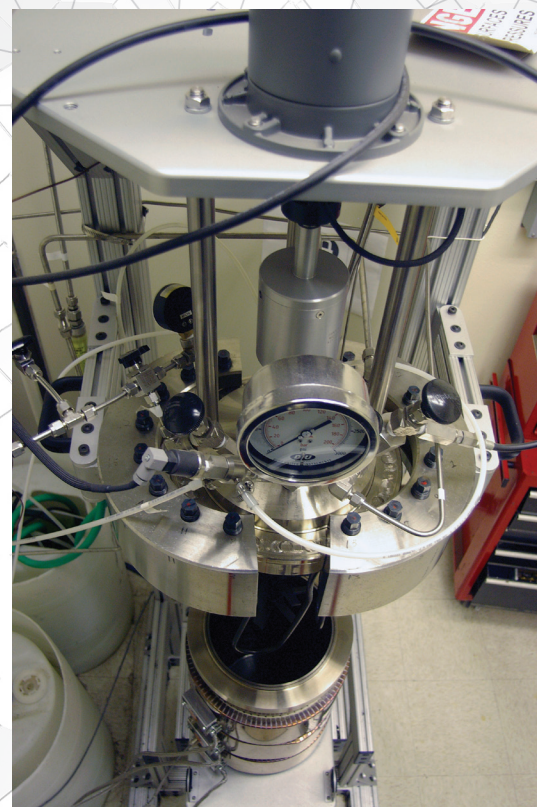
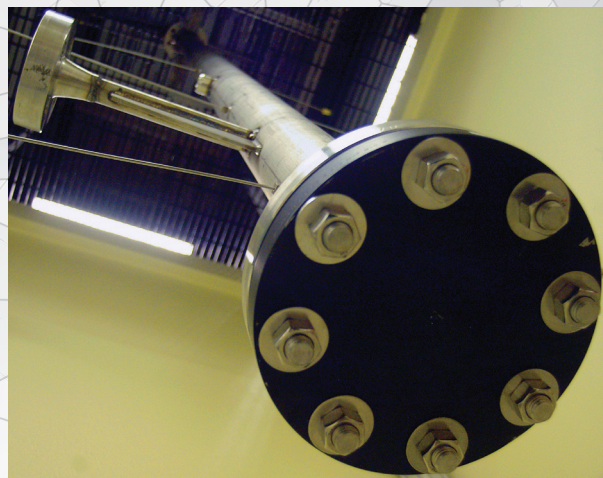
There are a number of key advantages to SHR, Park explained. Instead of wasting the time and energy to dry out feedstocks, SHR requires water as a key component in the reactor. Similarly, the process is projected to work well in smaller-size commercial plants since the process does not require an expensive oxygen production facility, so that they can be sited near sources of water and feedstocks (rivers, landfills, urban solid waste plants) making the facilities less expensive to build and operate.

Another key advantage of SHR is that it is designed to accept mixed feedstocks. As long as materials can be reduced to a slurry, any carbonaceous material can be combined for SHR processing.

Planning on a SHR plant on a river bank near Bangkok funded by the Thailand Institute of Scientific and Technological Research (TISTR) progressed this year following the joint agreement with CE-CERT to utilize the process there. Two researchers from Thailand worked at the Center during the year as part of the partnership. They are studying the application of SHR feedstock to the biomass which is especially abundant in Thailand such as algae and sugar cane.

Seizing on these flexible properties, the SHR team opened two new research areas in 2010, investigating algae and food wastes as additional feedstock sources. In both cases partnership have been formed which may represent ideal marriages of technologies, said Park.

The group has also begun working with another technology company specializing in wastewater treatment and water reuse. Algae grows very quickly in nutrient rich



Assembly of the new Steam Hydrogasification reactor began in 2010 (top). A new high-pressure pretreatment module was also completed to deliver slurry to the process.

wastewater treatment ponds when the sun is shining. Plus the biological action of algae effectively cleans the waste water.

Typical algae-to-fuel methods today squeeze the algae to extract its oils and disposes of the remainder. SHR could accept the complete algae structure along with the surrounding water as an endlessly renewable feedstock.

The group has also signed a contract with Food Recycle Science Inc. of Irvine, California to apply SHG to new food waste technologies. Once again, the current state of the art is the dewatering and pulping of food wastes for reuse in other material.

Park said CE-CERT and researchers at the Naval Facilities Engineering Command (NAVFAC) are evaluating the technologies for possible adoption for waste to energy conversion on overseas installations under the Strategic Environmental Research and Development Program (SERDP).

Basic research to optimize the SHR process also continued during the year. Particular attention was on pretreatment of mixed feedstocks to produce a viscosity that could move through the SHR reactor. A pretreatment apparatus was constructed by graduate student Wei He which was able to create a pumpable slurry from multiple feedstocks, including biomass or biosolids, using hydrothermal reactions.

In another study, the group demonstrated that the syngas ratio generated from steam hydrogasification can be carefully controlled over a wide range by varying the carbon to water and carbon to hydrogen ratios of the feedstock, which can be very useful for integrating with any downstream process that requires careful control of the syngas ratio.



A delegation of Thai Government officials visited the Center in November for an update on the joint project to build a steam hydrogasification plant on a riverbank near Bangkok.



Research Initiative for Solar Energy

The formative year for the Southern California Research Initiative for Solar Energy (SC-RISE) brought progress in each of the key areas the initiative has focused on to encourage the widespread adoption of solar energy — research, education, industry.

The organization continued to coalesce with the naming of a managing director, research faculty member, 23 affiliated faculty engineers from UCR's Bourns College of Engineering, and a Board of Advisors consisting of leadership from government, business and academia.

One major effort was a study of the solar "potential" of Riverside, California, achieved by evaluating the economic feasibility of rooftops and open spaces across the city for photovoltaic (PV) electricity generation. This Solar Road Map is expected to be completed in early 2011, beginning to quantify the prospects for the initiative's goal of adding 20 MW of solar generated power to the City's utility grid by 2020.

The economics of solar power are volatile and complex, as more players of varied experience enter the solar industry at various levels, according to Steve Pitzek, a UCR graduate researcher in Electrical Engineering, who is studying market feasibility for the Solar Road Map.

Pitzek calculated that a reasonable cost for a 10 kW PV system today is approximately \$5.75 per installed watt. In order to stimulate widespread adoption of PV, without unforeseen technological changes, Pitzek continued, consumers will need to be able to equate the scale of the investment with the purchase of a car. Incentives such as rebates will be essential, he said.

The SC-RISE board of advisors received a preliminary briefing on the development of the Road Map in September. They agreed that the price of electricity and the developing investment climate will always be wild cards in meeting SC-RISE's goals.

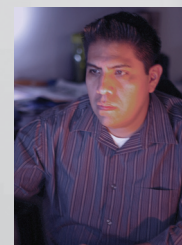
The Feed-in Tariff (FiT) is the mechanism that is likely to be most important to SC-RISE's solar goal. The ability of solar installations to sell power up-stream to the grid has been critical to the success of the proliferation of solar technology in Germany and Spain, according to Laura Berland-Shane, Business Development Manager of Solar Vertical Market Management for SIEMENS.

A recent study by UCLA's Luskin Center for Innovation for the LA Business Council recommended FiTs as effective for stimulating the economic, widespread adoption of solar power in Los Angeles.

Riverside Mayor Ronald Loveridge, a member of the board of advisors, said such a comprehensive examination of the issues is what is needed to advance the city's interest in sustainable energy production. "This is the big picture," he said, "something we don't normally get to take on."

Nanomaterials Specialist Named SC-RISE Director

Alfredo A. Martinez-Morales is managing director of the Southern California Research Initiative for Solar Energy, providing leadership for the organization along with Interim Faculty Director Matt Barth.



Martinez-Morales received his Ph.D., MS and BS degrees in Electrical Engineering from the University of California, Riverside. There he served as laboratory manager for Professor Mihrimah Ozkan in the research areas of thin-film amorphous silicon technology, bulk heterojunction solar cells based on nanowires, and inorganic/conjugated polymer solar cells.

Martinez-Morales has produced nearly a dozen research articles on nanotubes, nanowire arrays, quantum dots and other nanotechnology findings. He has received several research honors and fellowships including the UC Dissertation Year Fellowship.

"To fulfill its mission of being a catalyst for the adoption of affordable solar energy, SC-RISE must be about education, applied technology, research and especially connections with those in Southern California who are concerned with sustainable energy," said Barth, who also directs CE-CERT. "Alfredo brings us the expertise to move that diverse agenda forward."





Energy Researcher Ula Joins Initiative as Research Faculty

Sadrul Ula, formerly a Professor of Electrical and Computer Engineering at the University of Wyoming, has joined CE-CERT as research faculty affiliated with the Southern California Research Initiative for Solar Energy (SC-RISE).



Dr. Ula's research interests include renewable energy (solar and wind) electric power generation, electric power systems, energy management, and energy education.

Among the sponsors of Ula's research have been the National Science Foundation, the U.S. Department of Energy, the U.S. Department of Agriculture, the U.S. Department of Education, the Western Research Institute, and the Wyoming Business Council. He has also served as Director of Cooperative Education at University of Wyoming, Energy Advisor to the Governor of Wyoming, Advisor to the Power Minister of the Government of Bangladesh, and member of the Bangladeshi Planning Commission on long range national energy planning.

Also during 2010, educators representing public and private colleges, universities and workforce training programs evaluated a range of variables which control the demand for alternative energy in the region.

Participants represented Chaffey College, California Baptist University, the College of the Desert, Riverside Community College District, UC Riverside, and Renova Energy Corp.

At the meeting, participants agreed that currently there are no real mechanisms available to gauge supply and demand for "green technologies" at the contractor, labor force and consumer levels. Subsequently, medium- and long-term market information about demand at each level is critically needed and represents the sort of clarifying factor that open the market to solar technology. Reliable information about jobs and training programs as well as lower training costs will contribute to demand for training in solar and renewable energy in the Inland Empire, a group of educators concluded after a meeting sponsored by CE-CERT and SC-RISE.

Participants acknowledged the need for solar/sustainable energy training programs in Southern California, but pointed to high costs and low demand for such courses as barriers to the widespread adoption of these programs. Jennifer Campbell, program coordinator of UCR's Extension, said the University's own efforts to provide PV installer certification training was too expensive for market demand. Now the Extension is working with Renova Energy Corp., a leading provider of solar energy systems in the Coachella Valley, to provide four-day boot camps in solar installations in Palm Desert to make it more affordable for students.

Renova Chief Executive Officer Vincent Battaglia said his firm only began the boot camp out of a need to identify and train its own workforce. The difficulty of predicting employment trends or even of identifying the current needs of the nascent industry makes other institutions who might be interested in workforce development slow to act. A clear definition of "green" jobs and reliable projections of their availability are essential to a successful education strategy, the educators said.





Phase 2 of the Solar Thermal Storage research began with the design and construction of a new generation system.

Throughout the year, industry partner Terrafore brought a major research project to SC-RISE to develop ways to increase efficiency and decrease costs of thermal energy storage in large scale Solar Thermal Power installations.

Terrafore combines experience with large scale solar installations (photovoltaic (PV) and concentrated solar power (CSP) designs of various configurations) with innovative research and development programs.

A successful technology for storing solar energy overnight is to use molten salts in large insulated tanks. This project, funded by the U.S. Department of Energy (DOE), is investigating the use of inorganic salt mixtures with specific phase change properties with specially designed heat exchangers.

By reducing the amounts of salts required and increasing heat transfer efficiencies, the work has the potential to reduce the cost of energy storage and increasing the possibility of generating electricity during night time and periods of no sunshine. Phase two of the research began in November, after initial investigations of the phase change materials bore out their ability to improve the thermal to electric conversion efficiency due to more constant temperature storage.

The next steps will take place in an enlarged flow loop apparatus where the observations of the phase change properties and heat exchanger efficiencies will be scaled up.

In addition to SC-RISE, partners with Terrafore on the thermal storage research are NASA's Jet Propulsion Laboratory and Pratt & Whitney Rocketdyne.

Education Highlight:

CE-CERT was also the scene of three solar energy senior design projects this spring. The projects were tested at the Center with the potential for becoming examples of research demonstration projects under the Center's Southern California Research Initiative for Solar Energy (SC-RISE).

One team designed and built a prototype of a solar salt water desalination system intended to provide sufficient drinking water for a small community. Salt water was heated to boiling in a tube running the length of a parabolic trough solar collector. The steam was then directed to a condenser/evaporator and then to a condenser unit where fresh water was captured. This team consisted of Chihiro Iwahashi, Bethany Richie, Nico Schulte, Selcuk Sindir, and Raymond Vallido.

Another team, including Jorrell Gonzales, Alejandra Moreno-Aguilar, David Duong, Jonas Perlas, and Shanel Chand, demonstrated a solar appliance designed to act as a household cooking range. Their solar collector was designed to deliver hot motor oil to a salt storage tank where the heat could be used for cooking.

The third team devised a solar thermal wind generator. The apparatus was designed to use the sun's energy to create a pressure gradient inside which would generate wind pressure to turn a turbine to create electricity. This senior project was developed by Kevin Guevarra, Henry Hsu and Jason Miller.



Terrafore is working on a second R&D project in Energy Storage also funded by the DOE. They will be partnering with SC-RISE on this project also.

Terrafore also offered the opportunity to collaborate on the testing and evaluation of a Terrafore-designed and built prototype parabolic trough collector model “TerraTrough One.”

During the summer students, project scientists and UCR faculty operated the concentrator, gathering data on its performance. The prototype uses Therminol heat transfer oil protected with a nitrogen gas blanket to transfer heat energy to a heat exchanger. Several sensors, a control system and a data acquisition system formed the test setup.

Approximately 75-hours of performance data was recorded with the collector, successfully demonstrating the design performance and reliability of the prototype.

Terrafore envisions the application of several TerraTrough One collectors in a concentrated solar power system that can be used for producing electricity through an Organic Rankine Cycle turbine and/or for space heating or cooling using absorption cycle air conditioning.

SC-RISE also completed the engineering evaluation of a low profile vertical axis wind electric machine on-site in a location in Southern California. This project was funded by the inventors of this novel design where the complete wind driven electrical generator system is mounted on a trailer and could be placed in both urban and rural locations. It is very quiet during working conditions and does not require any tall structures which are considered as eye sores by many opponents of traditional vertical axis wind generators. Two undergraduate mechanical engineering students,

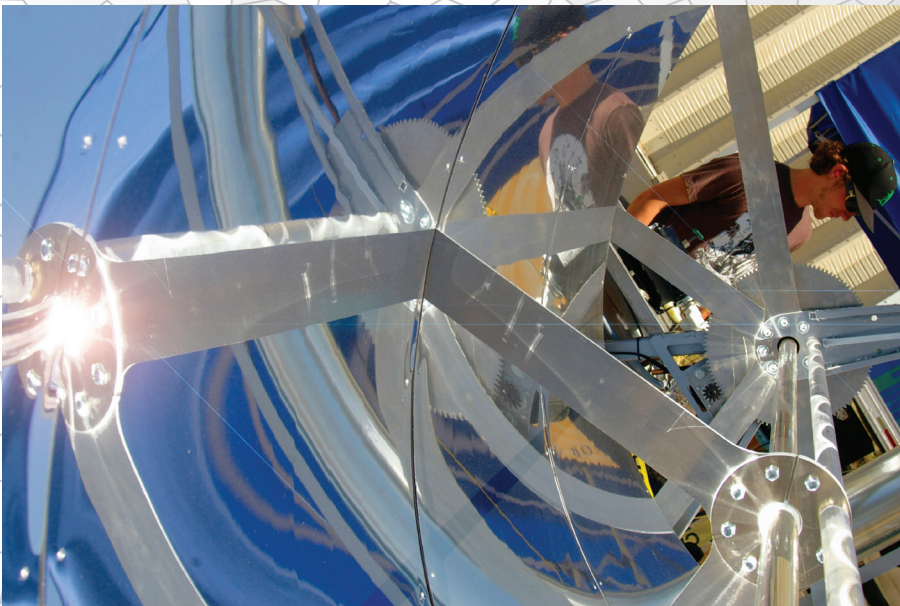


The first full year of operation the Solar Initiative attracted a number of corporate partners. In addition to major funding by the City of Riverside and Riverside Public Utilities, charter members joining the initiative included: Applied Materials, the City of Beaumont, California, Carson Development Corporation, SolarReserve, SolarMax Technology Inc., and Terrafore.

Shanel Chad and Jorell Gonzales, completed the evaluation of this project under the guidance of Research Faculty Sadrul Ula.

In another funded project, SC-RISE is helping the County of Riverside in evaluating solar PV potential for the various facilities located throughout the large geographical area of the county. As a part of this effort SC-RISE is also evaluating third-party proposals offering Power Purchase Agreements (PPA) to the county.

SC-RISE is also helping a number of Native American Tribes in Southern California to evaluate the application of solar PV for water pumping in remote parts of their reservations. As part of this effort, Ula visited Morongo and Pala Reservations and met with their Environmental and Water Resources personnel which led to a pre-proposal now under review at the U.S. Department of Agriculture's Natural Resources Conservation Service. Another pre-proposal is under review at the same federal agency for a statewide implementation of solar water pumping for all farmers and ranchers in remote locations in California.



Emissions and Fuels Research

Environmental Engineering undergraduate James Gutierrez stood on the deck of the German container ship Cap San Lorenzo on its third day out of Veracruz. Looking out at the arcing horizon of the Gulf of Mexico, he was struck by the pristine beauty of the scene and his role in helping keep it that way. He said it was his most vivid memory of this voyage to advance emissions science.

But before the ship docked at the Port of Houston, the Deepwater Horizon oil platform exploded, beginning one of the worst environmental crises in U.S. history. Gutierrez and Principal Development Engineer William Welch were taking part in a first study of lower sulfur marine fuels.

The U.S. Environmental Protection Agency and their counterparts in Mexico, in cooperation with the German shipper Hamburg Süd, were testing bunker fuels and ocean going vessel engines with a goal of reducing sulfur dioxide.

The container ship docked at the Port of Houston April 20, 2010, completing the first phase of the first study of lower sulfur marine fuels in the Gulf of Mexico that the U.S. Environmental Protection Agency hopes will reduce air pollution there. The data-gathering phase was handled by CE-CERT's Emissions and Fuels Research (EFR) Group, which has been pioneering port emissions research in California and Asia since 2003.

This research will be instrumental in the formulation of new EPA regulations. Beginning in 2012, stringent international emission controls will require that lower sulfur fuels be used by ships operating within up to 200 nautical miles of the majority of the U.S. and Canadian Atlantic and Pacific coastal waters, as well as the U.S. Gulf Coast.

EPA expects these international regulations to bring important benefits for human health by reducing particulate matter generated by sulfur dioxide in the atmosphere. Sulfur dioxide is an airborne by-product of burning fossil fuels, and is a substantial threat to public health in marine and terrestrial ecosystems. EPA expects these measures to avoid as many as 14,000 premature deaths annually, provide relief from respiratory symptoms for nearly five million people each year, and provide more than \$110 billion in health-related benefits by 2020.

The ports are a major contributor to air pollution in the South Coast Basin. Diesel

Center of Excellence Formed

An Alternative Transportation Fuels Research (ATFR) Center of Excellence has been formed at CE-CERT to provide a nexus of expertise to help meet the growing state and federal focus on the expanded use of alternative fuels to reduce dependence on petroleum, reduce greenhouse gas emissions, and maintain progress toward healthy air quality.

The addition this year of CE-CERT's new Heavy Duty Chassis Dynamometer completes a suite of tools for in-use testing and emissions characterization of all types of vehicles that is second to none, according to Emissions and Fuels Research Group leader Wayne Miller. The Center also boasts a Heavy Duty Engine Dynamometer, a Light Duty Chassis Dynamometer and the Mobile Emissions Laboratory, a reference laboratory for in-use measurements.

With the addition of two new project scientists, ATFR has eight leading fuel scientists and engineers together with more than 100 years of experience in the field, providing a foundation for research and testing that will give state and federal authorities the ready capability to assess and test fuels that stand to further their transportation energy objectives.

The seed money for the ATFR center of excellence came from a \$1.2 million grant from the California Energy Commission. The new center will work on characterizing the emissions and performance of



Welch, Gutierrez

to Help Meet Alt-Fuels Goals

proposed alternative fuels and ensuring these new fuels will not have adverse health or environmental impacts. The range of fuel formulations and vehicle technologies has continued to expand under the state's Alternative Fuel Technology Program, funded by Assembly Bill 118. The center of excellence has amassed the instrumentation and the expertise to evaluate the compatibilities of different fuel/engine/vehicle technologies, said Research Engineer Tom Durbin.

During 2010, Durbin *et al.* began working with the California Energy Commission to draft its Alternative Fuels Research Roadmap, which will help set funding priorities for research, development, and demonstration of alternative fuels to meet the state's renewable energy goals. The group has also been working with the California Air Resources Board (CARB) on a comprehensive study of biodiesel. This is the largest biodiesel study to date and will support implementation of CARB's Low Carbon Fuel Standard that will increase the use of renewable fuels in gasoline and diesel fuel sold in California.

The Center also conducted an intensive comparison study of diesel fuel meeting California requirements versus those meeting the less stringent Federal requirements. CARB commissioned the study to understand how the two diesel fuels performed with recent improvements in engine and control system engineering.

pollution, in particular, can have devastating health impacts, including cancer and a host of respiratory and cardiovascular ailments, according the California Air Resources Board (CARB).

"Establishing the scientific basis for industry and government to make our air healthier is a role we are proud of," said J. Wayne Miller, Adjunct Professor and Associate Director of Emissions and Fuels Research at CE-CERT. "Millions of people live near North American ports, so this work will have a direct impact on air quality."

At the 2010 Board of Advisors meeting, Miller presented a summary of national and state regulations which were developed with the help of EFR Group research:

Emission Regulation

- Backup generators
- Verification of controls for backup generators
- Cargo handling equipment
- Controls for main propulsion and auxiliary engines for ocean going vessels
- Vessel speed reduction of ocean going vessels
- Measurement of in-use atmospheric chloropicrin emissions

Fuel Regulation

- CA diesel fuel formulation
- Oxygenates: CARB Predictive and EPA Complex model
- Biodiesel program
- U.S./CA diesel comparison
- Gasoline with >10% ethanol

The EFR group also was selected by the U.S. Navy to evaluate the performance of new passenger ferries operating at the USS Arizona Memorial at Pearl Harbor, Hawaii. This study was a prime opportunity to measure the benefits of multiple current strategies to reduce air emissions from harbor craft. Ships are the largest contributors of pollutant emissions at port facilities. But harbor craft, including tugboats, are also significant contributors of marine-source emissions, which have attracted increasing interest because of the air quality impacts on surrounding population centers.

New technologies employed at Pearl Harbor included improved engine design, the use of a biofuel/diesel blend, as well as exhaust after-treatment. The team confirmed that the new ferry boats were considerably cleaner. NO_x emissions were cut by 47 percent compared to the old vessels they replaced. Particulate emissions were reduced by 83 percent, but were still higher than predicted by the manufacturer.

The results allowed CE-CERT to recommend that the Navy switch to 100 percent biofuel to further cut PM and other toxic air contaminants. They also recommended that control systems be added to heat the exhaust stream to reduce organic carbon to near zero.

The value of new abatement technology was also demonstrated in a study to evaluate the world's first hybrid tugboat for the Ports of Los Angeles and Long Beach. The research concluded that hybrid technology is effective for reducing emissions — as much as 73 percent for soot. Greenhouse gas emissions (carbon dioxide) was cut 27 percent and smog component NO_x was reduced by 51 percent.

Portable Sensors Taking Center Stage As Diesel Regulations Require ‘In-Use’ Measurement

In a sea change for clean air requirements, state and federal air quality regulators are beginning to require “in-use” compliance testing of particulate matter (PM) for diesel engines.

Until recently, in-use measurement was a unique job for a semi-trailer truck-sized rolling reference laboratory — CE-CERT’s Mobile Emission Laboratory (MEL). For enforcement of more accurate in-use regulations for the plethora of diesel engines operating on-road, off-road, on-water, and elsewhere, portable emission measurement systems are becoming essential.

During 2010, the Emissions and Fuels Research Group evaluated two of the three EPA certified PEMS (Portable Emissions Measurement System) devices that very recently became available to measure PM. CE-CERT previously had evaluated commercial gaseous PEMS systems.

EPA, CARB and the Engine Manufacturers Association (EMA) engaged CE-CERT to validate the measurement allowance, or a measure of the accuracy of PEMS compared to a reference measurement. The equipment is miniaturized enough that it can be carried in or on the diesel vehicles during normal use.

“We are entering a world where in-use measurement is becoming the standard,” said Research Engineer Kent Johnson, the PI on the project. “To our reference method (laboratory analysis of Teflon filters) we are adding a new reference method (real time measurements using various new techniques).

Are we ready? The two models tested performed well in certain measurements, but require additional development for others. PM represents particles with a range of sizes and compositions which new real-time measurement techniques can greatly overestimate or miss altogether, according to Johnson.

Just as importantly, the comparison found that measurements of the PEMS machines can be altered by conditions in the field, and that they can require hardware reconfiguration for the greatest accuracy in various applications. Regulators may be receiving compliance data from operators with a extremely wide range of knowledge and experience in monitoring.

On March 24, 2011 CE-CERT is presenting a day-long workshop on the new PEMS technology — sponsored by EMA, AQMD, AVL, CARB, Horiba, Emisense, Sensors and others. There, academics, manufacturers, regulators and users will gather to review the capabilities of the technology and the operatorational issues.



It's Not All Trial and Error Sometimes Science Just Delicious

Those who believe science is all about trial and error were not at the College of Engineering-Center for Environmental Research and Technology on May 12, 2010.

Then engineers cooked more than 700 cheese quesadillas in a marathon experiment – every one of them delicious.

The food was provided by Chipotle Mexican Grill, which hired CE-CERT to test the emissions profile from the grilling of the cheesy favorites. The results could affect how grills are configured at Chipotles in 35 states, Canada and Europe.

As a group, restaurants use more energy per square foot than any other commercial business, according to Bill Welch, Principal Development Engineer at CE-CERT. The Center has studied emissions from commercial kitchen appliances before, including charbroilers, griddles, ovens and deep fat fryers.

In 2011, CE-CERT is collaborating with the South Coast Air Quality Management District on research to determine the effectiveness of cooking emissions control technologies, Welch added.

The quesadilla research will help Chipotle configure and equip kitchen facilities to best conserve energy. Saving energy is a priority for the company, whose largest costs of doing business are labor and electricity.

Twenty-two graduate and undergraduate students working at the Center took shifts cooking quesadillas continuously at a much higher rate than would ever likely occur in an actual restaurant, Welch said, adding that they wanted to measure emissions at a very high activity rate. Meanwhile, Welch was on the roof of the cooking laboratory, monitoring the emissions equipment and collecting samples.

Observers representing Underwriters Laboratories (UL) were also on hand for the entire eight hour session to certify a UL approved test was taking place.

CE-CERT faculty, staff and students feasted on the tasty by-products of the research, random checks of which confirmed that were no errors in the cooking process. The rest were immediately placed in two large freezers for delivery to Redland’s-based Inland Harvest Food Bank.

UCR Opens Heavy-Duty Dynamometer for Buses and Trucks

Increased interest on the health effects of emissions from buses and trucks and their associated control technologies has created the need for a new research tool at the University of California, Riverside. Driven by that need, CE-CERT installed a Heavy-Duty Chassis Dynamometer (HDCD). Over nearly 20 years CE-CERT has conducted tens of thousands of vehicle emissions tests with its Light-Duty Chassis Dynamometer, Heavy-Duty Engine Dynamometer, and Mobile and Portable Emissions Laboratories.

The key component of the dynamometer is a rotating drum that simulates the forces of driving on the road. The HDCD is similar to dynamometers used in a “smog check,” but more sophisticated. “The dynamometer adds new capabilities in California that are only matched at a few other facilities in the country,” said Research Engineer Tom Durbin. State and federal requirements for emissions testing is trending away from steady state and engine testing in favor of transient conditions found in real-world driving, Durbin explained.

The new dynamometer can handle buses and trucks over on-road

driving conditions. It includes a 48” Electric AC Chassis Dynamometer with dual, direct connected, 300 horsepower motors attached to each roll set. The dynamometer applies appropriate loads to a vehicle to simulate factors such as the friction of the roadway and wind resistance that it would experience under typical driving. A driver accelerates and decelerates following a driving trace while on the dynamometer. As the on-road driving conditions are simulated, emissions measurements are collected with CE-CERT’s Mobile Emissions Laboratory (MEL).

Among the first research programs utilizing the new facility were a comparison of emissions from federally mandated diesel fuel with those from the stricter California formulation. Auxiliary equipment from the Ports of Los Angeles and Long Beach are also being evaluated, as well as natural gas busses and refuse haulers.

“This addition significantly expands our laboratory and measurement capabilities. It will help us better serve our clients and maintain our role as the leading experts in the field of emissions research,” said CE-CERT Director Matthew Barth.

The dynamometer system is designed to meet Heavy Duty Drive Schedules for diesel trucks in the weight range of 10,000 to 80,000 lbs including the following:

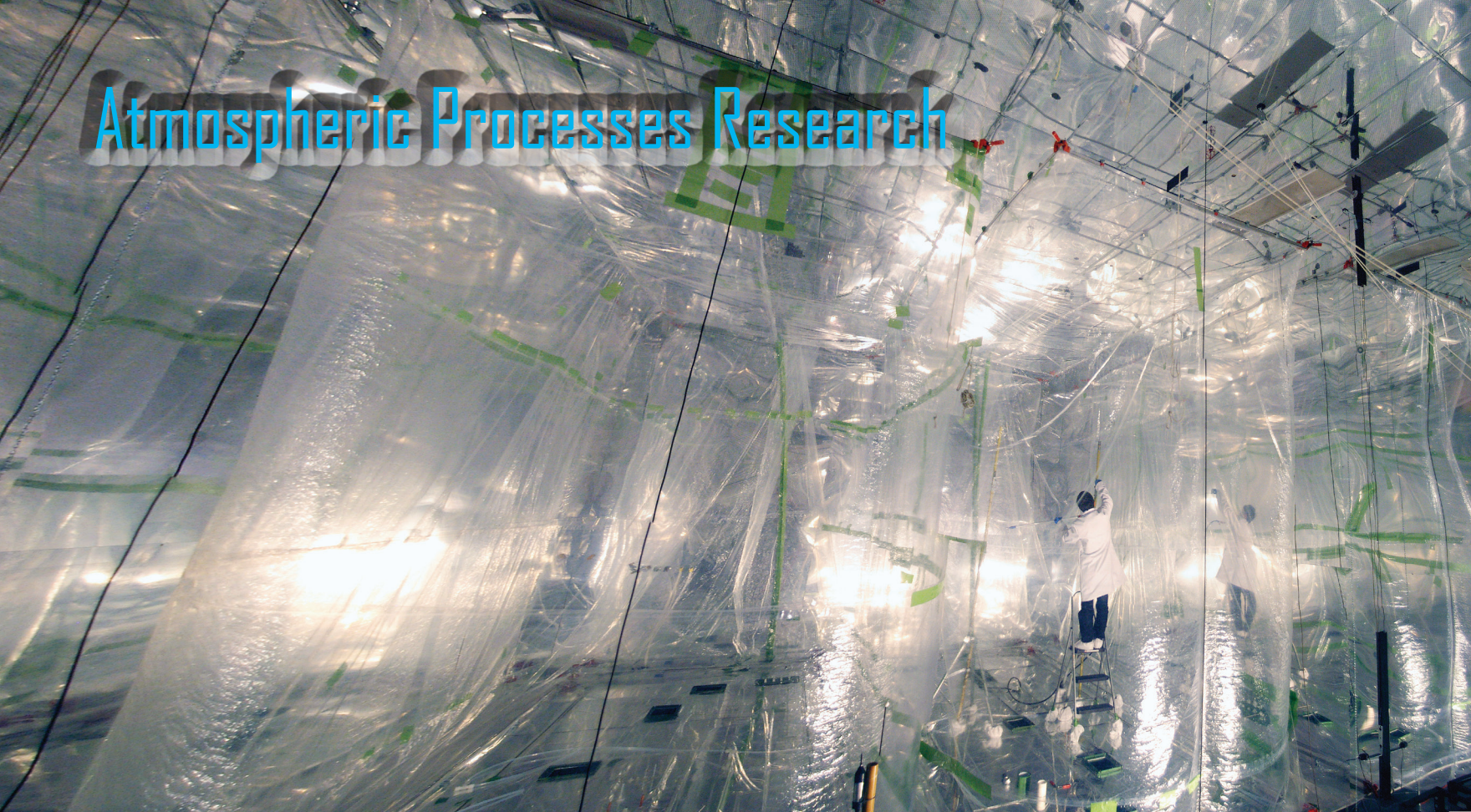
- CARB HHDDT Cruise Mode Drive Schedule;
- UDDS (Urban Dynamometer Drive Schedule);
- CARB 50 mph HHDDT Cruise Schedule;
- HHDDT Transient Mode Drive Schedule;
- WHM Refuse Drive Schedule;
- Bus cycles such as, the CBD, OC Bus cycle, NY bus cycle;
- In-use cycles for applications such as yard tractors.

Features/Specifications:

- A 48-inch Electric AC Chassis Dynamometer with dual, direct connected 300 horsepower motors;
- Acceleration and deceleration rates of up to 7 mph/sec;
- Handles loads in excess of 600 horsepower @ 70 mph.



Atmospheric Processes Research

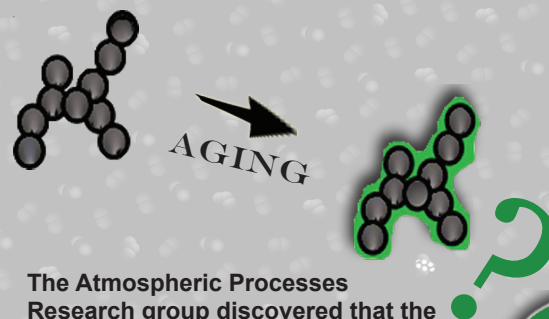


The Atmospheric Processes Research Group continued to expand its formidable array of cutting edge instrumentation which give them, in some cases, totally unique windows into real-time, *in-situ* reactions of gasses and particles — as they occur.

The additions to the laboratory extended the groups capability to strengthen regulatory models by studying the chemical mechanisms for the formation of ozone and particulate matter (PM).

UCR Professor of Chemistry Jingsong Zhang designed and built a capacity enhanced absorption spectrometer at the Atmospheric Processes Laboratory. This new device offers researchers an unprecedented ability to study the reactivity of NO_2 with key atmospheric species.

Also, the chamber's cavity ring down spectrometer was coupled with Peroxy Radical Chemical Amplifier (PERCA) techniques, creating the ability to measure 'in-situ' development of hydroperoxy- and peroxy-radicals. These compounds are important in both ozone and PM formation and the combined instruments will be critical to further enhancement of ozone models for SO_2 formation.



The Atmospheric Processes Research group discovered that the shape of microscopic particles can have a large affect on the interpretation of the number of particles observed to have been produced.



Third, a particle into liquid sampler (PILS) and an accurate mass time of flight mass spectrometer (ToFMS) were combined to observe in real time the evolution of chemical composition of particulates within the chamber. This is a one-of-a-kind instrument that gives CE-CERT researchers the unique capacity to employ the gentle ionizing properties of the ToFMS to observe parent molecules as they are formed or destroyed in real time.

The combination apparatus was able to reproduce results reported with the use of aerosol mass spectroscopy (AMS) and filter sampling mass spectral analysis. The research allowed the group to identify the advantages and disadvantages of all three techniques for change-state chemical characterization. For the new PILS-ToF method, advantages were its real-time capabilities and atmospheric pressure ionization. Key disadvantages found involved the dilution of samples and a tendency to introduce matrix effects.

According to David Cocker, Associate Professor of Chemical and Environmental Engineering, such exotic instruments are called for to study the chemical mechanisms of microscopic airborne molecules, often short-lived, unstable molecules, as they form, pass back and forth from gaseous to solid states, and combine and react as they “age.”

The group conducted the first study of amines for their potential for cloud formation. Amines are VOCs that are found in significantly high concentrations near agricultural areas where animals are kept. The work established that amines can form PM through oxidation with nitrate radicals and hydroxyl radical. However, they found the standard theory for explaining the formation of Cloud Condensation Nuclei (CCN) (k-Kohler theory) was not sufficient to evaluate the CCN activity of amine SOA. In future studies they will consider surface tension and solubility to better explain the CCN activity of these compounds. Understanding the impact of anthropogenic contributions of aerosol to cloud formation and the hydrological cycle is one of the most important open questions in the science of climate change.

Following the impact of volatile organic compounds (VOC) on atmospheric particulate matter, the group studied gas phase reactions of amines and their role in particle formation in agricultural areas. Amines emitted from areas where animals are kept in large numbers are a prime suspect, and a hotly debated issue worldwide, for particle formation in the atmosphere.

For the first time at UCR, the physical properties and aerosol forming potential of wood smoke and diesel exhaust was examined in the atmospheric chamber. The wood smoke work was an off shoot of earlier collaborations with the University of Montana and the U.S. Forest Service’s Fire Science Laboratory in Riverside.

Among the key findings that will influence future work was that the method of introducing the materials into the chamber greatly influenced the physical growth of particles in the experiments. Another important finding was that the shape of microscopic particles can have a large effect on the interpretation of the number of particles observed to have been produced. Both findings could have important influences on future measurements and experimental design.

Researcher Brings New Horizons with Climate, Biogenics Interest

The Atmospheric Processes Research Group acquired new research interests in climate and health with the addition of Akua A. Asa-Awuku, an Assistant Professor of Chemical and Environmental Engineering.

Professor Asa-Awuku’s primary goal is to understand the links between air quality, climate, and health with a specific focus on the ability of aerosols, particulate matter (PM), to uptake water. Particulate matter plays a key role in cloud formation, the hydrological cycle, and climate. Tiny solid or liquid PM can serve as seeds, called cloud condensation nuclei, for cloud droplet formation. Similar size particles affect air quality and health and can induce droplet formation in the lungs.

She looks forward to a day when the gas and particle phase findings of atmospheric scientists merge with our knowledge of epidemiological science of health effects and disease distribution, for a more complete biogenic perspective of life and the environment.

Professor Asa-Awuku completed her Ph.D. in chemical engineering from Georgia Tech where she studied the influences of water-soluble organic aerosols on cloud droplet formation processes.

As the Dreyfus Postdoctoral Fellow at the Center for Atmospheric Particle Studies at Carnegie Mellon University, she studied the mixing capabilities of primary organic aerosols and proved that they indeed can evaporate and react with other organic species. Since arriving at CE-CERT, she has established her laboratory near the atmospheric chamber. Her initial projects in the lab are varied and include the exploration of the surface tension properties of droplet solutions, the cloud condensation nuclei ability of aerosols, and the impacts of insoluble and soluble organic contributions.

UCR is a great place for a career in aerosol science because of the active and varied programs in atmospheric chemistry and engine and combustion testing, Asa-Awuku said. “It is rare to have daily access to state-of-the art atmospheric and source testing facilities. It offers a lot of avenues for my interests.”



Environmental Library Dedicated in Memory of CE-CERT's 'Guiding Light'

The Digital Environmental Library at the College of Engineering-Center for Environmental Research and Technology was officially dedicated in honor of Helen O. Petrauskas, the first female Vice President at Ford Motor Company and an early benefactor of the Center.

A group of dignitaries, including her succeeding Ford Vice President Susan Cischke honored her legacy of leadership in transportation health and safety at the dedication ceremony on April 14, 2010.

Photos: Above, Ford Motor Company Vice President Susan Cischke (left) and Professor of Environmental Engineering Joseph Norbeck celebrate the dedication of the Petrauskas Environmental Library. Below, Cischke recalled the influence Petrauskas had in the founding of CE-CERT.

Cischke recounted that when Petrauskas encouraged founding CE-CERT Director Joseph Norbeck to leave Ford to join UCR she was looking to the future. CE-CERT "had a clear mission – to become a recognized leader in environmental education, a collaborator with industry and government to improve the technical basis for regulation and policy."

"It was also to be a creative source for new technology and a contributor towards a greater understanding of environmental impacts," she continued. "That vision has been achieved. CE-CERT has built what very well may be the best vehicle emissions research facility at any university in this country. The work you do here continues to serve as a bridge between industry and government, between the present and the future. Helen would be proud of all you have accomplished."

Reza Abbaschian, dean of the Bourns College of Engineering, praised Ford's and Petrauskas' style of philanthropy which invested in a new idea to create environmental research center which could begin to bring government and industry together at a time when their relationship was adversarial.

Joe Norbeck said Petrauskas visited UCR when the \$10 million CE-CERT endowment was made. At that time, she impressed on Norbeck the importance of preparing new generations of environmental scientists, regulators and lawyers. "This is the most important thing I have done in my career," Norbeck quoted her as saying then. Petrauskas also



Ford Motor Company VP Susan Cischke (right top photo) joined the Center in dedicating its library in honor of her predecessor Helen Petrauskas.



used her influence with industry colleagues to introduce CE-CERT and its capabilities.

Chancellor Timothy White was in Korea establishing new connections with Asian universities and unable to attend the ceremony. He recorded a video greeting for the ceremony which succinctly captured the spirit of the event. "Unfortunately, I never had the pleasure of meeting Ms. Petrauskas," the Chancellor said, "but it's important for us to remember her legacy of working for increased safety and environmental improvement from a seat of power within the auto industry."

"The Ford Motor Company was the key patron for establishing this place where industry, government and academia have successfully worked on common goals for almost 20 years," White continued, "and Ms. Petrauskas' particular concern for educating new generations for this work makes the dedication of the Helen O. Petrauskas Environmental Library . . . a fundamentally appropriate symbol for her life, her work, and her memory."

Petrauskas died in 2006 at age 61. Friends and colleagues at Ford made contributions to help create the Petrauskas Environmental Library.

Yeager Brothers Honored for Strength of their Vision for Education, Research, Environment

Eugene Yeager Remembered



Gordon Bourns congratulated Gene Yeager at the dedication of the Yeager Brothers' Conference Room in May.

Eugene Yeager, among the earliest major philanthropists who helped establish CE-CERT at UCR, died Sept. 5, 2010 at Eisenhower Medical Center in Rancho Mirage.

Yeager and his brother Jacques built a significant amount of the infrastructure in Southern California through their E.L. Yeager Construction Company. Both civil engineers, the brothers became interested in new transportation technology during their work in highway building.

"Men of Gene's vision are rare," said Matthew Barth, CE-CERT Director and Yeager Families Professor of Environmental Engineering at the Bourns College of Engineering. "While he was busy building one of the nation's large public works and construction companies, he was also looking ahead to making our transportation system as safe and clean as possible."

"Gene, along with his family, have been such important forces for positive change in so many areas," Barth added. "He was critical to our success. He will be missed."

The major conference room at the College of Engineering- Center for Environmental Research and Technology (CE-CERT) was christened May 17, 2010 in honor of Jacques and Eugene Yeager.

The Jacques and Eugene Yeager Conference Room was named at a ceremony attended by more than 100 luminaries from around Southern California representing politics, business and education.

UCR Chancellor Timothy White led the chorus of praise for the two brothers who were central to the development of the whole region as owners of their family business, the E.L. Yeager Construction Company.

"From family friends, to political figures, all of us are here to honor two men of tremendous vision and generosity," Chancellor White said. "Both Jacques and Gene are leaders who possessed a vision for their company, a vision for their community, and a vision for this University."

Educated in civil engineering, the Yeagers have been among the leading philanthropists benefitting UCR, particularly the Bourns College of Engineering and CE-CERT. The Yeager Conference Room was chosen to commemorate the brothers' support because it is the chief meeting place where industry, government and academic researchers meet to present their work.

Engineering Dean Reza Abbaschian credited the Yeagers for having the vision to see the importance of CE-CERT and making principal contributions allowing the Center to meet the Ford Motor Company challenge grant establishing CE-CERT's endowment.

"Steeped in the science of engineering, they were impressed with the progressive research on road construction that was taking place in California," Abbaschian said. "They recognized the importance of future technologies – of sensors, emission controls, and new ways of designing transportation systems – technologies that formed the founding vision of CE-CERT."

"None of this could have happened without the vision and the support of individuals like Jacques and Gene Yeager," said CE-CERT Director Matthew Barth. "The Yeager brothers saw the importance of CE-CERT from the early years. There have been gatherings to honor this extraordinary family on campus before, but this recognition ties directly to their support of environmental issues and I, as CE-CERT director and as Yeager Family Professor of Electrical Engineering, am most honored to be here to play a part in it."



2010 Highlights

Wyman Placed Among World's Top 100 in Bioenergy

What do the U.S. Secretaries of Energy, Agriculture and the Navy have in common with a CE-CERT faculty engineer?

They are all on a list of the world's most influential experts in bioenergy compiled by the readers and editors of Biofuels Digest.

Charles Wyman, the Ford Motor Company Professor of Environmental Engineering at CE-CERT, was named to the list compiled from 15,000 votes by the publications readers, who identified more than 400 leaders in biofuels around the world.

The list was heavy with names of industry chief executive officers from a dozen nations, including those of three Brazilian bioenergy giants UNICA, Cosan and Petrobras.

Wyman was among eight academics noted on the list, including three from University of California campuses.

Knowledgeable sources noted that Wyman landed one of the highest vote totals as a co-founder of Mascoma (also high on the list) among other projects, and as a leader at the National Renewable Energy Laboratory.



Wyman

CE-CERT Synthetic Fuel Researcher Named State Renewable Fuel Advisor

Joseph Norbeck, founding director of CE-CERT, was named to the Advisory Committee of the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program.

The Advisory Committee provides technical and policy input on how to best spend the mandated funds to meet the State's transportation energy goals. Examples include identifying overlooked issues, methods for calculating funding levels and evaluating progress, improving program review, and streamlining implementation.

Norbeck is the holder of the W. Ruel Johnson Chair in Engineering. During nearly 20 years at CE-CERT, his research has focused on vehicle emissions and air quality, development of renewable fuels, and development of advanced vehicle technologies.

The patented Steam Hydrogasification Process, developed in Norbeck's lab, for producing synthetic diesel from any carbonaceous materials or wastes was recently rated the most efficient and least capital intensive of all gasification processes evaluated by the U.S. Department of Energy.

The State's Alternative Fuel Technology Program was established in 2007 by Assembly Bill 118, which provides over \$200 million annually to help California develop and deploy transportation technologies and fuels to reduce greenhouse gas emissions and petroleum dependence.

Norbeck has previously served in science and engineering advisory roles, including the California Inspection/Maintenance Review Committee, the Cal/EPA Environmental Technology Partnership Task Force, the Executive Research Advisory Committee of the Society of Automotive Engineers, and the Scientific Review Committee for the South Coast Air Quality Management District.

AQMD Honors IntelliShare System for Transportation Innovation

CE-CERT's ground breaking UCR IntelliShare shared-use vehicle system was honored with a South Coast Air Quality Management District (AQMD) Clean Air Award on Friday, Oct. 1, 2010 at LA's Millennium Biltmore Hotel.

The UCR IntelliShare program was recognized as an innovative transportation project in which a vehicle fleet is shared by many people throughout a day. At the University of California-Riverside, the research provided innovative carsharing services to faculty, staff, and students for several years.



The work yielded a vast amount of data on carsharing technology, resulting in 14 scientific papers, seven U.S. patents, and six international patents. Shared-use vehicle systems offer a tool to optimize land use in major congested areas such as university campuses, business centers, and tourist destinations.

"We still live in a society that is fixated on personal vehicle ownership," said Matthew Barth, CE-CERT Director and Principal Investigator on the UCR IntelliShare program. "But personal mobility without the burdens of vehicle ownership is a viable option for many people."

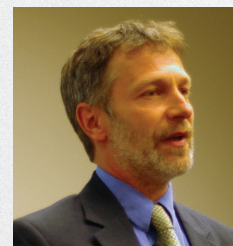
UCR IntelliShare provided individual mobility while minimizing the constraints of alternative fueled vehicles, parking congestion, and access to transit, added Michael Todd, project engineer for UCR IntelliShare. "Operation of the UCR IntelliShare testbed system has demonstrated that shared use vehicle systems can be efficient, economical, and flexible while providing emissions reductions," he said.

IntelliShare consisted of 35 Honda EV Plus electric vehicles, 10 Ford Think City vehicles, and 11 GEM Neighborhood Electric Vehicles (NEVs). In recent years, the system transitioned to 20 Clean Natural Gas (CNG) Honda Civic GXs that were available to UCR faculty, staff, and student employees at six stations located on and near the UCR campus. Most recently the system completed its transit linked evaluation during which two CNG Honda Civics operated between Riverside's Metrolink Station and the UCR campus.

Research on the functionality of share transportation systems is continuing at the Center with wireless telematic systems, vehicle fleet monitoring, and eco-driving architectures.



Orbach



Keller



Jorgensen

Jorgensen, Keller, Orbach Honored for CE-CERT Service

Robert A. Jorgensen, Martin Keller and Raymond Orbach were recognized with 2010 Distinguished Service Awards of the College of Engineering-Center for Environmental Research and Technology. The awards are given to individuals in industry, government and academia who have provided outstanding assistance helping CE-CERT further its agenda of research, teaching and service.

Orbach, a former UCR Chancellor and the first Under Secretary for Science in the U.S. Department of Energy is currently director of The University of Texas at Austin's Energy Institute. Previous winners from academia include Elizabeth Deakin, William Pierson, Robert Sawyer and Susan Hackwood.

Jorgensen is Executive Director, Product Environmental Management for Cummins, Inc. He also serves on the Center's Board of Advisors. Previous winners from industry include William Johnson, Samuel Leonard, Kelly Brown and Ben Knight.

Keller is associate lab director for biological and environmental sciences at Oak Ridge National Laboratory, who in his previous role as director of the BioEnergy Science Center (BESC), worked closely with biofuels researchers at CE-CERT. Previous governmental winners include Ronald Loveridge, Alan Lloyd, Congressman Ken Calvert and Tom Mullen. Charles Wyman, Ford Motor Company Professor at CE-CERT and colleague of Keller at BESC assisted in the award presentation.

The three awards, which reflect CE-CERT's mission of uniting government, industry and academia in science to benefit the environment, were announced at the Center's Board of Advisors meeting April 13, 2010. Keller delivered the keynote address that evening. Orbach received his Distinguished Service Award during a Nov. 3, 2009 ceremony naming UCR's Science Library in his honor.

Center of Excellence Announced During Alternative Fuels Day Events

CE-CERT has established a new Center of Excellence in Alternative Transportation Fuels Research (ATFR) to provide a foundation for research and testing that will give state and federal authorities the ready capability to assess and test fuels that stand to further their transportation energy objectives.

ATFR was announced August 14 during a day of presentations and discussion at the Center about alternative transportation fuels and their growing importance in the nation's energy future.

An Odyssey Day conference sponsored by the U.S. Department of Energy was held at the Yeager Conference Room consisting of educational talks on the importance of implementing new technologies for transportation that reduce U.S. dependence on foreign petroleum sources and cut the amount of greenhouse gases released by the internal combustion engine.

The same day the U.S. Department of Agriculture presented their Draft Biofuels Strategic Production Report. The report provides estimates for the biofuels industry as a comprehensive regional strategy to help recharge the rural American economy. Topics discussed included potential sources of feedstock, the current local infrastructure to support biofuels, and the estimated land use needed in California

for biofuels. In addition, input was sought on how state and/or federal government agencies can better partner with the private sector to increase demand for biofuels, and on how government agencies can assist with infrastructure improvements in the private sector.

Participating in the biofuels meeting were representatives from CE-CERT; the South Coast Air Quality Management District, Strategic Energy, Environmental and Transportation Alternatives (a non-profit based in Yorba Linda); the Desert Energy Enterprise Center at the College of the Desert; and Southern California commercial biofuel-farming companies.

The day also featured an expo of alternative fuels vehicles in the CE-CERT parking lot provided by: Daimler, Honda, the Port of Los Angeles, the South Coast Air Quality Management District, the City of Riverside, the Riverside Transit Authority, Burrtec, UCR's Transportation and Parking Services and How 2 Save Fuel, Inc.

The ATFR Center of Excellence will work on characterizing the emissions and performance of new alternative fuels and ensuring these new fuels will not have adverse health or environmental impacts. A \$1.2 million grant from the California Energy Commission will provide the seed funding for the center of excellence.

College Signs Agreement with Naval Surface Warfare Center

The Bourns School of Engineering (BCOE) signed an educational agreement with the Naval Surface Warfare Center (NSWC), Corona Division, on Oct. 6, formalizing a partnership that will strengthen ties between the two institutions.

Among other outcomes, the agreement will enhance BCoE students' experience and provide access to NSWC Corona's unique expertise, one-of-a-kind facilities and specialized equipment relating to naval warfare systems and technologies.

For NSWC Corona, the partnership enables it to tap top faculty to help solve challenging technical problems, as well as facilitating training and recruitment of UCR graduates as future employees of the science and engineering command. Some 95 percent of undergraduate interns later hire on with the command.

Dean Reza Abbaschian said the proposed new online master's program and seminars on engineering ethics are areas of immediate collaboration.



Dean Reza Abbaschian (left) and Captain Jay A. Kadowaki (center) sign an educational partnership agreement between the College of Engineering and the Naval Surface Warfare Center, Corona Division.



Wheeled Environmental Laboratory Receives Colorful Makeover

A frequent traveler on California highways has just become more recognizable. CE-CERT's Mobile Emissions Lab (MEL) has received a make-over in 2010, making it a more visible ambassador for University of California, Riverside scientific research.

The Mobile Emissions Lab has performed thousands of emissions tests of various diesel engines and fuel formulations while traveling along California highways over the past 10 years.

The once nondescript tractor trailer truck, originally designed to haul produce, might have escaped the attention of motorists before, but not any longer. With a grant from the Center's Ford Endowment, the MEL now sports a colorful mural utilizing some of the branding elements of the university.

"Research for a Better Environment" is the phrase carried on the truck, reflecting CE-CERT's important role in establishing the scientific basis for current rules and regulations that have helped improve air quality in California. But it is also intended to describe the full range of environmental work that takes place at the College of Engineering-Center of Environmental Research and Technology.

NSF Research Initiation Grants Assist Two Center Researchers

Two CE-CERT researchers have been awarded prestigious research initiation grants by the National Science Foundation (NSF).

Assistant Professors Akua Asa-Awuku and Elaine Haberer at the Bourns College of Engineering both received BRIGE awards (Broadening Participation Research Initiation Grants in Engineering).

Haberer is affiliated with CE-CERT through SC-RISE (Southern California Research Initiative for Solar Energy). Asa-Awuku's laboratory for the study of cloud formation is under development at CE-CERT's Atmospheric Processes Laboratory.

The NSF awards only 27 to 30 BRIGE grants per year. Faculty members at the College have received three BRIGE awards since the program began in 2008.



< **Akua Asa-Awuku**
Elaine Haberer >



Center's Solar Initiative Recognized as 'Diplomacy with Real Impact'

SC-RISE has been recognized as a leading example of international collaboration for sustainable energy by Sister Cities International (SCI).

The Southern California Research Initiative for Solar Energy is a collaboration of industry, academia and other interested parties to drive the adoption of solar energy throughout Southern California.



A meeting of the Solar Initiative working group.

The 2010 Innovation Award for Sustainable Energy Development was presented at SCI's 54th Annual Conference in Albuquerque in July. These awards recognize outstanding achievements in citizen diplomacy which demonstrate real impact in their own city and around the world.

The winner was the City of Riverside's Sister Cities Program, the catalyst which led to the establishment of SC-RISE. In 2007, while celebrating the 50th anniversary of the sister city relationship between Riverside and Sendai, Japan, Riverside Mayor Ronald O. Loveridge brought together the two cities' major research universities – UC Riverside and Tohoku University. From that meeting came SC-RISE.

Loveridge, a longtime UCR professor, said he takes pride that Sister Cities International selected Riverside to receive the award. "We are a city of arts and innovation. By making cutting-edge solar science and technology possible on an international scale, SC-RISE is good for UCR and CE-CERT, it is good for Riverside, and it is good for energy and the environment. SC-RISE is exactly what I challenged UCR, Tohoku University, Sendai and Riverside to make happen when we signed the four-party agreement in Sendai in 2007."

SC-RISE, launched in 2009 with major support from the City of Riverside, was the answer to that challenge.

"This sister city relationship has evoked momentum for critical goals in sustainability that were long overdue," said Matthew Barth,

faculty director of both SC-RISE and the College of Engineering-Center for Environmental Research and Technology. "I can't imagine a more productive town-gown relationship in one hemisphere, let alone two."

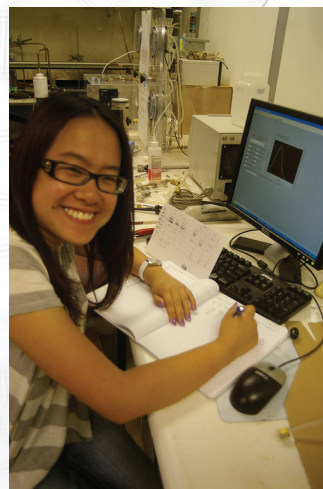
SC-RISE, and the concept behind it, has become an important element in Riverside's strategy for developing new Sister City relationships, according to the city's entry for the Innovation Award. For instance the City and UCR are already exploring additional sustainable energy partnerships in Europe and in Asia.

"This would indicate that Riverside may have captured an important way of leveraging and optimizing Sister City relationships in a world already without borders," the award citation concluded.

Aerosol Researcher Wins Two Fellowships

Doctoral candidate Anh Nguyen has been awarded a National Science Foundation (NSF) Graduate Research Fellowship.

Nguyen, was also awarded the 2010-2011 CE-CERT's Esther F. Hays Graduate Fellowship allowing her to travel to academic research conferences and to the Paul Scherrer Institute in Switzerland which, like CE-CERT, is the site of one of the world's few sophisticated indoor smog chambers.



Nguyen

A Ph.D. student in Mechanical Engineering, Nguyen studies the chemical composition of exhaust from diesel engines. In order to design more efficient diesel particulate filters (DPF), better understanding is needed of the kinetics of soot oxidation, Nguyen said. She is also examining the role of NO_2 in oxidation under varied engine conditions.

Her output kinetics data will be submitted to the Transportation Research Board as the fundamental database for combustion and DPFs to assist the transportation sector in engine emission control to make cost effective and appropriate regulation decisions. She hopes her work will also help improve mathematical models of engine function and combustion.

European Biofuels Researcher Adds to CE-CERT's Alternative Fuels Expertise

Georgios Karavalakis has joined the Center's research faculty as part of the Emissions and Fuels Research Group.



Karavalakis

He previously served as a research fellow at the National Technical University of Athens (NTUA) in Greece where he worked on catalytic systems for biofuels production, fuel quality issues, additives, and fuel technology. His research also included studies of engine combustion and vehicle emission measurements and characterization.

As a consulting engineer he developed novel multifunctional antioxidant additives for biodiesel fuels and he was involved in the development of the fuel analysis laboratory and fuel quality control monitoring of a biofuels production plant at Elin Biofuels in Volos, Greece.

Georgios received his Ph.D. from NTUA's School of Chemical Engineering where his doctoral research concerned optimization of biodiesel production and emissions performance from biodiesel-fueled vehicles.

He was also educated at the University of Portsmouth (UK), earning a Master's in Environmental Engineering and a Bachelor's Degree in Engineering.

"Georgios' involvement in multidisciplinary teams working toward a biofuels industry in Europe will bring us important experience in alternative fuel emission testing and engine performance," said Tom Durbin, Research Engineer in the Emissions and Fuels Research Group.

Chemist and Fuel Designer Russell Joins Emissions Research Group

Associate Project Scientist Robert L. Russell is now part of the Emissions and Fuels Research Group.

Specializing in diesel emission measurement and fuel studies, Russell was formerly Director of Fuel Research and Development for ORYXE Energy International, Inc.

While with Unocal he developed a patented cost-effective diesel fuel formulation which was qualified as emission equivalent to a 10 percent aromatic fuel by the California Air Resources Board for use on California roads.

He received his bachelor's degree from the University of New Hampshire and his Ph.D. in chemistry from UC, Irvine.



Russell

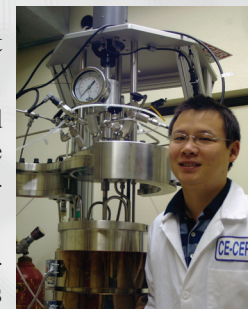
Synthetic Diesel Researcher Receives Pierson/Ford Graduate Fellowship

He Wei, has been awarded the 2010-2011 William R. Pierson/Ford Graduate Student Fellowship at CE-CERT.

Wei, a doctoral candidate in Chemical and Environmental Engineering, is part of the steam hydrogasification synthetic fuel project led by Joseph Norbeck and Chan Park.

He is investigating pre-processing techniques to convert carbonaceous feedstocks into the pumpable form of slurry in a pre-treatment reactor of his own design. The 0.1 ton/day demonstration scale system will utilize co-mingled woody waste and biosolids to produce improved slurry pumpability that could help lead to commercial scale systems of steam hydro-gasification for synthetic diesel production.

Wei said the Pierson Fellowship will provide resources to lead to a better understanding of the rheological properties of the slurries as a function of temperature to optimize the functionality and the energy usage of the preprocessing step.



Wei

NRC: Four Bourns Doctoral Programs Place in Top Quartile for Quality

In what is considered a definitive assessment of the quality of U.S. research doctorate programs, eight UCR programs, including four Bourns College of Engineering Programs, were ranked in the top quartile.

The National Research Council (NRC) released a data-based assessment of U.S. research doctorate programs Sept. 28, recognizing the quality of the College's computer science, electrical engineering, mechanical engineering and chemical engineering programs.

That is essentially the entire Engineering College, since its programs in bioengineering and materials science and engineering were too new at the time of the study to qualify for assessment. CE-CERT affiliated faculty researchers represent the College's faculty in bioengineering, chemical and environmental engineering, electrical engineering, and mechanical engineering.

Among the 27 UCR doctorate programs that were evaluated, the eight in the top quartile, in order of rank were: entomology, computer science, electrical engineering, mechanical engineering, chemical engineering, English, plant biology, and environmental toxicology. The University placed another six doctoral programs in the top third nationally: evolution, ecology, and organismal biology; psychology; soil and water science; plant pathology; physics; and political science.

The NRC study was based on data from 2005-06 that was collected in 2007. It evaluated more than 5,000 doctoral programs in 62 fields within 212 research universities in the U.S. The assessment is



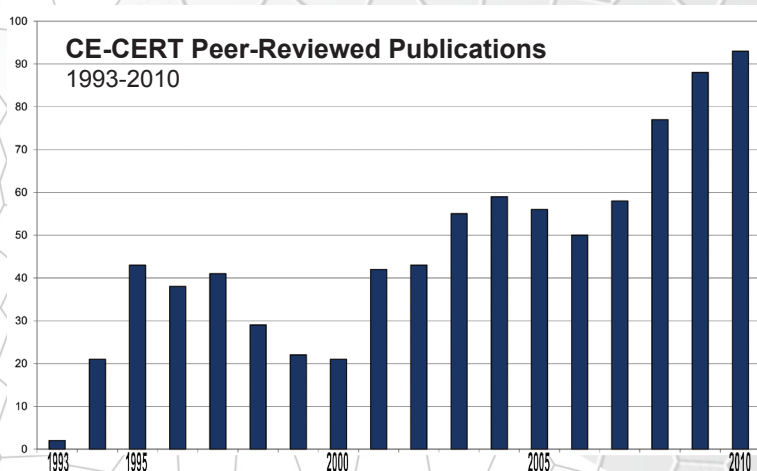
designed to assist students in evaluating the quality of the doctorate program they are considering, and for department chairs and administrators to see how where they can improve their programs, if needed.

"I am extraordinarily proud of our faculty for this stellar achievement," said Dean Reza Abbaschian. "For a college as young as ours to be recognized in this way is remarkable. When one looks at the quality of the faculty and their research, and the dedication to student success and diversity, we are among the nation's leaders. This assessment clearly demonstrates that."

The NRC gathered its data from four sources: an institution questionnaire, a program questionnaire, a faculty questionnaire and a rating of program quality questionnaire (given to a subset of faculty).

Unlike the NRC's previous assessments in 1982 and 1995, which were based on reputational surveys, this year's provides two sets of data-based rankings: an S-ranking (for "survey") and an R-rating (for "regression,") for overall measures of quality -- research activity, student support and outcomes, and diversity of the academic environment. Also notably different in this year's assessment is the absence of a rank-order listing of programs within a field. Instead, the programs were given a range.

The Bourns College of Engineering's rankings showed a marked rise over previous years, particularly when compared to peer institutions.



CE-CERT Biofuels Researcher Honored for Providing New Insights into Pretreatment of Cellulosic Biomass

Graduate Student Researcher Heather L. McKenzie received the Martin Keller Award for the best student poster presentation in the Characterization area at the Bioenergy Science Center (BESC) Summer Retreat. She is a Ph.D. candidate in chemical and environmental engineering at UCR's Bourns College of Engineering and works in



McKenzie

Professor Charles Wyman's Cellulosic Ethanol Pretreatment Laboratory at CE-CERT.

McKenzie's poster dealt with her research, done in collaboration with scientists and engineers in the Environmental and Chemical Sciences Divisions of the Oak Ridge National Laboratory, to understand the release of xylooligomers and lignin during the breakdown of cellulosic biomass to make sugars for fermentation to ethanol and other fuels. By flowing hot water through a fixed bed reactor containing poplar wood, the team was able to more closely follow biomass deconstruction than previously possible.

McKenzie also chaired the graduate student/post doc research session at the retreat, which included several other Graduate Student Researchers from CE-CERT's Cellulosic Ethanol Pretreatment Laboratory: Jaclyn DeMartini (winner of the 2009 Keller Award), Hongjia Li, and Xiadi Gao. All four are Ph.D. candidates in Wyman's group at the Bourns College of Engineering's Department of Chemical and Environmental Engineering.

Representatives of several BESC partners such as Cornell University and the National Renewable Energy Laboratory (NREL) remarked on the strength of the CE-CERT team, which is a leader in pretreatment technology for the national bioenergy team, according to Wyman, the Ford Motor Company Professor of Environmental Engineering at UCR.

BESC is a partnership to capitalize on leading scientific minds and resources to reach the U.S. Department of Energy's bioenergy goals. Based at Oak Ridge National Laboratory, BESC's five year mission is no less than to "revolutionize how bioenergy is processed," leading to the commercialization of cost effective biofuel technologies.

A high throughput pretreatment and hydrolysis (HTPH) system developed last year in Professor Wyman's laboratory is being employed by BESC for rapid screening of large numbers of combinations of plant varieties, pretreatment conditions, and enzyme loadings and formulations that are vital to achieving the BESC goal. Martin Keller, after whom the poster award is named, is the founding Director of BESC.

Vehicle Detection and Classification Approach Recognized at IEEE IV2010

Doctoral candidate Lili Huang received an Award of Distinction for her oral presentation at the 2010 Institute of Electrical and Electronics Engineers (IEEE) Intelligent Vehicles Symposium. The conference took place June 21-24 at University of California, San Diego.

IEEE IV2010 is the premier annual forum for researchers, academics, practitioners and students to discuss research and applications for Intelligent Vehicle And Intelligent Infrastructures. The presentation dealt with research by Huang and CE-CERT Director Matthew Barth's research on "Real-Time Multi-Vehicle Tracking Based on Feature Detection and Color Probability Model."

Part of the center's intelligent transportation systems research agenda, the paper proposed a real-time multi-vehicle tracking approach, which combines both local feature and a global color tracking model. Their vehicle detection and classification using sensor fusion systems has proven to be efficient in high density traffic surveillance.

In addition, a corner-feature detection and tracking algorithm is used to estimate vehicle positions and trajectories. The system accounts for vehicles that are only partially viewable using color probability calculations.

Huang is a graduate student in Electrical Engineering.



Huang, Barth

Successful Shanghai University Research Exchange Reaches Year Six

Four student researchers from CE-CERT traveled to Shanghai China recently to maintain the six-year exchange program of engineering students on opposite sides of the world.

Shanghai Jiao Tong University (SJTU) this year hosted a delegation of students from various CE-CERT research groups, led by Assistant Professor of Mechanical Engineering Heejung Jung.

UCR's continued participation in the research program is thanks to William Johnson, President of Johnson Machinery Company, who has generously supported travel costs and other expenses. Upon their return, the students thanked Mr. Johnson personally with a framed photo of them in front of the grand entrance to the Shanghai university.

The exchange continued to deepen students understanding of the research approaches of both nations. "We saw the possibility for many types of collaboration," said Corey Hardin, who is pursuing a master's in mechanical engineering at UCR. "One of the main openings I observed was the abundance of engine dynos and equipment at SJTU." One strength of the Chinese engineering program is the design/performance of internal combustion engines. CE-CERT's expertise in monitoring and characterizing emissions was a natural complement to the expertise of the SJTU program, he noted.

However, the visitors also looked inside the SJTU labs where emissions were being reduced by studying the combustion behavior and temperature profile inside engines. Yusuf Khan, a Ph.D. student in chemical and environmental engineering said the UCR students found this approach "astonishing."

There were other surprises, such as selective catalyst reduction for reducing NO_x to meet Euro IV and V standards, and SJTU-developed technology that powered clean Shanghai public transit buses with dimethyl ether, Khan added.

At the symposium students shared their own research findings, covering engine dynamics, atmospheric chemistry and renewable



The CE-CERT delegation (left to right, Heejung Jung, Shunsuke Nakao, Qian Luo, Yusuf Kahn, and Corey Hardin) poses in front of a current hero of the people. Entrepreneur and industrialist Sheng Xuan-huai was a key member of the Westernization Movement and one of the first generation industrialists in modern China. His style of capitalism practiced at his textile business in Shanghai proved successful through decades of turmoil and ultimately government supervision.

energy. Shunsuke Nakao, a doctoral student in chemical and environmental engineering, said the sessions revealed a lot of common ground in their interest to push forward the current state of the environmental science and technology.

Qian Luo, a Ph.D. student in chemical and environmental engineering, was struck by China's tremendous need for energy and alternative fuel sources. She said biodiesel should have an important future in that nation, particularly the steam hydrogasification process developed at CE-CERT.

The students all enjoyed the world-class hospitality of their hosts. Three students met them at Shanghai airport holding a UCR banner after which they were treated with day after day of good food and cultural trips for the appreciation of old and new China.

Summer Research Program Helps ‘Bridge’ Engineers to Graduate Study

David Torres’ summer was hot — sometimes reaching 870 degrees Celsius in his lab equipment as he analyzed filter samples of pollutants taken from massive ocean going vessel engines.

Torres, a senior in Chemical Engineering at the Bourns College of Engineering, is one of four undergraduate engineering students who worked at the Center as part of a U.S. Department of Education program to increase the number of low-income, Hispanic and transfer students enrolling in graduate programs in science and technology. The summer research experience is designed to “bridge” students between their undergraduate and graduate studies, thereby gaining valuable experience toward their engineering careers.

UCR’s STEM Pathway Project was awarded \$3,371,470 for a two-year grant funded by the College Cost Reduction and Access Act (CCRAA) and Hispanic Serving Institutions (HSI) Program through the U.S. DOE. UCR has demonstrated success in graduating Hispanic

students in STEM fields (Science, Technology, Engineering, Medicine). Last year the Accreditation Board for Engineering and Technology awarded the College a Claire Felbinger Award for its success in attracting underrepresented students to the engineering profession.

“The goal of the summer bridge program is to get them engaging in research so they are prepared for graduate school,” said Jun Wang, who coordinates the program as the professional development officer at

the Bourns College of Engineering.

Undergraduates who work in active research labs are much more likely to enroll in graduate school, Wang said. Jobs in research labs beats any other summer job for getting students excited about careers

in science, he added. The College has applied for an extension to continue the program next year.

The heat came from Torres’ use of Thermal Optical Analyzers to determine whether fuel or lubricants produce the large amount of particulate organic carbon (POC) pollution emitted from large ship engines. Emissions of large ocean going vessels have been little studied, Cocker explained. But studies that have been done show surprisingly large amount of organic carbon in the exhaust signatures, material that is suspected of major implication for the environment and human health, he said.

Torres assisted in calculating relative contributions of ship fuel and engine lubricants in the POC. “We are only beginning to understand particulate emissions and their origins,” Cocker said.

Another student participating in the STEM Pathway Project was senior Electrical Engineering student Daniel Sandez. He worked with Center Director Matthew Barth and Assistant Research Engineer Kanok Boriboonsomsin as part of their effort to creating “green” vehicle navigational systems that let drivers choose routes that reduce emissions and/or save gas. The technology will expand motorists options beyond current system which only offer the fastest or shortest routes.

Sandez also worked on research to quantify the ratio of air pollution contributed by residents and non-residents of several Inland Empire cities.

Also working under this program in CE-CERT labs this summer were Daniel Morton, a junior in Mechanical Engineering, mentored by Javier Garay; and James Gutierrez, a senior in Environmental Engineering, also mentored by David Cocker.

The 10-week Pathway Project bridge program recently completed with a research symposium during which the 21 participating students presented their research results. In addition to time in laboratories working with graduate students and faculty mentors, the students met weekly for workshops and seminars. The experience gives students a chance to try out career interests and understand the importance of faculty mentors to graduate program completion.



Sandez



Gutierrez



Torres

Undergraduate Environmental Research Comes into Focus at CE-CERT

Spring Quarter brought a flurry of environmental research by undergraduates in Chemical and Environmental Engineering at the Bourns College of Engineering and its Center for Environmental Research and Technology.



Two teams competed in the U.S. Environmental Protection Agency's (EPA) P3 (People, Prosperity and the Planet) competition in Washington DC.

Each team won \$10,000 last year to develop their sustainable technology designs and made them eligible for the 2010 showcase in the National Mall.

A team which developed its project in the CE-CERT labs of Charles Wyman was recognized with an honorable mention in Washington. Their work explored techniques for diverting green wastes from landfills to produce ethanol for transportation fuel. The team was made up of Anthony Turgman, Josh Garong, Vu Nguyen, and Christine Kwon.

Also competing in Washington in 2010 was a team working on concentrating solar power to improve methods of water desalinization. Undergraduates on that team were John Johnson, Christopher Salinas, Elizha West, Wesley Chen, Alex Chen and Luke Chen.

Again in 2010 the College won two additional EPA P3 National Sustainable Design Expo grants for the second straight year. The unusual success will send two more teams to the national student design competition and provide each with \$10,000 to conduct their research.

One team is working in Joe Norbeck's Steam Hydrogasification laboratory at CE-CERT to demonstrate technologies to reduce waste streams generated on campus to produce energy sources through diesel and methane. That team consists of Douglas Duchon, Phillip Brendecke, Joshua Comfort, Thinh Vo, and Stephanie Stasiuk.

The second team is working in Yushan Yan's laboratories to explore ways to provide electricity in remote areas using unitized regenerative hydroxide exchange membrane fuel cell. This work is being conducted by Marcus Chiu, Christian Contreras, Joon-Bok Lee, and Jason Skovgard.

Bourns Chemical and Environmental Engineering undergraduates also won second place at the WERC 20th International Environmental Design Contest in Las Cruces, NM this spring. It was the highest place ever for UCR in the competition in which the students dealt with the problem of "Reduction of Direct Greenhouse Gas Emissions from a Mine."

WERC is a consortium for environmental education and technology development based in New Mexico. The design competition challenges teams with one of a series of engineering challenges for which they develop bench-scale demonstrations, papers, oral presentations, and poster presentations. The WERC award-winning team includes Mina Ghabbour, Bryan Goldsmith, Robert Bonderer, Kyle Pease and Dylan Switzer.

Faculty/research advisors for the above projects included Sundar V, Mark Matsumoto, Joe Norbeck, Yushan Yan, Charles Wyman, and Kawai Tam. Tam has coordinated UCR's participation in the EPA P3 competition at UCR since 2004, sending six teams to the national design expo in that time.



Food Waste-to-Fuel Team Works With Public Utility

A student team working in CE-CERT's Steam Hydrogasification (SHG) Laboratory has received a second research grant to support their study of generating liquid transportation fuel from food wastes.

The undergraduate engineering students are evaluating the feasibility of diverting UC Riverside waste streams away from landfills, producing synthetic diesel fuel for the university's vehicle fleet.

The American Public Power Association (APPA) awarded one of its 10 annual DEED (Demonstration of Energy-Efficient Development) grants to support the study.



Duchon, Stasiuk, Vo

Evaluations of both sorted and non-sorted waste streams revealed proportions of wastes (41 percent paper/wood, 46 percent landscaping waste, 13 percent food). Processing of simulated food waste suggested a favorable carbon conversion rate.

The study also found waste streams from the University alone were not enough to make the idea economically viable. The APPA grant is allowing them to partner with the Riverside Public Utilities, which is also interested in fueling its vehicle fleet with diverted wastes.

CE-CERT Advisor Delivers 2010 Commencement Address

Ford Motor Company executive Robert D. Brown delivered an uplifting Commencement Address at the University of California, Riverside Bourns College of Engineering Commencement Ceremony on June 14.



Brown

Brown, Director for Vehicle Environmental Engineering at Ford, is a member of the Board of Advisors at the College of Engineering-Center for Environmental Research and Technology. His message to graduates earning BS, MS and Ph.D. degrees stressed the importance of teachers, family and ethical character as the foundation of meaningful lives.

“You have been taught to work for goals that transcend the individual,” Brown told the Class of 2010. “As engineers you have also been trained to acquire and apply technical, scientific, and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realized a desired objective and that improve the quality of life. I ask that you use a significant portion of the time and talent that you have, and the treasure that you will surely accumulate to serve others.”

Brown closed by urging graduates to make good use of the gifts of family, education and character. “Go forth in the certain knowledge that all you will eventually leave behind are your good name, your

good works, and the blessings of your children. Graduates, your only limitations are your dreams. So dream well and dream large. And, always remember it is the content and quality of your character that ultimately defines who you are.”

A video of his address can be viewed at UCR’s Commencement 2010 “A Look Back” page.

Sustainable Energy Group Welcomes Enzyme Research Specialist

Rajeev Kumar has joined CE-CERT as Assistant Research Engineer in the Sustainable Energy Systems Research Group.

He comes to the Center from Zymetis, Inc. of College Park, Maryland where he was Director of Enzyme Product Development.

Much of his research has been in lignocellulosic biomass pretreatment, including biomass characterizations, substrate-enzymes interactions, and hydrolysis of biomass in the production of biofuels.



Kumar

Kumar earned his Ph.D. in Biochemical and Chemical Engineering from the Thayer School of Engineering at Dartmouth College, NH. His Masters and Bachelor’s Degrees came from the Indian Institute of Technology, Kanpur and Punjab Technical University, Punjab, respectively.

Because enzymes are key catalysts in the process of releasing energy from cellulosic biomass and are essential for the economic production of biofuels, Kumar will bring significant expertise to the Center’s effort toward making ethanol production from such materials commercializable, said Charles Wyman, Ford Motor Company Chair in Environmental Engineering, and co-leader of the sustainable fuels group.

CE-CERT is investigating the biofuel potential of a range of types of cellulosic biomass including “yard wastes,” agricultural residues (e.g., corn stover), forestry residues (e.g., sawdust), and woody (e.g., poplar) and herbaceous (e.g., switchgrass) energy crops.



A lawn mower exchange was hosted in the CE-CERT/ Bourns Inc. parking lot on June 5. The Southern California Air Quality Management District (SCAQMD) and the California Air Resources Board sponsored the event during which gasoline mowers were exchanged for a significant discount on a new electric, zero-emission lawn mower. According to SCAQMD a conventional lawn mower’s annual emissions can equal that of a car driven more than 20,000 miles.

Bank of America Program Yields Successful Collaboration for Science

Ten Riverside high school students who worked at UCR labs will move on to compete in the Inland Area Science and Engineering Fair in April, having scored gold or silver medals in the Riverside Unified School District (RUSD) science and engineering competition held at UC Riverside in February.

Thanks to a grant by Bank of America, faculty and researchers affiliated with the College of Engineering-Center for Environmental Research and Technology (CE-CERT) mentored through the Center's Global Climate Change and Energy Workshops. The students, selected by their teachers, were able to experience firsthand the role of science and engineering in dealing with some of our most problematic environmental issues.

"Engineers will play a pivotal role in our ability to respond to these challenges and it is important to introduce bright students to their potential roles for environmental progress," said CE-CERT Director Matt Barth, who mentored three winning entries himself in various solar energy technologies.

In addition to solar projects, CE-CERT also hosted high school science projects in biofuels, fuel cells, and planetary atmospheric modeling.

The exposure to the world of the environmental engineer is important, according to Dale Moore, Instructional Specialist for the RUSD. "At that age students interested in science are thinking about medicine, dentistry or nursing. They don't have a good concept of engineering. An experience like this gives them new ideas about all the areas open to them," Moore said.

The Gold Medal team of Neerha and Nehaly Shah from King High School compared the performance of a photovoltaic solar cell when paired with a mirror or a concentrating Fresnel lens. The lens improved the voltage output by nearly 10 times and indicated to them that solar power is practical even in cloudier regions of the world.

"There are a lot of preconceived notions in the public that are no longer true," Neerha said. "We want to stay on this Earth as long as we can and at this rate the climate is going to make that difficult," sister Nehaly added.

Watching school budgets dwindle, they suggested that all schools install panels on their roofs, both to save money and to teach communities that the era of solar power is now. "It would be a great statement for education," Nehaly said.

King High School's Imran Ahmed, Elma Frias and Shanta Hareesh spent their winter working in the biofuels laboratory of Charles Wyman. The experience paid off with gold as the group joined the search for the best way to turn landfill wastes into transportation fuel. The trio was satisfied with their initiation to 'green' fuel since their participation in their school's Science Club revolves mainly around environmental protection, said Shanta.

They studied methods to release sugar from wood wastes using heat, acids and enzymes. Those sugars are then fermented to produce ethanol for powering cars and trucks.

"I didn't know anything about ethanol," said Elma. "We basically wanted to do a 'green' project but we just got so interested. This is new technology that might really help us be more green."

They proudly pointed to their certificates for completing UCR's lab safety course. "They let us work in the lab, not just follow them around. That was cool the support and trust they gave us."

Another King High School student Sarah Trisorus also scored a gold medal in the regional competition for her "Simulation of atmospheric conditions on another planet" under the mentorship of Akua Asa-Awuku.

Their science teacher Michele Hampton at King High said the lab experience was important. "Their project is awesome. I want to thank CE-CERT for all they have done!"



Her colleague, Lillian McCandless at North High agreed. “I found the contact with the scientists to be very helpful,” she said. “I found it invaluable for the students to experience research at the college level.”

When offered the chance to work with UCR engineers on their high school science fair projects, Arnav Mishra (Poly High) and Abdul Jones (North High) chose Hydroxyl Exchange Membrane (HEM) Fuel Cells.

“It looked the most cutting edge and the one with the most impact on future science,” said Mishra. He and Jones, from North High conducted their science fair research during hours in Professor Yushan Yan’s laboratory at the Bourns College of Engineering working with Yan, Dr. Kawai Tam, and graduate students Kurt Jensen and Shaun Alia.

Cutting edge indeed. HEM Fuel Cells are the breakthrough technology which has recently revitalized hopes world-wide that fuel cells can be perfected at lower cost, making them a realistic source of sustainable energy.

Other area students also had brushes with the latest technology and concepts while working with research mentors at CE-CERT as part of a program funded by Bank of America to help focus the issues of Global Climate Change for students participating in the Riverside Unified School District’s Science and Engineering Fair held at UCR.

North High’s Cindy Quintero and Talia Barth also studied hydroxide exchange membrane fuel cells in Prof. Yan’s lab. They happily explained the importance of their work. “If we can find a better way to power cars that is cleaner that will be better for the environment,” Quintero said. “Fuel cells are cleaner and more efficient,” Barth offered. “But we need to find a metal that is much cheaper than platinum that is almost as good.”

The students explained how the old Proton Exchange Membrane (PEM) fuel cell used only platinum (more expensive than gold) as its key catalyst in an acid system to produce electricity. Yan’s breakthrough was to switch to a base system using hydroxyl exchange membranes allowing much of the platinum to be replaced with cheaper metals.

The high school students joined the search for other metals, testing the ability of silver and nickel to generate power in a fuel cell. Mishra and Jones studied the replacement of platinum by nickel for the anode of the HEM fuel cells, while Quintero and Barth were evaluating the possibility of using silver to replace platinum.



de Palma

Boskovich

Pierce

Gazzolo

Transportation Center Fellowships Awarded in Diverse Disciplines

Four University of California Transportation Center Fellowships were awarded to UCR students this year. The fellowships can be for up to \$20,000 to support research in any discipline doing work impacting transportation.

Scott Boskovich, is a graduate student researcher in the Transportation Systems Research Laboratory at CE-CERT.

Elijah DePalma is currently a Ph.D. student in applied statistics at UCR.

Brandn Gazzolo is a graduate student in mechanical engineering.

Russell Pierce, is pursuing a Ph.D. in psychology.



From the control room of the new Heavy Duty Chassis Dynamometer, full in-use schedule conditions can be simulated through the software interface.

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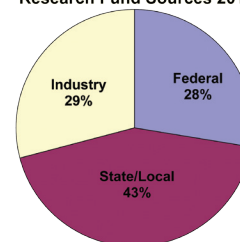
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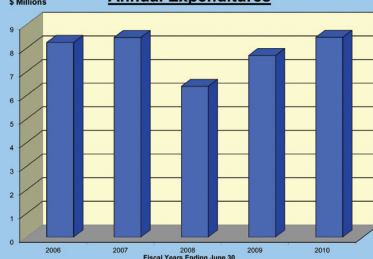
Financial Indicators

2010 turned in another solid year with 59 new research projects, about \$6 million in sponsored research and more than \$8 million in total expenditures

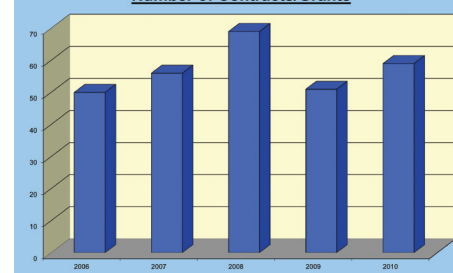
Research Fund Sources 2010



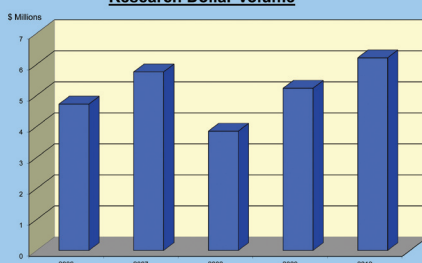
Annual Expenditures



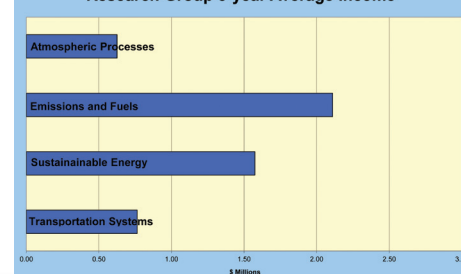
Number of Contracts/Grants



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Research Group 3-year Average Income



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Vu, A., Barth, M. (2010). "Vehicle Parameterization and Tracking from Traffic Videos." Proceedings of the 13th International IEEE Annual Conference on Intelligent Transportation Systems, Madeira Island, Portugal, September 2010, 105-110, 2010.

Weise, D., Jung, H., Cocker III, D.R., Hosseini, E., Li, Q., Shrivastava, M., McCorison, M. (2010). "Do Polyethylene Plastic Covers Affect Smoke Emissions from Debris Piles." 3rd Fire Behavior and Fuels Conference, Spokane, WA, October, 2010.

Weise, D., Miller, J.W., Cocker III, D.R., Jung, H., Yokelson, R., Hao, W., Urbanski, S., Princevac, M., Hosseini, E., Mahalingham, S., Burling, I. (2010). "Development of New Fuels and Emissions Data for Maritime Chaparral and Madrean Oak Woodland Fuel Types." 3rd Fire Behavior and Fuels Conference, Spokane, WA, October, 2010.

Wu, G. Boriboonsomsin, K. Zhang, W., Li, M. Barth M. (2010). "Energy and Emission Benefit Comparison Between Stationary and In-Vehicle Advanced Driving Alert Systems." Proceedings of the 89th Annual Meeting of the Transportation Research Board, Washington, DC, January 2010, 18 pp., 2010.

Zheng, Z., Jung, H., Tang, X., Asa-Awuku, A. (2010). "Synthesis of Metal Particles from

Heavy Fuel Oil Using Spray Flame Pyrolysis for Health Effects Studies." University of California Riverside, American Association for Aerosol Research (AAAR) 29th Annual Conference. Portland, OR, October, 2010.

Zhu, W., Boriboonsomsin, K. Barth M. (2010) "Estimating truck traffic speed from single-loop detector data." Proceedings of the 89th Annual Meeting of the Transportation Research Board. Washington, DC, January 2010.

Patents

U.S. Patent No. or International Patent No: 11/879,267 Park, C.S., Norbeck, J.M., Singh, S. (2010) "Two Stage Gasifier for Steam Hydrogasification Process", 11/879,267

U.S. Patent No. or International Patent No: 7,654,160 Pisano, J. (2010). "Sampling Probe Enabling the Measurement of Gaseous Species in Particulate-Laden Flue Gas" 7,654,160.



CE-CERT participated in the South Coast Air Quality Management District's environmental conference for 8,000 high school students at Los Angeles Convention Center in May. The event gave students ideas about how they can live more sustainably and introduced them to available careers in environmental sciences. Representing the Department of Chemical and Environmental Engineering was graduate student Kurt Jensen.

New Contracts and Grants

Arnott, Richard, UC Transportation Center, "An Aggregative Model of Downtown Parking and Traffic Congestion Incorporating Mass Transit."

Asa-Awuku, Akua A, National Science Foundation (NSF), BRIGE: "Development of a Novel Organic-Water Thermodynamic Measurement and Modeling Technique for Health and Climate Applications."

Barth, Matthew, Federal Highway Administration, "Advanced Traffic Signal Control Algorithms."

Barth, Matthew, California Department of Transportation, "Phase 3: Research and Development of an Alternative Fuel Fleet Monitoring System."

Barth, Matthew, Research and Innovative Technology Administration (FHWA, AERIS), "ECO-ITS: ITS Applications to Improve Environmental Performance."

Barth, Matthew, Gem Power, "Phase 2: Electronics Evaluation for Aircraft Battery SOC and Integrity Estimation."

Barth, Matthew, Vision Motors, "Heavy Duty Fuel Cell Vehicle CAN Bus Development."

Barth, Matthew, UC Transportation Center, "ECO-Friendly Navigation System Research for Heavy-Duty Trucks."

Boriboonsomsin, Kanok, California Department of Transportation, "High Occupancy Vehicle (HOV) System Analysis Tools-District 8 HOV Facility Performance Analysis."

Boriboonsomsin, Kanok, UC Transportation Center, "Development and Evaluation of Intelligent Energy Management Strategies for Plug-In Hybrid Electric Vehicles."

Carter, William, Environ, "Environmental Chamber Experiments to Evaluate NO_x Sinks and Recycling in Atmospheric Chemical Mechanisms."

Cocker, David, National Science Foundation (NSF), "Reactions and Fate of Amines in

the Atmosphere Emitted from Animal Feeding Operations."

Cocker, David, Concawe, "Investigation of the Origin of OC from Large Marine Engines."

Dames, Christopher, Terrafore, "Thermal Trough Assembly Design, Assembly, and Evaluation."

Durbin, Tom, South Coast Air Quality Management District, "Technical Assistance on Advanced, Low, and Zero Emission Activities Technologies and Implementation."

Durbin, Tom, Coordinating Research Council, "Effects of Olefins Content on Exhaust Emissions."

Durbin, Tom, California Air Resources Board, "Evaluation of the Performance and Air Pollutant Emissions of Vehicles Operating on Various Natural Gas Blends."

Durbin, Tom, Coordinating Research Council, "Alternative Transportation Fuels Research Testing Program."

Fitz, Dennis, South Coast Air Quality Management District, "Evaluation of a Protocol for Measuring VOC Emissions from Cleaning Paint Brushes with Solvent."

Fitz, Dennis, Propane Educational Research Council, "Ozone-Forming Potential of Propane and Propane-Powered Combustion Sources."

Goliff, Wendy, South Coast Air Quality Management District, "Development and Operation of a Test Facility for Determination of Emissions Control Efficiency for Commercial Cooking Operations."

Johnson, Kent, Southern California Ship Services, "Proposal to Measure the Emissions Factors for a DDC 12V71 Ti Engine with the Clean Cam Technology System (CCTS) Emission Control Technology."

Johnson, Kent, Southwest Research Institute, "PM PEMS In-Use Validation: Augmented Measurements and Analysis."

Johnson, Kent, Sensors, "Supplemental Testing of PPMD at CE-CERT to Resolve Issues

with the PPMD Observed During the HDIUT PM MA Program."

Johnson, Kent, Engine, Fuel, and Emission Engineering (EFEE), "PEMS Comparison Test."

Johnson, Kent, URS Corporation, "UCR/BNSF Truck Activity Survey."

Jung, Heejung, Fossil Energy Research Corp., "Control Strategies and Technologies for Particulate Matter Under 2.5 Microns (PM2.5) and Ultrafine Particulate Emissions from Natural Gas-Fired Gas Turbine Power Plants."

Karavalakis, George, Calumet, "Evaluation of Regulated and Toxic Emissions from Two-Stroke Utility Engines."

Kumar, Rajeev, Dartmouth, "Operation of Continuous Stirred Fermentation Systems."

Martinez-Morales, Alfredo, City of Riverside, "Southern California Research Initiative for Solar Energy Year 2."

Miller, J, Wayne, ICF Incorporated, "On-Board C3 Marine Engine Measurement of Emission Reductions from Fuel Switching at the Port of Houston and a Mexican Port."

Miller, J, Wayne, URS Corporation, "Proposal to Measure the Effectiveness of the CCST Emissions Control Technology on a Rubber Tyre Gantry Crane."

Miller, J, Wayne, California Air Resources Board, "Emissions from Modern Yard Trucks."

Miller, J, Wayne, Army, "New Tools for Estimating and Managing Local/Regional Air Quality Impacts of Prescribed Burns."

Norbeck, Joseph, Cal EPA Air Resources Board, "Converting Campus Waste Streams into Locally Used Energy Products through Steam Hydrogasification and Methane Reformation."

Park, Chan Seung, Power Waste Gasification, LLC, "Proposal to Evaluate a Waste-To-Energy Gasification Process."

Park, Chan Seung, Viresco, "Viresco Pilot Plant Design Support 1."

Park, Chan Seung, South Coast Air Quality Management District, “Bench Scale Demonstration of Substituted Natural Gas Production from Co-Mingled Biosolids with Biomass Waste Using Steam Hydrogasification Process.”

Russell, Robert, South Coast Air Quality Management District, “Performance Evaluation of Devices to Remove Particulate Matter in Classrooms.”

Russell, Robert, British Petroleum, “Comparison of Emission Characteristics (Regulated and Toxic) of 4 Fuels Using Late Model Vehicles.”

Ula, Sadrul, Wattenberg Industries, “Evaluation of a Novel Low Profile Vertical Axis Wind Electric Machine.”

Wyman, Charles, Logos Technologies, “Phase 2: Production of Sugars and Conversion to TAG.”

Wyman, Charles, Environmental Protection Agency, “Using Waste to Clean Up the Environment: Cellulosic Ethanol, the Future of Fuels.”

Wyman, Charles, Mascoma, “Graduate Student Support for Mascoma Pretreatment and Enzymatic Hydrolysis Research for 2010.”

Wyman, Charles, UT Battelle ORNL BESC, “Biomass Characterization Pretreatment Research (Agave).”

Wyman, Charles, UT Battelle ORNL BESC, “Biomass Characterization Pretreatment Research.”

Wyman, Charles, University of Massachusetts, “Production of JP-8 Range Alkanes from Lignocellulosic Biomass.”

Wyman, Charles, Logos Technologies, “Production of JP-8 Range Alkanes from Lignocellulosic Biomass.”

Scholarship and Award Winners

Lorelei Adams (mentor, David Cocker), Research Advancement Program (RAP) Award.

Richard Arnott, Excellence in Refereeing, American Economic Review.

Akua Asa-Awuku, Advance Purdue Conference Fellowship.

Matthew Barth (as PI), Innovative Transportation Systems Clean Air Award, (to CE-CERT) Southern California Association of Governments (with Honda), 2010.

Scott Boskovich, UC Transportation Center Graduate Fellowship.

Jaclyn DeMartini, awarded the best poster prize at 32nd Symposium on Biotechnology for Fuels and Biotechnology, Florida, April 2010.

Elijah DePalma, UC Transportation Center Graduate Fellowship.

Joshua Dolson (mentor, Alfredo A. Martinez-Morales), Research Advancement Program (RAP) Award.

Sean Engineer (mentor, Heejung Jung), Research Advancement Program (RAP) Award.

Brandn Gazzolo, UC Transportation Center Graduate Fellowship.

Wei He, William R. Pierson Graduate Fellowship.

Lili Huang, received an Award of Distinction for her oral presentation at the 2010 Institute of Electrical and Electronics Engineers (IEEE) Intelligent Vehicles Symposium at UC San Diego, June, 2010.

George Karavalakis, received most outstanding SAE Technical Paper of 2010 for, “An Experimental Study on the Impact of Biodiesel Origin and Type on the Exhaust Emissions from a Euro 4 Pick-up Truck.”

Heather L. McKenzie, awarded the Martin Keller Award for the best student poster presentation in the characterization area at the Bioenergy Science Center (BESC) Summer Retreat, 2010.

Jeremy Nelson, awarded \$40,000 worth of scholarships by NASA’s Aeronautics Research Mission Directorate.

Anh Nguyen, Graduate Student Researcher, National Science Foundation, Graduate Research Fellowship.

Anh Nguyen, Esther Hays Graduate Fellowship

Joe Norbeck (PI), Chan Park (Co-PI), Kawai Tam (Co-PI), Doug Duchon (alumni advisor) and students, Michael Bagtang, Phillip Brendecke, Josh Comfort, Stephanie Stasiuk, and Thinh Vo – U.S. Environmental Protection Agency P3 (People, Prosperity and the Planet) Award, “Converting campus wastes into locally used energy products through steam hydrogasification and methane reformation.”

Robin Picchi, Ford Motor Company Undergraduate Scholarship.

Russell Pierce, UC Transportation Center Graduate Fellowship.

Nigel Williams (Mentor, Matthew Barth), Research Advancement Program (RAP) Award.

Yushan Yan (PI), and students, Marcus Chiu, Christian Contreras, Joon-Bok Lee and Jason Skovgard – U.S. Environmental Protection Agency P3 (People, Prosperity and the Planet) Award, “Grid-independent Electricity Generation for Remote Areas based on a Unitized Regenerative Hydroxide Exchange Membrane Fuel Cell System.”

Key Events of 2010



1. UCR Chancellor Tours New Dynamometer facility.
2. Dedication of the Jacques and Eugene Yeager Conference Room
3. CE-CERT Holiday Celebration
4. Tour for Mitty Onozato, Exec. VP of TEL (Tokyo Electron Ltd.)
5. Top Korean students toured CE-CERT labs while on a college tour of the U.S.
6. SC-RISE presents "The Real Smart Grid"
7. CE-CERT Board of Advisors Meeting
8. Odyssey Day Alt-Fuels Vehicle Expo
9. Distinguished Lecture by Wayne Miller at Bourns College of Engineering
10. Tour for Endowed Chair Benefactors Jacques, Gene, and Billie Yeager, and Sue and Bill Johnson
11. Ribbon Cutting Ceremony for Heavy-Duty Chassis Dynamometer
12. UCR Inland Empire Alumni Chapter Meeting
13. SACNAS tour to encourage science study among Hispanics and Native Americans
14. RAP Program Research Presenters Kevin Castillo, Rugsy Kandah and Faith Morel
15. Hunter Park Chamber of Commerce
16. Tour for Colton, Redlands, Yucaipa - Regional Occupation Program's Extreme Summer Day Camp.

Regulatory Impact of Research

- Emission Regulation**
 - Backup generators (HUGs) (CARB)
 - Verification of controls for HUGs (CARB)
 - Cargo Handling Equipment (YTs, RTGAs) (CARB)
 - Controls for main propulsion and auxiliary engines for ocean going vessels (CARB)
- Measurement allowance for gases on HDDTs (EPA/HARB)
- Fuel speed reduction of OGV (HARB)
- Measurement methods for marine emission (EPA)
- Gulf of Mexico SECA (International EPA + Mexico)
- Fuel Regulation**
 - Diesel fuel formulation (CARB)
 - Sulfur & oxygenates: EPA & CARB gasoline models
 - Biodiesel emissions: EPA (CARB)
 - Federal ethanol: diesel (CA leg)
 - Federal ethanol: gasoline (CA leg)
 - Federal ethanol: other alcohols (CEC)

Students

During 2010, 53 graduate students and 68 undergraduate students worked as part of CE-CERT research programs.

Graduate Students: Scott Boskovich, Phillip Brendecke, Chia-Li Chen, Christopher Clark,

Jaclyn DeMartini, Elijah DePalma, Poornima Dixit, David Dreisbach, Xin Fan, Michael Giordano, Xiadi Gao, Maryam Hajbabaee, Corey Hardin, Wei He, Seyedehsan Hosseini, Lili Huang, Varalakshimi Jayaram, Yi Jin, Mohammad Yusuf Khan, Hongjia Li, Yang Li, Tao Li, Ying Liu, Zhongzhe Liu, Xiaom-

ing Lu, Qian Luo, Huiqing Ma, Sindhura Mandava, Heather McKenzie, Shunsuke Nakao, Anh Nguyen, Hansheng Pan, Stefan Pitzek, Derek Price, Li Qi, Qing Qing, Melina Roshandell, George Scora, Joseph Silva, Amornrat Suemanotham, Sarath Suvarna, Ping Tang, Xiaochen Tang, Yoothana Thanmongkhon, Anh Vu, James Yang, Qichi Yang, Haiyu Zhang, Yanqi Zhang, Yulin Zhang, Sheng Zhao, Zhongqing Zheng.

Faculty

Richard Arnott, Professor of Economics

Akua Asa-Awuku, Assistant Professor of Chemical and Environmental Engineering

Matthew Barth, CE-CERT Director and Professor of Electrical Engineering

Kanok Boriboonsomsin, Research Faculty, Transportation Systems Research Group

William Carter, Research Faculty, Atmospheric Processes Group

David Cocker, Associate Professor of Chemical and Environmental Engineering

Thomas Durbin, Research Faculty, Emissions and Fuels Research Group

Dennis Fitz, Research Faculty, Atmospheric Processes Group

Wendy Goliff, Research Faculty, Atmospheric Processes Group

Kent Johnson, Research Faculty, Emissions and Fuels Research Group

Heejung Jung, Assistant Professor of Mechanical Engineering

George Karavalakis, Research Faculty, Emissions and Fuels Research Group

Rajeev Kumar, Research Faculty, Sustainable Energy Group

Alfredo Martinez-Morales, Research Faculty, Southern California Research Initiative for Solar Energy

J. Wayne Miller, Research Faculty, Emissions and Fuels Research Group

Joseph Norbeck, Professor of Chemical and Environmental Engineering

Chan Seung Park, Research Faculty, Sustainable Energy Group

Robert Russell, Research Faculty, Emissions and Fuels Research Group

Kawai Tam, Research Faculty, Sustainable Energy Group

Sadrul Ula, Research Faculty, Southern California Research Initiative for Solar Energy

Charles Wyman, Professor of Chemical and Environmental Engineering

Yushan Yan, Professor of Chemical and Environmental Engineering

Postdoctoral Scholars

Gookyung Heo, Atmospheric Processes Group

Huan Liu, Transportation Systems Research Group

Jiacheng Shen, Sustainable Energy Group

Jian Shi, Sustainable Energy Group

Deepti Tanjore, Sustainable Energy Group

Guoyuan Wu, Transportation Systems Research Group

Qian Xu, Atmospheric Processes Group

Taiying Zhang, Sustainable Energy Group

Weihua Zhu, Transportation Systems Research Group

Undergraduates: Lorelei Adams, Dionicio Ayala, Michael Bagtang, Sarah Bates, Tony Beavers, Andrew Calderon, Amy Marie Calgaro, Eric Cardiel, Dante Carrillos, Kevin Castillo, Shanel Chand, Neil Chaney, Eduardo Cuevas, Joseph Dean, Douglas Duchon, Wyatt Duvall, Duresameen Farooq, Spencer Fish, Oscar Garcia, Jorell Gonzales, Payam Goshtasbi, James Gutierrez, Nan-Hsun Han, Norman Ho, Daniel Hormozi, Mary Kacarab, Thomas Kwan, Gary Te-Yung Li, Kyle Loggins, Gabriel Marroquin, Sean McClanahan, Yesenia Melchor, Faith Morel, Daniel Morton, Jeremy Nelson, Duc Minh Nguyen, Duyen Nguyen, Kevin Nguyen, Ray Nishii, Wendy Ochoa, Thi Pham, Robin Picchi, Ali Roohani, Jesus Adrian Sahagun, Mohammed Salih, Monique Sanchez, Daniel Sandez, Luis Sanguino, Srihari Santhanam, Eric Seo, Manjot Singh, Letia Solomon, Stephanie Stasiuk, Dylan Switzer, Justin Tao, Min Thai, David Torres, Kathy Bao Vang, Jamie Vang, Tiffany Viggiano, Mark Jonathan Villela, Charles Wardle, Arianna Williams, Eric Wittenmeier, Davis Seokho Yoon, Larissa Yates, Chien Cheng Yeh.

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