Engineers have the opportunity and responsibility to develop solutions for the world’s greatest challenges – challenges such as developing clean and renewable energy, improving human health and the environment, and developing technology and infrastructure that improves the quality of life. It is through the education of students and the development of new knowledge that colleges of engineering have the greatest global impact.

Sandra Woods

Woods joined Colorado State University in 2001 and has served as dean of the College of Engineering since 2005. She earned her B.S. in civil engineering from Michigan State University and her M.S. and Ph.D. from the University of Washington.

I invite you to spend a few minutes reading this publication to see how a few College of Engineering students and faculty are addressing energy issues through their academic and research programs. This publication is the first in a series focusing on great global challenges related to energy, the environment, human health, and infrastructure.

In this issue, we focus on energy research that leads to new manufacturing processes for production of photovoltaics, the ability to incorporate renewable energy sources into the grid, the development of alternative fuels, hydropower, and energy storage.

It’s clear that we need to use a systems approach to address energy issues. Colorado State University students are being prepared for engineering careers in the energy field through our existing academic programs. However, we also have launched a new Master of Engineering program in systems engineering.

Eight excellent new energy faculty have joined Colorado State University’s College of Engineering in the last two years. These faculty are strong teachers both in the classroom and one-on-one through their mentoring of undergraduate and graduate students working on energy-related research.

In Energy, you will catch a glimpse of the impact we have on energy research and education. A common element throughout is the commitment of our outstanding faculty, staff, and students.

Sandra Woods, Dean
In an effort to move to energy independence, Colorado State University and Spirae, Inc. – a Fort Collins company specializing in the characterization and integration of renewable and distributed power into smart-grid systems – are partnering to develop a smart grid integration center to lead the transformation of the U.S. electric power grid from a central power generating station model to more distributed use of renewable power generation sources. This effort builds on the success of the InteGrid Test and Development Laboratory, jointly owned and operated by Colorado State’s Engines and Energy Conversion Laboratory and Spirae.

The facility will work with a team of clean energy companies as part of Fort Zed, a three-way partnership between the City of Fort Collins, Northern Colorado Clean Energy Cluster, and UniverCity Connections. Fort Collins was also selected by the Department of Energy as one of nine demonstration projects nationwide that will demonstrate peak load reduction on substation feeders using renewable and distributed energy technologies.

Engineering faculty members are leveraging the unique large-scale experimentation capabilities of the InteGrid Lab for technical projects relating to grid reliability and demand management. Controlling the various aspects of reconﬁgurable power grids so as to deliver high performance while at the same time maintaining guaranteed stability has proved challenging to researchers. Peter Young is addressing these challenges by leading research to develop and test advanced tools for microgrid operations. Tom Bradley and Morgan DeFoort are developing methods for using Plug-in Hybrid Electric Vehicles (PHEV) as energy storage devices for grid management applications. PHEV with Vehicle-to-Grid (V2G) technology can provide the utility a unique energy storage capability for both intelligent charging and discharging to match load usage and renewable generation availability. On the commercial front, Spirae, Inc., completed a V2G demonstration project for Xcel Energy, converting a Ford Escape Hybrid PHEV vehicle to put power on the grid on demand.

The proposed center is expected to accelerate projects such as these, enhance academic and commercial research and development capabilities, and position Colorado State and Northern Colorado as smart grid innovators.

What is exciting to me about CSU is that we are looking at these renewable energy problems in a near-term way, developing solutions that can be applied within the next five to ten years instead of 50 years from now. And we’re not just studying these problems from an academic side; we are developing new smart grid technologies and then moving quickly into commercialization. Academia is actively participating in solving these global challenges, working with industry to deploy clean, sustainable energy on a large scale.

Thomas Bradley

Bradley earned his B.S. and M.S. from the University of California-Davis and his Ph.D. from Georgia Tech. He joined Colorado State University as an assistant professor in Fall 2008.
Clean and Cost-Effective Production of Photovoltaics

Pioneering studies on the viability of solar electric power generation began in the 1970s at Colorado State’s Materials Engineering Laboratory. Over a period of 15 years, Professor W.S. Sampath and fellow researchers Kurt Barth and Al Enzenroth developed a clean and efficient high-throughput inline manufacturing process. They were eager to make solar power affordable and easily available to everyone, and were dedicated to making their contributions to help solve the world’s energy and environmental problems.

Their goal was to generate electricity from the sun at the lowest possible cost, using a process that produces no solid or liquid waste, and eventually to manufacture photovoltaic solar cells on a large scale. With Department of Energy funding, the collaborators steadily progressed from 3”x3” to 16”x16” glass panels, continuously refining the process and improving the solar cells.

“The University was fertile ground for our partnership,” says Barth, “and our friendship grew along with the research.”

A clean and renewable energy source, photovoltaic conversion of sunlight into electricity is the most efficient and direct way to use the sun’s energy for electrical generation. But around 90 percent of the solar cells in production today are made from crystalline silicon which, because of the purity and amount of material required, has made solar electricity expensive.

Instead of using traditional silicon to manufacture solar cells, the Colorado State team patented a continuous production process that turns a piece of glass into a solar cell by coating it with a thin film using cadmium telluride derived from the waste stream of copper mining. That process has evolved into a commercial spin-off company, AVA Solar, which intends to produce solar panels on a large scale next year.

“Solar cells have to be manufactured like other mass-produced items. Then, photovoltaics will be one of the most environmentally clean and cost-effective energy sources,” says Sampath.

AVA Solar is in final characterization with its pilot production system and will complete its first large-scale manufacturing facility in early 2009. The 200-megawatt factory is expected to employ several hundred people. Utilizing fully automated fast processing, the new technology will be capable of producing one solar cell every two minutes, enough PV modules to power a home in less than three hours. Produced at less than $1 per watt, the panels will have the ability to provide solar electricity at costs competitive with current methods of electricity generation in most parts of the United States and the world.

Over the past 10 years, the market for such products has grown by more than 35 percent each year and is continuing to grow with renewed national and statewide emphasis on renewable energy solutions. By the year 2010, solar cell manufacturing alone is expected to be a $25 billion-plus industry, and investors are eager to share in the growth of this sustainable energy technology.

“This technology offers a significant improvement in capital and labor productivity and overall manufacturing efficiency,” says Sampath. “The current market is more than $5 billion annually, and additional markets are developing.”

AVA Solar is truly rooted in the College of Engineering. Kurt Barth and Al Enzenroth are both alumni of Colorado State’s Department of Mechanical Engineering. Kurt earned his B.S. in 1990 and his M.S. in 1994; Al earned his B.S. in 1994. They joined AVA Solar’s team in 2007, retaining their affiliation with Colorado State.

Sampath continues to teach undergraduate and graduate courses at Colorado State, as well as to explore photovoltaic research with a new team of scientists and students in his laboratory in the Simons Building at the Engineering Research Center. Dr. Srinivas Sathiraju is one of Sampath’s associates; he has 15 years of academic and industrial experience and is contributing to the zinc telluride process optimization and other material issues. Nathan Schuh is a master’s student studying with Sampath and contributing to new product development. Through funding from the National Renewable Energy Laboratory and the National Science Foundation, Sampath and his team are producing solar cells that will someday power homes and businesses around the world.

W.S. Sampath

Sampath received his M.S. and Ph.D. degrees from Arizona State University and has been a part of Colorado State University’s mechanical engineering faculty since 1985.

By developing the manufacturing process that reduces the cost of solar panels, we move beyond generating electricity for computers and electronic transactions, and we provide light sources to the poorest people, replacing the kerosene lamps that cause death and illness.

“...the kerosene lamps that cause death and illness.

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Sampath received his M.S. and Ph.D. degrees from Arizona State University and has been a part of Colorado State University’s mechanical engineering faculty since 1985.

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Professor V. Manivannan and his graduate students are building a better hybrid car battery that is more powerful, requires less frequent recharging, and contains all the safety features that drivers want. With escalating gasoline prices and an increased awareness of the environmental impact of fossil fuels, car manufacturers are expanding production of advanced and plug-in hybrid vehicles. Manivannan and his team are developing the technology to replace the metal hydride batteries in current hybrid vehicles with lithium-ion (Li-ion) batteries, collaborating with the National Renewable Energy Laboratory on the research.

Li-ion batteries are currently used in small-scale devices such as cell phones, PDAs, laptops, and cordless power tools. The mobility of the lithium ion back and forth within the battery is what creates the energy; this process is called Rocking Chair Battery Technology. Lead acid batteries are only 50 percent efficient, and lithium-ion batteries are up to 97 percent efficient, so they can store more energy.

The limitations of today’s hybrid car batteries make them more suited to innercity driving than mountain excursions or long-distance trips, and because they are high-energy devices, explosions can occur when they heat up. Lithium-ion batteries are the answer because of their high energy density, light weight, safety, and recycling life.

“The key technology driver is coming up with new and improved human-made materials in the research lab that will have high energy density and high power capability, are affordable, and have all the safety features inherently built in because the material itself is fundamentally and intrinsically safe,” says Manivannan.

Graduate students Jake Barker, Nicole Landau, Brandon Kelly, and Josh Garrett each play a unique role in the development of these new batteries, working on various aspects of battery development. Their aim is to improve the electrochemical performance and safety while reducing production costs. Improvements they are making in energy density and cyclability will impact mobile electronic devices and justify replacing lead-acid car batteries with Li-ion batteries.

“There are only a few commercial materials that are used in lithium batteries, despite decades of research,” says Manivannan. “We are seeing activity internationally and are hoping to discover some new materials here in our lab. The technology developed at CSU will transition from the lab to manufacturing, then on to commercialization to meet societal needs on a global level.”

The technology developed at CSU will transition from the lab to manufacturing, then on to commercialization to meet societal needs on a global level.

V. Manivannan

Manivannan received his Ph.D. from the Indian Institute of Science in 1995. In 2006, after spending several years at General Electric as a research scientist and project leader, he joined the Department of Mechanical Engineering at Colorado State University, where he teaches courses in materials engineering.
Students Excel at Designing Energy-Efficient, Human-Powered Vehicles

In April, a team of students from Colorado State’s mechanical engineering program created a vehicle for their senior design project to compete in the Human Powered Vehicle (HPV) 2008 Spring Competition in Reno, Nevada. This annual competition, sponsored by the American Society of Mechanical Engineers, requires participating students to design and construct an HPV that can be used to commute short distances for everyday activities such as running errands and getting to and from work. The human-powered vehicles are similar to recumbent bicycles, only more complex with additions such as built-in compartments or bags for storage and aerodynamic features that allow them to move at high speeds.

The competition consisted of three separate events to test the student-made vehicles: a utility race, an endurance race, and the sprint event. Colorado State’s team built their vehicle specifically for the utility race, which focused on handling a package that simulated a grocery bag, putting it into the designed cargo compartment, driving around an obstacle course, and safely unloading it at a specified destination. In the design process, the seniors referenced the structure of bicycles. “We looked at production models and tried to use some of the strengths we found in those and modified them to accommodate the things that we needed, such as the cargo compartment and the roll bar, which you won’t see on normal production recumbents,” says team member Judd Nutting.

The team, also consisting of seniors Scott Brewer, Cole Emerson, Caleb Dean, Aaron Vaughn, Steve Verderaike, Kyle Frerichs, and honorary member Erin Dorociak, won first place in the utility event and second place in the utility class overall. The Colorado State vehicle was capable of speeds up to 30 mph. Colorado State’s team raced their vehicle in all three events, and although they had originally built their vehicle specifically for utility, they placed sixth out of 25 teams in the endurance race, beating teams that had designed their vehicles for endurance.

In the search for renewable energy, the Human Powered Vehicle Competition inspires students to look at alternate forms of transportation while giving them a real-life application for engineering principles they learned in class. “A mechanical engineering major gives you a lot more hands-on experience than other majors,” says senior Caleb Dean. “It’s rewarding to see the project through from design to fabrication.”

You can view the team video on the College of Engineering website: www.engr.colostate.edu, select Video Archive and Student Videos.

One of our department goals is to have our students be globally competitive. This HPV competition is an opportunity for our students to compete at the national level with students from other schools across the country. We are very pleased with the winning performances of the CSU teams over the last few years.

Allan Kirkpatrick

Kirkpatrick, department head of mechanical engineering, received his B.S. and Ph.D. from MIT. He teaches a course in thermodynamics of flow processes at Colorado State University.
Colorado State University Takes Graduate Education to New Depths

As biofuel development continues to expand worldwide, the limitations of current production methods have led to the need for new energy crops; biological, chemical, and thermal conversion technologies; and new byproducts. Continued and sustainable development of the biofuel industry faces two significant needs: technological innovation and integrated, multidisciplinary training and perspectives. Researchers at Colorado State University are addressing these needs through a comprehensive doctoral training program that incorporates cross-disciplinary teamwork, coursework in multiple disciplines, and research projects that span multiple focus areas.

One of only 20 universities honored this year nationwide, Colorado State University was recently awarded $3 million from the Integrative Graduate Education and Research Traineeship (IGERT) program to develop the Multidisciplinary Approaches to Sustainable Bioenergy (MASB) program. A National Science Foundation endeavor, IGERT was developed to train scientists and engineers to address the global questions of the future. MASB will prepare Ph.D. graduates who are trained as interdisciplinary scientists with full understanding of the technical challenges facing the emerging biofuels industry. Students will focus their training in four areas of biorefining: crop sciences and plant biotechnology; biological, chemical and thermal biomass conversions; product engineering; and economic and environmental assessment.

“The MASB is a holistic, integrated approach to graduate education. The biofuels industry needs employees who understand where the biomass comes from and all the ways in which the biomass is transformed into fuels and chemicals,” says Ken Reardon, lead investigator of the Colorado State program and professor of chemical and biological engineering. “Students graduating from this program will understand how the fuels are produced and used and will have a perspective on the sustainability of the entire production process.”

The Colleges of Natural Sciences, Agricultural Sciences, and Engineering will all contribute support to the program. In addition to Reardon, the multidisciplinary project team includes Dan Bush, professor and chairman of the biology department; Jan Leach, professor of bioagricultural sciences and pest management; and Keith Paustian, professor of soil and crop sciences. In conjunction with work at CSU, funds from the MASB program will also serve as a “bridge to the doctorate” for students from Colorado State University-Pueblo.

Ken Reardon

Reardon received his M.S. and Ph.D. from the California Institute of Technology. He joined the Colorado State University faculty in the Department of Chemical and Biological Engineering in 1988.
By refining a membrane extraction process to convert biomass to ethanol, researchers at Colorado State are hoping to reduce ethanol production costs. With gasoline prices rising, the push is on for biorefineries to increase their production of ethanol to keep up with the demand for automobiles that run on mixtures of gasoline and ethanol. In Germany, for example, cars run with a mixture of 20 percent ethanol and 80 percent gasoline, and the new cars they are building may have even higher ratios of ethanol to gasoline.

Ranil Wickramasinghe, professor of chemical and biological engineering, and graduate student David Grzenia are exploring new technologies that improve upon traditional methods of extracting sulfuric and acetic acids from biomass. In collaboration with the National Renewable Energy Laboratory (NREL), the team is using sulfuric acid and high pressure to pretreat biomass prior to fermentation for production of ethanol. Their research was recently published in the Journal of Membrane Science. “Membrane-based separation processes are much less costly to run than conventional unit operations,” says Wickramasinghe. “Consequently, we believe there are numerous opportunities for membrane-based separations in future biorefineries.”

Acetic acid is highly toxic to microorganisms, and its costly removal is a major impediment to ethanol production. Using a hollow fiber-based liquid extraction process and Alamine 336 dissolved in octanol, the researchers have removed more than 60 percent of the acetic acid from the biomass solution. This results in a biomass solution that can then be used for fermentation and ethanol production.

Daniel Schell, who is supervising David’s research at NREL, says, “The reason we have David at NREL is because he is actually much closer to the production, has access to different types of resources, and gets to interact with a lot of researchers who are trying to develop and improve this technology, so it’s very advantageous for him.”

The biomass feedstock used in their studies is comprised of stalks, leaves, cobs, and husks of corn. Pretreatment with dilute sulfuric acid leads to the release of five carbon sugars. However, compounds that are toxic to microorganisms are also produced. Overliming removes these compounds but does not remove acetic acid.

The biochemical platform for converting biomass to ethanol has been known for many years, but the high production costs have limited its use. Bringing the biomass-to-ethanol production costs down to compete with other fuels is the goal of the project. The researchers are not only developing the enzymes, they are also studying the full process from milling and pretreatment to product storage in order to determine better methods of production.
Modeling Algal Growth for Biodiesel Production

The U.S. Department of Energy reports that, without biofuels, the United States would have to use 7.2 billion more gallons of gasoline in 2008 in order to maintain current levels of travel, driving up the price Americans pay at the pump. Currently, producers and consumers alike are turning to corn-based ethanol in order to supplement fossil fuels; however, food crops still leaves much to be desired.

Working toward an environmentally friendly and cost-effective solution to high gas prices and greenhouse gas emissions, researchers are looking to algae to significantly ease our reliance on foreign oil. Solix Biofuels, a Fort Collins company, in partnership with Colorado State University’s Engines and Energy Conversion Laboratory (EECL), has developed an algae oil production system (photobioreactor) that could mitigate U.S. demand for foreign oil used for the production of diesel fuel without competing with food crops for land.

One step closer to harnessing algae for energy, Ph.D. student Mike Buehner is working on production systems that are efficient, scalable, and affordable. Buehner and Peter Young are developing a series of dynamic models to optimize algal growth and lipid production, while minimizing capital costs. Although microalgae harvest energy from the sun through photosynthesis for growth, too much light exposure can reduce the photosynthetic efficiency of algae and reduce the productivity of the photobioreactors. Their model will be used to predict the amount of CO₂ required to maximize sun utilization and will regulate the delivery of CO₂ and other nutrients to the microalgae through a feed-forward control system.

In addition, a systems model that is based on research at the EECL will determine the optimum conditions to deplete algae of nutrients – the foundation of lipid production – and harvest them for biodiesel. Because algae growth does not always take place as predicted and disturbances can occur, a feedback monitoring system utilizing CO₂ will be in place to regulate the pH of media encasing the microalgae.

Through the use of modeling and control systems, scientists hope to reduce the number of sensors needed in the conversion process and subsequently the overhead cost of bio-oil production. Currently, sensors are attached to each bag of algae to monitor and control these sensitive environments. However, once the models have been populated through measurements and data collection, researchers can extrapolate the response of an entire algal growth system to differing environmental conditions from only a few strategically placed sensors.

The potential for algae to deliver sustainable fuel production is tremendous. Facilitating efficient production of biofuel from algae could have profound economic and environmental impacts worldwide.

Peter Young

Young is an alumnus of Oxford University and the California Institute of Technology. He joined the faculty in the Colorado State University Department of Electrical and Computer Engineering in 1995 and works in the area of mathematical system theory and feedback controls.
Growing concern for the future of the energy supply has stimulated the development of alternative fuels as an environmentally sound replacement or supplement to traditional fuels.

The use of alternative gaseous fuels in natural gas-fueled internal combustion engines is dependent on implementation by engine manufacturers.

An important parameter in the development of engine fuels and their widespread acceptance is knock tendency - an abnormal combustion event that can occur within internal combustion engines when a portion of the air-fuel mixture uncontrollably combusts. Since knock is detrimental to engine operation and can dictate engine design and performance, the knock tendency of fuels must be evaluated.

Researchers at Colorado State University’s Engines and Energy Conversion Laboratory (EECL) are examining the compatibility of these fuels with current energy conversion equipment. For his master’s thesis under Daniel Olsen, assistant professor of mechanical engineering, Marty Malenshek developed an experimental apparatus capable of blending simulated alternative gaseous fuels and evaluating their knock tendency.

Knock tendency was evaluated by measuring the methane number in a Cooperative Fuel Research (CFR) F-2 engine at the EECL. Analogous to octane number, high methane number has high knock resistance, and low methane number has high knock tendency. Malenshek characterized knock tendency to improve current methane number models, and subsequently the fuel applicability to engines. Through this procedure, the knock tendency of typical natural gas was directly compared to different alternative gaseous test blends, including those selected to represent wood gas, coal gas, reformed natural gas, digester gas, and landfill gas. The test results showed significant differences in the knock properties of these varied alternative gaseous fuels. This research will assist manufacturers as they design engines to run on alternative fuels with better efficiency, lower emissions, and longer engine life.

The next phase is to go to field sites where alternative fuels are produced and collect fuel with a mobile gas collection system developed by graduate student Brett Wilson. Wilson will examine the effect of trace constituents in alternative gas fuels that are difficult to simulate with a gas-blending system.

As alternative fuels are developed, it is critical that there is a parallel, collaborative effort to design combustion equipment that enables alternative fuels to be utilized in an efficient and cost-effective manner without increasing harmful emissions.

Daniel Olsen

Olsen joined the mechanical engineering faculty in 2006 after completing advanced degrees at Oregon State and Colorado State University. His industrial experience includes Ball Aerospace, Battelle Northwest and United Nuclear.
Researchers Maximize Hydropower and Reservoir System Use

For thousands of years, humans have been harnessing water in order to generate power. Today, 10 percent of the total energy used in the United States can be accounted for by hydroelectricity, and hydropower represents 19 percent of total electricity production worldwide. However, as populations increase and economies develop rapidly worldwide, the resulting increase in demand for limited water resources has called attention to the need for optimized river basin management systems.

Researchers at Colorado State University are working to not only maximize hydropower production in these systems but also maintain a balance in reservoir operations to accommodate other uses of this precious resource. Reservoir systems are a source of hydroelectric power, and they also may be used for flood protection, municipal and industrial water supply, irrigation purposes, recreation, and environmental uses such as improving water quality and enhancing aquatic habitat for endangered species. However, reservoir systems are susceptible to variables such as climate, population, and seasonal water demands.

Neil Grigg is an expert on managing hydropower infrastructure so that it remains a viable energy option into the future. Grigg’s expertise focuses on the overall planning of water resources systems, including water supply and energy.

Darrell Fontane, director of the International School for Water Resources, works to develop sustainable management and operational strategies to meet multipurpose use demands of existing water projects and facilities.

“From an operations perspective, you need to balance the operation for hydropower with the other uses of the water, and that can be an interesting challenge,” says Fontane. Working to accommodate competing water and energy demands, Fontane utilizes optimization models created by Professor John Labadie to test inflow sequences for reservoir systems and determine reservoir regulation strategies that meet a wide variety of objectives.

Labadie has developed GeoMODSIM, a comprehensive, GIS-based river basin management decision support system. The system provides a planning framework for integrated river basin development and management and aids in real-time river basin operations and control. Designed for integrated evaluation of hydrologic, economic, environmental, and institutional/legal impacts as related to alternative development and management scenarios, GeoMODSIM is capable of creating any river basin system topology within a GIS, allowing users to customize the model to their specific system. This robust model is required to gain a better understanding of the need for coordinated operations in complex river basin systems and to make sound management decisions in such an evolving environment.

“Our research is trying to apply system optimization modeling to increase reliable hydropower energy production while still satisfying all the other beneficial uses of reservoirs.”

John Labadie

Labadie received his Ph.D. from the University of California-Berkeley.
Since he arrived on campus a year ago, Ron Sega, Woodward Professor of Systems Engineering at Colorado State University, has approached development of the systems engineering education program as a collaborative effort with industry, government, and other universities. For example, the Foundations of Systems Engineering course offered this fall will utilize case studies and guest lectures from prominent leaders in industry and government.

Sega was charged with developing a systems engineering program as part of his role as a professor in the College of Engineering. He also serves as the vice president for energy, environment and other universites. For example, the Foundations of Systems Engineering course offered this fall will utilize case studies and guest lectures from prominent leaders in industry and government.

Colorado State University offered new graduate coursework in systems engineering starting Fall Semester 2008 to meet the growing demands of employers. "For a long time, we have been hearing from our industry partners that they would like our graduates to have a deep understanding of systems engineering," says Tony Maciejewski, head of the Department of Electrical and Computer Engineering, who helped launch the systems engineering program and is co-teaching one of its core courses. "This new program addresses the current trend toward increasingly complex systems that exists across a variety of disciplines, making our alumni even more marketable and desirable to employers."

The Master of Engineering degree is designed to provide a broad understanding of the fundamentals of systems engineering, while offering considerable flexibility as the student progresses through the program. Upon completion of the core fundamental courses, students may tailor their coursework, choosing among in-depth courses and electives that align with their area of interest. The program culminates with a capstone special project, giving students an opportunity to apply their knowledge to a real-world problem.

For additional information, including specific courses and requirements, visit www.engr.colostate.edu/ece.

This new program addresses the current trend toward increasingly complex systems that exists across a variety of disciplines, making our alumni even more marketable and desirable to employers.

Tony Maciejewski

Maciejewski is professor and head of the Department of Electrical and Computer Engineering, joining Colorado State University in 2001.
Rebecca Atadero, assistant professor
B.S., civil engineering, Colorado State University; M.S., Ph.D., structural engineering, University of California, San Diego.
Atadero studies the repair and rehabilitation of existing structures. She has researched fiber-reinforced polymer composite materials for use in repair and strengthening and has recently been conducting research on the life-cycle cost implications of active methods to protect wind turbine gearboxes.

Thomas Bradley, assistant professor
B.S., M.S., mechanical engineering, University of California at Davis; Ph.D., mechanical engineering, Georgia Institute of Technology.
Bradley’s primary research interests include the design of automotive, aerospace, and energy systems; integrated controls and design optimization; and the validation of engineering design methods. He is working on the system design of fuel-cell and hybrid vehicles to include new design criteria, including new environmental performance constraints on plug-in hybrid electric vehicles, technological sensitivity studies for fuel cell-powered, unmanned aerial vehicles, and application of complex system design techniques to micro-grids, space systems, and renewable energy systems.

V. “Mani” Manivannan, associate professor
M.S., materials science and engineering, Anna University; Ph.D., materials science and engineering, Indian Institute of Science.
Manivannan’s work focuses on discovery and processing of innovative concepts and application of advanced engineering materials toward technological advancement. His research concentrates on energy materials including solar cells, Lithium-ion batteries, superconductivity, and fuel cells.

Anthony Marchese, associate professor
B.S., M.S., mechanical engineering, Rensselaer; Ph.D., mechanical and aerospace engineering, Princeton.
Marchese conducts research on gas biodiesel-combustion chemistry. He is collaborating with mechanical engineering faculty Azer Yalin and Dan Olsen on pollutant formation in biofuel droplet combustion and the effect of fuel additives on emissions in heavy-duty diesel engines.
New Energy Faculty

Daniel Olsen, assistant professor
B.S., physics, Eastern Oregon State College; M.S., mechanical engineering, Oregon State University; Ph.D., mechanical engineering, Colorado State University.

Olsen’s research in the area of applied thermal sciences focuses on emission reduction in engines and includes natural gas engine design and the study of combustion characteristics of alternative gaseous fuels.

Christie Peebles, assistant professor
B.S., chemical engineering, Texas Tech University; Ph.D., bioengineering, Rice University.

Peebles’ research focuses on the production of biochemicals, biofuels, and biopharmaceuticals in plants and algae through the use of techniques such as metabolic engineering and systems biology. The toolbox to engineer algae and plants is limited compared to some systems. Her goal is to expand the toolbox to create industrial-relevant strains in an efficient manner.

Sudeep Pasricha, assistant professor
B.E., electronics and communications engineering; M.S., Ph.D., computer science, University of California, Irvine.

Pasricha’s primary research interests include the design and optimization of emerging multi-core embedded systems, which are at the heart of intelligent electronic systems found in the consumer, networking, automotive, aerospace, and defense domains. He is working on power-aware optimizations and low-power design of the next generation of embedded system chips, which will have a critical impact on a wide range of applications, from creating portable handheld devices with improved battery life, to reducing kilowatts of power dissipation in large computing server farms.

Ronald Sega, Woodward Professor of Systems Engineering
B.S., mathematics and physics, Air Force Academy; M.S., physics, University of Ohio; Ph.D., electrical engineering, University of Colorado.

Former NASA astronaut and undersecretary for the U.S. Air Force, Sega is building Colorado State’s systems engineering program in collaboration with industry and other universities in the state. The program will address complex systems in such areas as aerospace, energy, environment, natural resources, and bioscience/health. Sega has also been named vice president for energy, the environment, and applied research at the Colorado State University Research Foundation. Sega led the creation of a new energy strategy for the Air Force and won the 2007 Presidential Award for Energy Management.