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A REPORT FROM THE UNIVERSITY OF CALIFORNIA PRESIDENT FOR FRIENDS AND ADVOCATES OF UC

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RESEARCH IN ACTION WORKING FOR THE PEOPLE OF CALIFORNIA

This special report highlights UC's forward-thinking work in producing the next generation of biofuels. Table scraps, algae, poplar trees – they could all fuel the transportation of the future. (Inside)

did you know?

- UC produces an average of three inventions every day.
- More than 1,100 California biotech and R&D companies have benefited from UC research.
- Technology from the Lawrence Berkeley National Laboratory alone has formed the basis for 20 startups since 1990, creating 1,000 new jobs.

UC alumni honor higher ed supporters

LEGISLATORS OF THE YEAR

The Alumni Associations of the University of California have selected Sen. Jack Scott and Assemblymember John Laird as the 2008 Legislators of the Year.

The two will be honored at events in Sacramento during UC Day. About 300 alumni and friends are expected to attend the university's annual advocacy day, held this year on March 4. Both Scott, D-Pasadena, and Laird, D-Santa Cruz, have been longtime legislative and personal advocates for UC and higher education.

"Both Sen. Scott and Assemblymember Laird have demonstrated lifelong commitments to higher education and have been true friends of the University of California," said UC President Robert C. Dynes. "It certainly is fitting that the Alumni Associations recognize their ongoing efforts to make a UC education accessible and affordable for the people of California. Their support for the university will have an impact on many future generations of UC alumni."

Laird, who serves as chair of the Assembly Committee on Budget and is vice-chair of the Joint Legislative Budget Committee, is being recognized for his ongoing support for UC's mission of education, public service and innovation, particularly in alternative energy research.

Donna Blitzer, director of Government and Community Relations for UC Santa Cruz, praised Laird for always making education a top priority in Sacramento.

"He's smart, and he has a great sense of humor," Blitzer said. "He's very analytical and effective. He's honest and straightforward and will always give you the real story."

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Spirited by the Sierra Club's recognition of UC as one of the top 10 "green" universities in the nation, UC is hosting a green Alumni Associations of the University of California Day in Sacramento. Under a large tent on the **north Capitol lawn, 10 a.m. to 4 p.m.**, students and researchers will showcase UC's green innovation projects.

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John Laird

A 1972 graduate of UC Santa Cruz, Laird majored in politics and served nine years on the Santa Cruz City Council, including two terms as mayor. He was one of the first openly gay mayors in the United States.

"I remember the first paper I turned in as a student," Laird said of his UCSC days. "The professor wrote on it, 'If there is a point here, I'm missing it.' I went from that to writing an honors thesis and to being elected to public office. That's what a UC education did for me."

First elected to the Assembly in 2002, Laird said he's proud that he captures a strong majority among both city and campus voters, a testimony to his efforts to strengthen the town-gown relationship.

"He's been really terrific on funding for the UC system and for enrollment growth," said Karen French, interim director of UC State Governmental Relations. "Laird has always been open and accessible to everyone. He strives very hard to improve the relationship between campus and community and to mitigate the impact of campus growth on Santa Cruz."

French also praised Scott for his efforts on UC's behalf as chair of the Senate Education Committee and Budget Subcommittee on Education and former chair of the Assembly Budget Subcommittee on Education.

Even when Scott criticized UC, French said, he did it supportively, particularly in encouraging UC to strive for greater transparency and accountability in executive compensation.

"While in the Assembly and the Senate, Sen. Jack Scott has been a vital friend to the University of California," said Keith Parker, assistant vice chancellor of Government and Community Relations at UCLA. "He has consistently taken principled positions regarding what is best for the education of the people of our state. I have always been impressed with his knowledge and passion for maintaining the unparalleled excellence of higher education in California."

Scott said he is honored by the Alumni Associations' award and proud of his support for outreach, enrollment growth and the UCLA-based Institute for Research on Labor and Employment when budget cuts threatened those programs.

"If I have a quarrel with the University of California, it's a lover's quarrel," Scott said. "I'm very proud of UC and its contributions to the state. My own son graduated from UC Berkeley. I have a very personal connection to UC."


Jack Scott

As the former president of both Cypress College and Pasadena City College, Scott developed close working relationships with UCLA and UC Irvine. Known as a passionate advocate for community colleges and all higher education institutions, Scott, who has a master of divinity degree from Yale and a doctorate in American history from Claremont Graduate University, said he appreciates the richness education brings to his own life.

"The University of California is a treasure," Scott said. "It's something we are so proud of as Californians. It makes a tremendous difference as an economic engine. The university can be a great friend of California."

UC students focus lobby conference on budget

More than 340 students were expected to descend on Sacramento for the University of California Student Association's annual Student Lobby Conference.

The event, March 1 to 3, teaches students how to lobby their district legislators and to develop advocacy skills they can take back to their campuses.

"A lot of people think lobbying is intimidating, especially young students," said Courtney Weaver, legislative director for the student association and a 2006 UC Santa Barbara alumna. "We'll teach them it's not such a scary process. They have the right to go in and fight for their cause."

This year the cause most on student minds is the escalating state budget deficit and the impact it could have on student fees and services.

"Although we are facing a $14.5 million budget deficit, there is no slowdown in student activism for higher education issues," said UC Berkeley student Maximillian Reyes. "In fact, it has been only making us do more organizing. We know it's going to be an uphill battle to keep UC a truly public institution, but I believe that students across the state are doing an excellent job of making the public aware of the crisis college students are in and what negative consequences will occur if this trend in fee increases continues."

At UC Merced, students want to work collaboratively with their legislators, said junior Danielle Traphagen, to preserve state support for public education and for UC Merced until it is self-sustaining. Melissa Atkins, UC Irvine student legislative liaison, teaches a one-unit class in lobbying on her campus, which is sending 52 students to the three-day event. Although Atkins will graduate this year, she said she wants to do something to benefit future UC students.

The student groups will be asking legislators to freeze fees, she said, but if that isn't possible, to minimize budget cut impacts by maintaining financial aid, student mental health services, graduate student support and academic preparation.

UC center maps human impact on oceans

Human activities heavily affect more than 40 percent of the world's oceans, and few, if any, areas remain untouched, according to the first global-scale study of human influence on marine ecosystems.

By overlaying maps of 17 different impacts such as fishing, climate change and pollution, the researchers have produced a composite map of the toll that humans have exacted on the seas.

The work, published in the Feb. 15 issue of Science, was conducted at the National Center for Ecological Analysis and Synthesis at UC Santa Barbara. Past studies have focused on single activities or single ecosystems in isolation, and rarely on the global scale. In this study, 19 scientists from UC and other universities and agencies looked at human activities across the entire ocean.

The most heavily affected waters in the world include large areas of the North Sea, the South and East China seas, the Caribbean Sea, the East Coast of North America, the Mediterranean Sea, the Red Sea, the Persian Gulf, the Bering Sea, and several regions in the Western Pacific. The least affected areas are largely near the poles.

More information: www.nceas.ucsb.edu/GlobalMarine

Lake Mead could be dry by 2021

There is a 50 percent chance Lake Mead, a key source of water for millions of people in the southwestern United States, will be dry by 2021, according to researchers at Scripps Institution of Oceanography at UC San Diego.

Photo: Ken Dewey, Applied Climate Sciences, School of Natural Resources, University of Nebraska, Lincoln

Without Lake Mead and neighboring Lake Powell, the Colorado River system can't sustain the Southwest through an unusually dry year or a drought. Marine physicist Tim Barnett and climate scientist David Pierce concluded that human demand, natural forces like evaporation, and human-induced climate change are creating a net deficit of nearly 1 million acre-feet of water per year from the Colorado River system, enough to supply roughly 8 million people. The researchers estimated that there is a 10 percent chance that Lake Mead could be dry by 2014 and a 50 percent chance that reservoir levels will drop too low to allow hydroelectric power generation by 2017.

Even if water agencies follow current drought contingency plans, it might not be enough to counter natural forces, especially if the region enters a period of sustained drought and/or human-induced climate changes occur as currently predicted.

For an e-mail copy of the paper, contact pweiss@agu.org

UC Irvine to generate solar energy

A 20-year agreement with Chicago-based UPC Solar will generate enough power on the UC Irvine campus to supply the equivalent of 200 average Irvine homes. The initiative is the largest of its kind in the University of California system and Orange County and among the largest in California.

UPC Solar will design, install, own and maintain 6,500 solar panels to be placed on 11 campus buildings, resulting in a total system size of 1.2 megawatts. UC Irvine then will purchase clean, green power from UPC. There is no net change in electricity costs to UCI, but the solar power system will deliver an annual reduction of approximately 2 million pounds of carbon dioxide.

Kiosks located strategically around the campus will monitor the system and provide ready information to passersby about how much energy is being generated and the size of the carbon offset.

"We've been working on acquiring solar power at UC Irvine for more than two years," said Wendell Brase, vice chancellor of Administrative and Business Services, who led the initiative. "This contract allows us to harness solar-powered electricity with no capital outlay by the campus. And UCI will be among the first to help the UC system reach its goal of providing 10 megawatts of local renewable power by 2014."

17 UC faculty win Sloan fellowships

UC faculty members received more Alfred P. Sloan Research Fellowships than any other university. The foundation awarded the prestigious two-year, $50,000 fellowships to 118 scientists, mathematicians and economists with 17 going to UC researchers.

The New York-based Sloan Foundation awarded $5.9 million in fellowships to faculty at 64 U.S. and Canadian colleges and universities. The fellowships support the work of exceptional researchers early in their academic careers.

Since 1955, 35 Sloan fellows have gone on to win the Nobel Prize in their field, and 14 have received the Fields Medal, the top honor in mathematics.

The UC winners are UC Berkeley researchers Sanjit A. Seshia, computer science; Yun S. Song, molecular biology; Noureddine El Karoui, mathematics; Feng Wang, physics; Raj Chetty, economics; Diana Bautista, neuroscience; and Stefano Della Vigna, economics.

The UC Davis fellows are Xi Chen, chemistry, and Katherine S. Pollard, molecular biology. Fellows from UC Irvine are Bill Tomlinson, computer science, and Alan F. Heyduk, chemistry; from UCLA, Inwon C. Kim, mathematics, and Yaroslav Tserkovnyak, physics; from UC San Diego, Adam R. Aron, neuroscience, and Congjun Wu, physics; from UC San Francisco, Yuriy Kirichok, neuroscience, and from UC Santa Barbara, Paolo Cascini, mathematics.

UC San Diego students pave way to cleaner water

The 90 UC San Diego students hard at work in a canyon neighborhood in Tijuana on a Saturday afternoon are learning about environmental sustainability, municipal infrastructure and border economics one street paver at a time.

The UC San Diego Urban Studies and Planning Club is part of a binational pilot project to reduce water pollution by applying porous, or pervious, surfacing technology to dirt roads. The project focuses on the Tijuana River Watershed, which stretches across the U.S.-Mexico border, and its Los Laureles Canyon where 80,000 Tijuanans live in makeshift homes with no streets, sewers or power.

Oscar Romo shows Tijuana residents how to build street pavers.

With support from both the U.S. and Mexican governments, the students are helping residents build and install 35,000 pervious street pavers to absorb wastewater and prevent runoff into the Tijuana River Estuary and the adjoining San Diego Bay.

"There is one thing you might keep in mind," Oscar Romo told the students at a midweek orientation. "We're doing this project in Mexico in part because we're trying to save wetlands in the United States."

An international border doesn't stop pollution, and it doesn't stop poverty.

Romo, a pioneer in transborder environmental protection efforts, works at the Tijuana River National Estuarine Research Reserve and teaches at UC San Diego. He has spent decades trying to alert the public that runoff from unsustainable development creates hazardous erosion, pollutes dwindling water supplies and spreads disease.

Border demographics and economics have given Romo's campaign a new urgency. With a population that has increased sixfold from 235,000 in 1964 to more than 1.5 million today, Tijuana has outpaced Las Vegas as North America's fastest-growing city. Those numbers have spiked over the past decade since the North American Free Trade Agreement ushered in border manufacturing plants, called *maquiladoras*, that attract low-wage workers from throughout Latin America.

The Los Laureles neighborhood of Colonia de San Bernardo has sprung up as a settlement for *maquila* workers and their families. Homes are thrown together from scrap plywood, used cinder blocks and even discarded garage doors, much of it from San Diego.

As student club leader Adam Krohn explained on the bus ride to the project site, "The people of the *colonia* can't afford building materials, so they've become very good at using things that we throw out."

Krohn reminded the students that the *maquilas* are thriving (and driving the population surge that strains the environment) because they produce electronic goods that are so popular with young U.S. consumers.

"This isn't meant as a guilt trip on you guys," he said. "I just want you to recognize while we're here that everything is interconnected. An international border doesn't stop pollution, and it doesn't stop poverty."

The interdisciplinary value of the Tijuana project extends to cross-cultural studies. During the orientation, a student asked if she could bring bags of used clothing to donate to the impoverished canyon residents.

"Thank you, that is a kind offer," Romo said gently. "But I would advise against it. The people of the *colonia* are very proud. They appreciate our help with the pavers, but any kind of gift would be an affront to their dignity. The kids might like it, but the parents would not."

Colonia residents have set a goal of laying 70,000 pavers to cover a half-mile stretch of the main road. The foot-wide hexagonal pavers are made of gravel, cement and water poured into wooden frames and allowed to harden.

Once in place, they drain wastewater into the ground where naturally occurring bacteria remove harmful effluent. If the pilot project succeeds, its binational backers, which include the city of Tijuana and the California Coastal Conservancy, will look to replicate the low-cost technology throughout the region.

For the UC San Diego students, paver construction is a hands-on lesson about how good science can produce good public policy through local empowerment.

"This is a wonderful example of civically engaged service-learning with a strong research component of deploying new biomolecular tools in a community setting," said Keith Pezzoli, a UC San Diego professor in the Urban Studies and Planning Program who also does research for UC San Diego's Superfund Basic Research Program.

The ultimate payoff of the students' Tijuana project may occur back home in San Diego. Krohn, whose senior thesis is on best practices in watershed management, believes that pervious paving technology could catch on in the United States, where construction of roads, sidewalks, parking lots and driveways has typically relied on impervious surfacing.

"The fact that it can be done here in Tijuana on an informal basis gives students a one-of-a-kind opportunity to see how sustainability and planning theory can be directly applied to the world around them," Krohn said.

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Better biofuels: UC drives the research

Always a leader in advancing scientific discovery, the University of California is applying its research muscle to the quest for alternative fuels. Interdisciplinary teams of researchers across the UC system are at work with the goal of reducing U.S. petroleum dependence and the harmful impacts of greenhouse gas emissions.

Producing the next generation of biofuels – a cost-effective vehicle fuel replacement derived from plant biomass – is only one part of UC's climate change-related research push. But it is a research area already attracting support from private entrepreneurs and public agencies alike. Global energy firm BP, for example, is funding the Energy Biosciences Institute at UC Berkeley, run in partnership with Lawrence Berkeley National Laboratory, the lead partner for the U.S. Department of Energy-funded Joint BioEnergy Institute. That support demonstrates the potential for technology transfer to private industry and green job creation.

A host of biofuel research projects are under way at UC exploring promising biomass feedstocks – from table scraps to algae. Here is just a sample of UC's visionary research into the transportation fuels of the future.

Garbage powers vehicles

Ruihong Zhang, professor, Biological and Agricultural Engineering Department, UC Davis
http://bae.engineering.ucdavis.edu/pages/faculty/zhang.html

The Biogas Energy Project launched at UC Davis in fall 2006 with a demonstration facility to process 8 tons of organic waste a day. Food scraps from Bay Area restaurants and the UC Davis campus fed the pilot project's "digester," which converts organic waste into natural gas for heating, electricity and clean vehicle fuels.

Now, Onsite Power Systems, which licenses the biogas technology from the university, is creating for the City of Industry's garbage hauler a commercial digester that can process 250 tons of waste a day. The fuel produced will power the company's garbage trucks, said UC Davis professor Ruihong Zhang, who developed the anaerobic phased solid digester technology.

The City of Industry plant will process green clippings and food waste, including scraps from food-processing plants located in the city, which collects 35,000 to 50,000 tons of processing food waste a day. The waste hauler expects to process 50 percent of the green and food wastes the city generates.

The residue left from the biofuel process will be used as compost since the digester destroys any pathogens in the organic materials being processed.

Zhang says her waste-conversion technology not only produces cost-effective biofuels but also reduces waste pollution and produces public health benefits.

"The waste is now going to landfills or is put on agricultural land without treatment," says Zhang. "We can quickly convert the wastes to products that are used for energy and compost."

The U.S. Environmental Protection Agency estimates that 44 million tons of food wastes are buried in landfills each year. Diverting a portion of that waste into energy helps reduce greenhouse gas emissions and odors from the dumpsites and saves hauling costs.

"Biogas fuel is very cost-effective compared to natural gas because we have savings on waste disposal," Zhang says.

Unlike existing biodigesters, her innovative technology can process both solid and liquid waste with minimal pretreatment in half the time as other digesters. Working with UC Davis students in the lab, Zhang has determined the best process conditions and microorganisms to convert the waste into gas. Unlike digesters used in wastewater treatment plants that produce only methane gas, Zhang's digester produces both methane and hydrogen. Those improvements to the digester technology make Zhang's technology a promising method for efficiently producing alternative energy.

The digester technology has many possible uses in both rural and urban communities. This month the digester housed on the UC Davis campus is gearing up with new equipment to test the processing of food manufacturing and dairy farm wastes.

Critical biomass growing for green industry

Jay Keasling, professor of chemical and bioengineering, UC Berkeley, CEO of the Joint BioEnergy Institute
www.jbei.org

The Joint BioEnergy Institute is one of three new U.S. Department of Energy research centers pursuing the next generation of biofuels. The institute brings together scientists from UC Berkeley, UC Davis, Stanford University and the Lawrence Berkeley, Lawrence Livermore and Sandia national laboratories.

This research hub is dedicated to both improving current ethanol production and creating new environmentally friendly transportation fuels. The DOE centers were established to advance the goals of President Bush to make cellulosic ethanol cost-competitive with gasoline by 2012 and to reduce U.S. gas consumption in 10 years.

JBEI researchers are focusing on three biofuel challenges: producing better feedstock plants to use as biomass, the organic raw material of biofuels; perfecting deconstruction methods for breaking down plant lignocellulose into sugars; and fuel synthesizing by genetically engineering the microbes that convert biomass sugar into ethanol and other fuels. The goal is rapid commercialization to bring the research into the marketplace. The institute courts industry partnerships and is adopting an entrepreneurial start-up approach to solving research problems.

"This is a tremendous economic opportunity for California just by having the Joint BioEnergy Institute in the East Bay," says institute CEO Jay Keasling. "The Bay Area is really going to be a hotbed for green technology. I think we'll be known as much for green technology as for the computer and biotech industries."

Keasling, a pioneer in synthetic biology, is using the same microbe-engineering techniques for biofuel research as he used in his ground-breaking work to develop an inexpensive anti-malarial drug to be used in developing countries.

The research has the potential to revolutionize the U.S. agriculture industry along with the energy industry, says Keasling. The biomass plants used can vary for each U.S. region, for example, switch grass in the Midwest, poplar trees in the Northwest and sugar cane in the South.

"This could be a renaissance for agriculture," Keasling says. "If we're serious about this, we can make the Midwest into the Middle East. They're sitting on 'oil fields' of cellulose."

Algae floated as ideal feedstock for fuel

B. Gregory Mitchell, research biologist, senior lecturer, Scripps Institution of Oceanography, UC San Diego
http://spg.ucsd.edu

In the quest for the perfect biofuel feedstock, Greg Mitchell believes the lowly algae have a lot to recommend them.

This diverse and plentiful organism grows in both fresh and saltwater and can double in size in a day, making it an ideal source of biomass to produce fuel, Mitchell says. Its yields are 10 times greater than terrestrial plants, so less growing land is needed.

He envisions cultivating microalgae in open ponds in the desert, using land and water not suitable for agriculture. Critics say growing food crops such as soybeans and corn for ethanol production will soak up too much valuable agriculture land, driving up food cost.

So it makes sense, Mitchell says, to cultivate a nonfood crop like algae. That would put producers in dry western states in a better position to get a piece of the biofuel industry.

"In California we're not going to be growing the massive amounts of corn for ethanol," Mitchell says, but arid parts of the state could be ideal for algae farms.

He estimates that 20 million acres devoted to algae farming could supply all U.S. transportation fuel.

"I consider this potentially transformative on the order of the industrial revolution, sailing ships and jet flight, " Mitchell says.

The idea of using algae as a biofuel feedstock isn't new. The National Renewable Energy Laboratory, the principal research lab for the Department of Energy, studied algae-derived biofuel from 1978 to the project's closure in 1996. At the time, algal biofuel just couldn't compete in cost with petroleum. A lot has changed since then.

The price of a barrel of oil has rolled over the $100 mark, and bioscience has advanced. Researchers can now genetically modify the algae to create a feedstock with higher oil content to make production more cost-effective.

A handful of entrepreneurial start-ups are experimenting with algae biofuel, and Chevron Corp. last year announced a collaboration with the National Renewable Energy Laboratory to produce new strains of algae for biofuel. The Defense Advanced Research Projects Agency, the R&D organization for the Department of Defense, is soliciting proposals for developing algae as a biomass for jet fuel production. There is no one right or wrong biofuel process or feedstock, Mitchell says, and the United States should be looking at all possibilities if it ever wants to achieve energy independence.

"I do believe this is a really important opportunity," Mitchell says. "We really need to be careful to invest in a balanced way."

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