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CIFAR CONFERENCE XXIX

BIOFUELS: A GLOBAL PIPELINE

APRIL 4, 2011
UC DAVIS CONFERENCE CENTER

2011

UC ENERGY WEEK

2011

UC ENERGY WEEK

WELCOME

As part of the University of California Energy Week, CIFAR's XXIXth conference will provide the arena for an engaging listening and interactive conversation on where we are and where we may be going with biofuels and bioproducts derived from agricultural, forestry and industrial processes, and waste streams, including food processing wastes.

The discussion will be substantial and wide ranging in addressing the complex aspects of this emerging bio-industry, emphasizing sustainable cellulosic biofuels and co-products, as conceived in ***integrated biorefineries***, and the grand challenges, realities, and opportunities going forward. Both real-world, current day practices and academic-world knowledge-building technologies will be woven together in this mosaic.

The topic is important, timely, complex and controversial. Is it "food or fuel"? "food and fuel"? or "food and feed and chemicals and materials and energy"? This searching question will be addressed from many perspectives by the speakers and by the participants. The organizers encourage a balanced discussion throughout the afternoon and evening.

A Chinese proverb used by the leading California pistachio grower Dave Fiddyment, on the occasion of his 80th birthday is "The land is the host and humans merely guests". It follows---Can we think SMART to create more value and less waste while at the same time not jeopardizing the future of our children and grandchildren. California is the golden state, the place where new things happen, where California goes, so goes the nation and the world, so as citizens of one world, we can "change the world". Biofuels are only a small part of the overall equation but it can be significant.

On behalf of the CIFAR affiliate members and sponsors, I invite you to listen, learn and share your thoughts and also consider attending additional events during our UC Energy Week (*www.energy.ucdavis.edu*). Our door is OPEN for your active participation!

Sharon P. Shoemaker, PhD
Founding Executive Director, California Institute of Food & Agricultural Research
Associate Director, External Programs, Energy Institute
University of California, Davis

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Philip Madson, P.E., President, KATZEN International, Cincinnati, OH

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Douglas Rivers, PhD, Director of Research and Development, ICM, Inc., Colwich, KS

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Neil Koehler, President and CEO, Pacific Ethanol, Sacramento, CA

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Douglas Cameron, PhD, Founder and Managing Director, Alberti Advisors LLC, Plymouth, MN

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Melissa Klembara, Technical Manager of Integrated Biorefinery and Deployment, Energy Efficiency and Renewable Energy, Washington D.C.

15:45 **Q & A**

15:55 **Break and Posters**

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16:15 — **Panel 3: Some Outcomes, Still Evolving**

Enzyme Development for Biofuel Production from Cellulosic Biomass: Application of Advanced Technology to Enable the Biorefinery.
Mark Wogulis, PhD, Senior Scientist of Protein Improvement and Optimization, Novozymes, Inc, Davis, CA

Catalytic Conversion of Pyrolysis Oils to Fuels and Value-added Chemicals.
David Block, PhD, Professor, Viticulture and Enology, and Chemical Engineering and Material Science, UC Davis.

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Dennis Schuetzle, PhD, President, and Renewable Energy Institute International and Chief Technology Officer for Pacific Renewable Fuels and Chemicals, McClellan, CA

Algae Biofuels for California.
John Benemann, PhD, MicroBio Engineering, Inc., Walnut Creek, CA

17:45 — **Q & A**
Beverages and appetizer choices brought to your table

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The Global Pipeline begins with the Canada-California Strategic Innovation Partnership.
Donald Smith, PhD, James McGill Professor of Plant Sciences, Director, Green Crop Strategic Research Network, and Director, McGill Network for Innovation in Biofuels and Bioproducts, McGill University, Montreal, Quebec, Canada.

Strength in Partnerships: A Perspective from China.
Pingfan Rao, PhD, Professor and Founder of the School of Biotechnology, Fuzhou University, Fuzhou, Fujian, China

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Jim Seiber, PhD, Chair and Professor, Food Science and Technology, UC Davis

19:00 — **Wrap Up with Posters and Networking Reception with Heavy Hors D'Oeuvres**

21:00 — **Adjourn**

SPEAKERS

Neal Van Alfen, Ph.D.

Dean, College of Agriculture and Environmental Sciences, UC Davis

Neal Van Alfen is Dean of the College of Agricultural and Environmental Sciences at the University of California, Davis — the leading college of its kind in the nation. Van Alfen oversees cutting-edge research and top-ranked education programs addressing critical issues related to agriculture and food systems, the environment, and human and social sciences.

Prior to earning a doctoral degree in plant pathology from UC Davis, Van Alfen earned bachelor's (chemistry) and master's (botany) degrees from Brigham Young University. His research focuses on fungal molecular biology with the goal of controlling plant diseases using low-input, sustainable methods such as biological control. He also has expertise on the effects of air pollution on environmental health.

An elected fellow of the American Association for the Advancement of Science and the American Phytopathological Society, Van Alfen has served on numerous national committees and boards, including a number of National Research Council studies on biological control. He is the editor of the Annual Review of Phytopathology, and served as president of the American Phytopathological Society. Dean Van Alfen chaired the National Agricultural Biotechnology Council and was a founder of the Agricultural Biotechnology Communicators group.

SETTING THE STAGE: THE GLOBAL GRAND CHALLENGES

Sharon P. Shoemaker, Ph.D.

Executive Director, California Institute of Food and Agricultural Research and Associate Director, External Programs, Energy Institute, UC Davis

Sharon Shoemaker joined UC Davis in 1991 as Founder and Executive Director of the California Institute of Food and Agricultural Research (CIFAR), where she brings together a wide variety of organizations and individuals, forming collaborations and project teams to conduct applied research, and organize conferences to disseminate state-of-the-art knowledge in emerging technology areas.

Shoemaker conducted pioneering collaborative research on microbial cellulase, ligninase and cellulose biosynthetic systems, first at Cetus Corporation (1978-85) and later at Genencor International (1985-1911) and UC Davis (since 1991). This resulted in the first sequence of a cellulase gene, isolation and development of hyperproducing cellulase strains (still regarded as one of the best), first demonstration of bacterial cellulose biosythnesis in stirred tank reactors, and development of a ligninase system for replacing chlorine in pulp and paper operations. At UC Davis, she has collaborated on numerous projects and mentored students in feedstock characterization and conversion of agricultural 'wastes' (e.g.. rice straw, wood, and food processing effluent streams) to sugars, ethanol and other products. One project, in collaboration with Argonne National Laboratory, developed strains and fermentation systems for production of lactic acid.

Shoemaker is a signaturee in the original DOE Biomass Roadmap Compact, a DOE Industries of the Future valued partner in Agriculture, and was an invited lecturer at the Marcus Wallenburg Prize. She has been a long-time contributor to strategic plans, technical programs and organizing committees for DOE, USDA, and American Chemical Society (ACS) and currently serves as chair of the scientific advisory board of DOE's BioEnergy Science Center, as board member of Canada's Green Crop Network, and advisor to the Chinese Institute of Food Science and Technology. Shoemaker also serves on the editorial board of the ACS Journal of Agricultural and Food Chemistry and is the 2002 recipient of the Charles D. Scott Award for Biotechnology Research Applied to Production of Fuels and Chemicals. Shoemaker holds B.S. degree in Chemistry, M.S. degree in Food Science and Ph.D. degree in Biochemistry and Nutrition from Virginia Tech.

EXPLORING THE PROSPECTS FOR ETHANOL GENERATION 1.5

Philip W. Madson, P.E.

President, KATZEN International, Inc.

Phil Madson has served as President of KATZEN International, Inc. since 1993. He has held a number of technical and executive positions since joining the firm in 1980, including process engineering, project management, startup services, and marketing. KATZEN's focus throughout this period has been the research and development, design and execution of advanced technology for the fuel, industrial, and potable ethanol industries worldwide. Madson has concentrated his efforts in the field of value-added agricultural processing as it integrates with ethanol production. His technical specialty is advanced distillation systems development and design. Madson received B.S. and M.S. degrees in Chemical Engineering from Iowa State University and is a registered Professional Engineer.

ICM PERSPECTIVES ON CELLULOSE TO ETHANOL PROCESS DEVELOPMENT

Douglas B. Rivers, Ph.D.

Director, Research and Development, ICM, Inc.

Douglas B. Rivers, Ph.D., Director of Research and Development at ICM, Inc., leads the company's R&D efforts in facilities across two states. He is responsible for laboratory operations in Colwich, KS and St. Joseph, MO., and pilot plant operations in St. Joseph, MO. He oversees ICM's development and technology and its transition to commercial production. ICM develops products and processes that produce food, feed, and fuel from grain and cellulosic feedstocks, and that add value to agriculture, biofuels, and biobased product industries.

Rivers serves on the board of the Kansas Alliance for Biorefining and Bioenergy (KABB). KABB is a State of Kansas alliance between industry and its two primary research institutions, Kansas State University and the University of Kansas, working to develop and commercialize a rapidly growing biofuels and bioprocess industry in Kansas.

Prior to joining ICM, Rivers was responsible for a variety of successful development, scale-up and commercialization efforts, including starch and cellulose conversion to ethanol. At MBI (Lansing, MI), he directed development, scale-up, and commercialization of fermentations producing lactic acid in a joint venture with Cargill. He also was responsible for fermentations producing succinic acid and butanol, as well as other efforts resulting in commercial products such as optically-pure chiral chemicals derived from fermentation that form the backbone of the drug Crestor®, the plant growth modulator AuxiGro®, and enhanced animal feeds.

While at ADM (Clinton, IA), Rivers was responsible for implementing the first commercial-scale application of adsorption/desorption technology, dramatic improvements in the production of thermostable alpha-amylase, and installation of yeast propagation systems for fuel and potable ethanol production. He also contributed to the first wave of cellulosic ethanol development in the late 1970s and early 1980s as a development/scale-up leader for the Gulf Oil Corporation and the University of Arkansas where he was responsible for feedstock evaluations, scale-up of simultaneous saccharification fermentation, and development of pretreatment methods and equipment.

ABSTRACT

Although ICM is a developer of cellulose to ethanol technology, ICM neither conducts basic or applied research. Instead, ICM views itself as a technology integrator. Thus we focus on our strengths that play off of our basic core capabilities that have been in place since our inception in 1995: design, engineering, manufacturing, and project management. With this in mind, ICM leverages off of its success in the grain ethanol industry where we have build 102 U.S. plants that produce over 6.5 MGY, over half the U.S. production. As an integrator, we constantly review technologies that are coming out of universities and start-up companies that may be ready to enter the development phase. This philosophy has led ICM to the point where we are nearing readiness to pilot what we believe will be one of the first commercial cellulose technologies.

In December 2009, ICM was awarded a $31,250,000 U.S. Department of Energy (DOE) – American Recovery and Reinvestment Act (ARRA) contract to modify its existing 10,000 sq. ft. dry fractionation grain pilot plant located in St. Joseph, MO to be able to process 10 dry metric tons of cellulosic biomass per day into ethanol. Initially, ICM completed the NEPA documentation process, which resulted in a Categorical Exclusion (CX) ruling. By late August 2010 ICM began construction to add approximately 15,000 sq. ft. of pilot plant space that will include additional unit operations such as feedstock receiving and handling, pretreatment, and hydrolysis. Construction is expected to be completed by June 30, 2011 with hydraulic testing and qualification operations using corn fiber (bran) fractionated from existing corn grind operations scheduled to follow. By the fourth quarter of 2011, ICM expects to conduct its first fully integrated run with a high-impact feedstock, switchgrass.

CHALLENGES AND OPPORTUNITIES IN USING CORN ETHANOL AS THE BRIDGE TO CELLULOSIC ETHANOL

Neil Koehler

President and CEO, Pacific Ethanol

Neil Koehler has over twenty years experience in ethanol production, sales, and marketing in the western United States. He was co-founder and general manager of Parallel Products, a California-based ethanol production company, which he sold to a public company in 1998. He also founded Kinergy Marketing, an ethanol sales and distribution firm that was acquired by PEI in May 2004.

Koehler is a Renewable Fuels Association board member and the director of the California Renewable Fuels Partnership. He is also a sought-after speaker on the issue of renewable fuels. He has a B.A. degree in Government from Pomona College.

INVESTING IN A SUSTAINABLE FUTURE

Douglas Cameron, Ph.D.

Founder and Managing Director, Alberti Advisors LLC

Doug Cameron is Founder and Managing Director of Alberti Advisors, a venture advisory firm focused on business, science and engineering at the intersection between clean technology and agriculture. Prior to founding Alberti Advisors, Cameron was Chief Science Advisor and Managing Director in the cleantech investment banking group at Piper Jaffray, a global investment bank headquartered in Minneapolis.

From 2006-2008, Cameron was chief scientific officer at Khosla Ventures, a premier Silicon Valley-based cleantech venture capital firm. From 1998-2006, he was at Cargill, Inc. where he held the position of Director of Biotechnology and Chief Scientist. From 1986-2000, Cameron was a professor of chemical engineering at the University of Wisconsin, Madison.

In 2009, Cameron was the recipient of the Raphael Katzen Award for his contributions in furthering the deployment and commercialization of biotechnology to produce fuels and chemicals from renewable resources. He is also a fellow of the American Association for the Advancement of Science (AAAS), the Society for Industrial Microbiology, and the American Institute for Medical & Biological Engineering.

Cameron graduated magna cum laude from Duke University with a BSE in biomedical engineering and earned a PhD in biochemical engineering from the Massachusetts Institute of Technology.

DOE'S INTEGRATED BIOREFINERY PROGRAM, STATUS AND CHALLENGES

Melissa Klembara

Technical Manager, Integrated Biorefinery and Deployment, Energy Efficiency and Renewable Energy

Melissa Klembara is Technology Manager for Integrated Biorefinery Deployment with the U.S. Department of Energy's Office of the Biomass Program. The Department is currently investing over $1 billion to deploy 29 integrated biorefineries at pilot, demonstration, and commercial scale that will validate the technical and economic performance of processing various non-food biomass resources using innovative conversion technologies to produce a suite of biofuels, bioproducts, and biopower. This work is in direct support of meeting the Energy Independence and Security Act's Renewable Fuels Standard for "advanced biofuels". Prior to working at the Department of Energy, Melissa was with International Paper Company in Memphis, TN, working in a dual role a process engineering and corporate financial auditor and placed on special cost savings projects in pulp and paper mills. Klembara holds a Bachelors of Science in Chemical Engineering from University of Maryland, as well as an M.B.A. and a Master of Science in Energy from Heriot-Watt University in Edinburgh, Scotland.

ABSTRACT

The U.S. Department of Energy is making significant investments in building biorefineries at various scales, using a wide variety of non-food biomass resources and innovative conversion technologies. The Department plans to assess the technical, environmental, and economic performance of these various biorefinery designs and compare them to their petroleum derived counterparts. However, these 29 biorefineries, if successfully deployed, would only bring a total of roughly 170 million gallons of advanced biofuels in annual production capacity online by 2014, a drop in the bucket (<1%) compared to U.S. gasoline consumption of 378 million gallons per day (EIA petroleum statistics, October 2010). This capacity is also significantly less than the Energy Independence and Security Act of 2007, Renewable Fuels Standard targets (3.75 billion for advanced biofuels by 2014).

Ideally, government's investment in these pilot, demonstration, and commercial scale projects should reduce the technical risks enough to entice private sector financing of future commercial scale facilities and replications of the designs. However, today's market uncertainties and economic conditions still make it difficult for the private sector to finance pioneer plants -- even with potential government loan guarantees. The U.S. Department of Energy must continue to coordinate its efforts with other agencies, industry, universities, and other key stakeholders to develop a strategy that accelerates deployment of biorefineries at a significant scale to meet U.S. energy goals in an environmentally responsible way.

ENZYME DEVELOPMENT FOR BIOFUEL PRODUCTION FROM CELLULOSIC BIOMASS: APPLICATION OF ADVANCED TECHNOLOGY TO ENABLE THE BIOREFINERY

Mark Wogulis, Ph.D.

Senior Scientist, Protein Improvement and Optimization, Novozymes, Inc.

Mark Wogulis is a senior scientist in the Artificial Evolution department at Novozymes, Inc. He has been at Novozymes since July of 2008, working on engineering improved enzymes for biomass hydrolysis. He has a B.S. and M.S in Biological Sciences from Stanford University and a Ph.D. in Biochemistry and Molecular Biology from UC Davis, where he studied X-ray crystallography in the lab of Professor David K. Wilson. Wogulis did post-doctoral studies in the lab of Professor Judy Callis, studying enzymes in the ubiquitin system. Wogulis has also worked in the pharmaceutical industry at Athena Neurosciences and Elan Pharmaceuticals, searching for treatments for Alzheimer's Disease.

ABSTRACT

Cutting edge technologies that enable cost reductions across diverse production platforms are essential to commercialization of fuel production from biomass. Novozymes has launched a commercially viable enzyme product which demonstrates performance improvements on a variety of feedstock and under varying pretreatment conditions. We coupled enzyme versatility and advanced performance with application development to address the interactions between pretreatment, enzymatic hydrolysis and fermentation. In order to attain a holistic view of the entire process and its associated costs, and to identify potential development opportunities for further cost reductions, cost-modeling tools are used to suggest process specifications that minimize the ethanol selling price.
We have developed a robust, versatile enzyme cocktail with increased catalytic activity and thermostability, and improved tolerance to inhibition. We have developed enzymes that work well in a variety of processes and conditions on pretreated agricultural residues as well as woody based substrates. Our recent and continued success results from continued searching in natural diversity, engineering improved specific activity and thermostability of the enzymes present in our existing cellulase products, addition of accessory proteins that improve performance on some substrates, and introduction of superior proteins into high-yielding Trichoderma reesei production strains.

Novozymes works with industry leaders to integrate the technologies both upstream and downstream of enzymatic hydrolysis. This needed integration of technologies drives our open and broad approach to partnering, with a focus on innovative companies representing varied cellulose based substrates and pretreatment methods, and cutting edge technologies. As a result, Novozymes' technologies enable companies to move aggressively from pilot scale testing to commercialization.

CATALYTIC CONVERSION OF PYROLYSIS OILS TO FUELS AND VALUE-ADDED CHEMICALS

David Block, Ph.D.

Vice Chair and Professor, Viticulture and Enology, and Chemical Engineering and Material Science, UC Davis

David Block is Vice Chair and Professor in Viticulture and Enology at UC Davis, with a joint appointment in the Department of Chemical Engineering and Materials Science. He has recently been appointed to the Ernest Gallo Endowed Chair in the Department of Viticulture and Enology. Since joining UC Davis, his research spans a number of different areas, including development of fermentation datamining, modeling, and optimization methods, metabolic engineering of yeast and lactic acid bacteria for improved biofuel and recombinant protein production, and catalytic conversion of agricultural waste streams into fuels and value-added chemicals.

Block has received multiple awards for his teaching, including an award from the Northern California American Institute of Chemical Engineers for Excellence in Chemical Engineering Teaching and a Distinguished Teaching Award from the UC Davis Academic Senate. Prior to joining UC Davis, he worked for Hoffmann-La Roche, Inc. in Nutley, NJ where he was in charge of fermentation process development groups, as well as designing and operating process control systems for new biopharmaceutical manufacturing facilities. Block holds a B.S.E. from the University of Pennsylvania and a Ph.D. from the University of Minnesota, both in Chemical Engineering.

EMERGING THERMOCHEMICAL APPROACHES FOR THE ECONOMICAL PRODUCTION OF RENEWABLE FUELS AND CHEMICALS

Dennis Schuetzle, Ph.D.

President, Renewable Energy Institute International (REII) and
Chief Technology Officer for Pacific Renewable Fuels and Chemicals (PRFC)

Dennis Schuetzle has 38 years of experience in managing scientific and engineering research, product development and manufacturing, renewable energy and fuel production processes, and environmental science and technology programs in collaboration with organizations in North America, Asia, Europe, South America, Russia and South Africa. His current R, D &D efforts include the management of ~$30 million in projects on next generation research, development, demonstration and deployment efforts for the production of renewable fuels and energy. Prior to his positions with REII and PRF, he was Director/VP of International Research and Technology (IR&T) for Ford Motor Company. As the leader of Ford's IR&T, he established and managed 39 projects that involved more than 200 engineers and scientists in 18 countries. He has published 108 scientific and engineering papers, edited four books, and contributed to 76 technical volumes. He is the recipient of eleven international awards including 5 RD100 awards for the successful deployment of commercial technologies into the global marketplace.

ABSTRACT

Thermochemical conversion of biomass is proving to be a versatile, economical process for the distributed conversion of virtually any biomass feedstock into clean, renewable liquid fuels and renewable specialty chemicals. Such processes are ideal for the production of high quality, synthetic diesel (syndiesel) and jet (JP-8 type) fuels. These “drop-in” fuels contain no sulfur; have high cetane content and excellent lubricity, resulting in efficient operation with in-use, current and future model engines. For example, this syndiesel reduces CO, HC and particulate emissions from diesel engines by up to 50% and NOx by 5-10% compared to current #2 diesel fuels. Life cycle assessment (LCA) modeling demonstrates that this renewable syndiesel will reduce greenhouse gas emissions by 89% compared to current diesel fuel formulations. REII’s economic models predict a syndiesel fuel production price of ¢$3.00/gallon with a 20% return on investment at the 300 dry tons per day (dtpd) commercial plant scale. These thermochemical processes with minor process modifications (e.g. changes in catalyst formulations) also have the capability of producing a wide variety of renewable specialty chemicals. REII’s GIS models indicate that there is enough biomass available in the U.S. to support the deployment of several thousand 300 dtpd thermochemical plants.

ALGAE BIOFUELS FOR CALIFORNIA

John R. Benemann, Ph.D.

Benemann Associates, MicroBio Engineering, Inc.

In 1980 Benemann started a small microalgae biotechnology company and from 1983 to 1988 he served Associate Professor in the Department of Applied Biology, Georgia Institute of Technology. For past 20 years he has been a consultant and also part-time researcher at UC Berkeley, adjunct professor at the University of Hawaii, manager of the "Microalgae Biofixation Network", under the International Energy Agency (IEA) and founding director of the Algal Biomass Organization, a not-for-profit trade organization. He is the author of over a hundred peer reviewed publications, reports and reviews, and has presented at numerous conferences. Benemann received a B.S. in Chemistry and a Ph.D. in Biochemistry, from UC Berkeley and was postdoctoral fellow in the Chemistry Department of UC San Diego.

ABSTRACT

Biofuels from both microalgae (pond scum) and macroalgae (seaweeds) are the focus of major worldwide R&D programs, with California the leader in this space. California also has a long history of research and commercialization of algae biotechnologies, from seaweed harvesting and processing to wastewater treatment and nutritional products from microalgae. Although not a panacea, as promised by some, algae could contribute to the biofuel and biomass resources that California requires to move into a sustainable future. The prospects, limitations and R&D needs for algae biofuels in California, will be discussed.

THE GLOBAL PIPELINE BEGINS WITH THE CANADA-CALIFORNIA STRATEGIC INNOVATION PARTNERSHIP

Donald Smith, Ph.D.

James McGill Professor, Plant Sciences, McGill University
Director, Green Crop Strategic Research Network
Director, McGill Network for Innovation in Biofuels and Bioproducts, McGill University
www.mcgill.ca/plant/faculty/smith/

B.S. - Acadia University, Wolfville, Nova Scotia, 1975
M.S. - Acadia University, Wolfville, Nova Scotia, 1979
Ph.D. - University of Guelph, Guelph, Ontario, 1984

During his 25 years at McGill, Don Smith has mentored 53 graduate students (31 Ph.D. and 22 M.S.). These have worked largely in production and physiology of crop plants, more recently with an emphasis on plant-microbe interactions. The areas of research investigation are as follows: nitrogen metabolism, nitrogen fixation, root zone temperature stress and nodule development, development of methods for injection of metabolites into developing plants, barley production, use of plant growth regulators, intercropping, the dynamics of inter-plant competition, plant-microbe signaling, plants and climate change, biofuel crops, crop stress responses and biochar as a soil amendment. He is involved in the physiological responses of crop plants to increasing atmospheric CO2 levels and to climate change, plant-microbe signaling and biochar effects on crop productivity. Throughout his research career, work on nitrogen fixation has been a consistent theme, beginning with an undergraduate research project on cyanobacteria in 1974. Current work in this area includes signaling between symbiotic partners during establishment of the legume-rhizobia symbiosis. Altogether this research activity has resulted over 260 publications (from his postgraduate research activities and those of his graduate students), five patents issued and three others applied for, and a spin-off company (Bios Agriculture Inc.).

During his 25 years at McGill, Don Smith has been principal investigator on research grants totaling over $10 million, and has been a co-applicant on approximately $12.5 million in other funds. He currently leads the NSERC funded ($1.2 million per year) Green Crop Network (www.greencropnetwork.com) on crops and climate change, including work on biofuels, and also heads the McGill Network for Innovation in Biofuels and Bioproducts (McNIBB - http://mcnibb.mcgill.ca/index.html). He has had international collaborations with the US, India, China, Russia, Brazil and Africa.

ABSTRACT

Three of the great challenges of this century are energy supply & security, climate change, and world food security; these converge in biofuels. The urgent need to displace fossil fuel consumption requires development of alternatives, including biofuels, as quickly and efficiently as possible. Rapid development of biofuels requires the full integration of all relevant components. Much of our daily activities are only possible if a reliable energy source is available. During the 20th century we came to rely increasingly on fossil fuels, but replacements for these must now be found or we face a forced and extensive reorganization of our society that is likely to result in degraded living conditions. In 2009 we established the Green Energy Canada-California Consortium as an effort to address this situation through international collaboration. The overall objective of the GE-C3 was to produce an R&D Business Plan for concerted development of biofuels, bioproducts and biorefining (BBB) to a functional and integrated sector of the economies of Canada and the United States. The business plan was produced in three forms: 1) scientific and technical review papers suitable for publication in a peer reviewed journal, 2) a white paper document for use in advancing policy development by government, and 3) a road map for the R&D effort needed to bring BBB to an integrated and fully functional state. In general, this effort focuses on research activities in 4 key areas – biomass feedstocks, biomass conversion, biofuel utilization, and socio-economic and environmental sustainability (SEES) promotion. This effort has resulted in BBB workshops in both Canada and California, with cross attendance in each case, and the thinking from these has, most recently, resulted in the development of a Networks of Centres of Excellence proposal in Canada.

STRENGTH IN PARTNERSHIPS: A PERSPECTIVE FROM CHINA

Pingfan Rao, Ph.D.

Professor and Founder, School of Biotechnology, Fuzhou University, China

Pingfan Rao, Ph.D., received BEng in food technology from Fuzhou University of China in 1982, MS in food science from Hiroshima University of Japan in 1986, and PhD in biochemistry from Osaka University of Japan in 1989. He has been teaching for over twenty years at Fuzhou University, and is a Professor and current Director of the Institute of Biotechnology Fuzhou University. Rao is actively involved in the food and biotechnology industries, as the founder and advisor of food and biotech companies, the President-elect of the International Union of Food Science and Technology, a fellow of International Academy of Food Science and Technology and an advisor to municipal governments. He has also been the Vice President of the Chinese Institute of Food Science and Technology since 2001.

Rao's research focuses primarily on identifying and characterizing bioactive proteins and expression and large scale production of recombinant enzymes, protein derivatives as the active ingredients of tradition Chinese medicine and food, new methodology for cell separation and acupuncture meridian. In addition to his work in China, Rao is also a Distinguished Visiting Professor of the University of Ulster, UK, a supervisor of joint PhD program with the University of Edinburgh, UK and Wageningen University, Holland.

MAPPING A ROUTE TO SUSTAINABLE EFFICIENCIES FOR THE CALIFORNIA FOOD PROCESSING INDUSTRY

James N. Seiber, Ph.D.

Chair and Professor, Food Science and Technology, UC Davis

James N. Seiber, a native of Missouri, received his degrees in chemistry from Bellarmine College, AB (Louisville, KY), Arizona State University.M.S. (Tempe, AZ) and Utah State University Ph.D. (Logan, Utah). He has held positions as a research scientist at Dow Chemical Company (Midland, MI and Walnut Creek, CA) before becoming a faculty member at UC Davis' Department of Environmental Toxicology (1969 to 1992). At UC Davis he served as Professor and Department Chair, and as Associate Dean for Research in the College of Agricultural and Environmental Sciences. He returned to UC Davis in 2009 as Chair of the Department of Food Science and Technology.

Seiber was founding director of the Center for Environmental Sciences and Engineering at the University of Nevada, Reno (UNR) in 1992, where he initiated a multidisciplinary program of research and graduate education involving 125 faculty and 250 students. He provided system-wide coordination between Desert Research Institute and both UNR and UNLV campuses in environmental sciences and engineering, and coordinated programs in the Lake Tahoe Basin.

Seiber has mentored 40 graduate students to M.S. and Ph.D. degrees at UC Davis and UNR, mostly focused on analytical method development and transport/fate, notably in agricultural and forested environments, and food safety. His work included systematic studies of agricultural chemicals in fog. Seiber joined the USDA Agricultural Research Service in 1998 as Director of the Western Regional Research Center (WRRC) in Albany, CA. and was involved in their development and implementation of food safety and biobased product initiatives. Since January 1999, Seiber has served as Editor of the Journal of Agricultural and Food Chemistry. JAFC publishes approximately 1,500 manuscripts per year in 24 issues, submitted by U.S. (25%) and international (75%) authors.

ABSTRACT

California's food processing industry, a $30 to 40 Billion Dollar enterprise with major ties to the state's economy, is continuing to face major challenges in energy costs, water costs and availability, and regulations tied to emission reduction. The Robert Mondavi Institute's new August A. Busch III Brewing and Food Science Laboratory offers an opportunity to address improved efficiencies in a new facility built to the latest standards of environmental efficiencies, and to provide training for a new generation of food processors with efficiency and sustainability considerations front and center in the training context.

THE GREEN ENERGY CANADA-CALIFORNIA CONSORTIUM (GE-C^3)

Harnessing the Power of Canada-California R&D Cooperation to Develop Novel Biofuels for Green and Sustainable Energy

Three of the great challenges of the 21st century are a renewable and sustainable fuel supply, climate change and global food security. Facing these challenges will necessitate drawing on our scientific expertise and developing innovative solutions to drive the development of sustainable alternative energy sources.

The Green Energy Canada-California Consortium (GE-C^3) is an integrated partnership between Canadian and Californian researchers that capitalizes on complementary strengths to address these complex problems. Our multidisciplinary team covers the necessary array of expertise from feedstock development, to biomass conversion, biofuel utilization and aspects of socio-economics & sustainability, including water supply, related to biofuels and bioproducts. This multidisciplinary team supported by CCSIP and jointly led by McGill University and University of California, Davis (UC Davis), regroups expertise from 8 Canadian universities (McGill University and the Universities of Western Ontario, Manitoba, Alberta, Saskatchewan, Toronto, Sherbrooke, École Polytechnique de Montréal) and 5 of the UC campuses (Davis, San Diego, Riverside, Los Angeles, and Berkeley).

Our mission is to address these challenges and contribute to accelerating the birth of a new energy sector that reduces greenhouse gas emissions without significant competition with the food production sector. Key to this mission is training the needed personnel for deployment in both the public and private sectors.

Our objective is to create a road map for biofuel and bioproduct R&D and its subsequent development by researchers active in the field, defining key strategies and collaboration priorities and including the development of position papers for policy makers

This approach will require a new model of collaboration between Canada and California that leverages key research capabilities and opportunities, addresses common priorities, and, most importantly, accelerates the delivery of research results for a novel, reliable and environmentally beneficial energy source as soon as possible, while also developing a new sector of the economy (with particular benefit to rural economies). Our efforts will result in new crops, effective biorefineries for biofuel production, interactions with the user sector (aerospace and surface transport) and understanding of biofuel combustion properties for their engines and, finally, the economics, social effects and environmental aspects of a new and vibrant biofuel and bioproduct industry.

There is a clear and urgent need to develop alternative and renewable energy sources. Both the public and the policy makers are aware of the need to create biofuels/bioproducts to address this. The GE-C^3 will be a world leader in research, development and policymaking in this area.

FACT SHEET –
CALIFORNIA INSTITUTE OF FOOD AND AGRICULTURAL RESEARCH
www.cifar.ucdavis.edu

CIFAR, founded in 1991, is a self-funded program that serves as a portal and catalyst for collaborative research and technology exchange between UC Davis and the agriculture, food and beverage, health, and integrated bio-refining industries.

CIFAR is a college program that is housed within the Department of Food Science and Technology at UC Davis and is an affiliated organization with UC Davis' Robert Mondavi Institute, Energy Institute, Foods for Health Institute and Global HealthshareTM Initiative. It maintains a worldwide scope with an emphasis on seeking out and being aware of new technologies, industry trends, and opportunities for collaboration between Industry and Academia.

CIFAR has strong international connections, with active projects in China, Canada, Thailand, UK and Italy. CIFAR is the point of contact for the Chinese Institute of Food Science and Technology, and is the point of contact for UC and Canadian universities in biofuels and bioproducts.

CIFAR sponsors two technology conferences/forums per year, the topics being decided from input of its member affiliates.

CIFAR's partnership with Nuffer, Smith, Tucker (San Diego) provides an annual update of Food Foresight Trends analysis, a highly regarded product by current industry members. The International Food Information Council and other member organizations also provide input to trends.

CIFAR has an extensive network for contacts, technology, etc.
Technology focus areas include the following:

- Food trends, major industry issue tracking;
- Food for health and well-being;
- Food safety;
- Sustainable production and practices;
- New product, processing and packaging technologies;
- Integrated BioRefineries (IBR);
- Energy, water and waste management.

Affiliates earn the following benefits:

- Rub elbows with other member affiliates while sitting in on board meetings;
- Guide CIFAR's direction;
- Portal to UC Davis research, faculty and facility expertise.
- Free attendance to conferences (worth $500=$750 per year per person);
- Energy efficiency consultation (priceless);
- Assistance in setting up research collaborations – CIFAR provides guidance on academic talent and jumping through administrative hoops;
- Assistance with early stages of contracting research projects that may require separate funding and contracting agreements with the University;
- White papers (literature review) on issues of concern;
- General ongoing access to research center;
- Assistance in identifying students and scholars for potential employment.

CIFAR has 39 members (as of March 1, 2011).

UNIVERSITY OF CALIFORNIA SPONSOR DESCRIPTIONS

CIFAR

The California Institute of Food and Agricultural Research (CIFAR, founded 1991) creates opportunities for collaboration, program sponsorship and technology exchange in agricultural and food technologies and energy resource management, by maintaining a "finger on the pulse" of innovations, advanced technologies, and industrial practices, and by integrating its academic base, its global group of industrial member affiliates and its Food Foresight strategic planning collaboration. CIFAR leverages the many programs and expertise of the campus to bring value to its industrial member base by providing information and assistance in areas of new technology and product development for safe, sustainable and effective resource utilization in food processing operations, energy, water and supply chain management, and production of biofuel and bioproducts from agricultural and food wastes.

http://cifar.ucdavis.edu

Energy Institute

The Energy Institute at UC Davis is home to energy research and education programs of the University of California, Davis, and was established with a view toward accelerating the global transformation to a sustainable energy future, integrating energy efficiency with renewable energy solutions, and training the next generation of engineering, scientific, and policy leaders. The Institute is structured to foster innovation, public service, and informed decision-making for new energy solutions, to coordinate campus strengths in energy research, education, and outreach, and to position UC Davis as an institution of choice for energy research and education.

http://energy.ucdavis.edu

Robert Mondavi Institute

In 2001, Robert Mondavi, renowned California wine producer, made a personal gift of $25 million to establish the Robert Mondavi Institute for Wine and Food Science (RMI) within the College of Agricultural and Environmental Sciences at UC Davis. Mr. Mondavi's vision was to provide "a prestigious forum for collaboration between the Department of Viticulture and Enology and the Department of Food Science and Technology." Additional funds from the State of California and UC Davis enabled the campus to construct a state-of-the-art facility which now houses these two distinguished academic departments under one roof. The Institute was dedicated on October 10, 2008.

http://rmi.ucdavis.edu

Food Science and Technology (FS&T)

The Department of Food Science and Technology is a premier research and teaching department at the University of California, Davis dedicated to ensuring the availability of safe, nutritious, appealing and affordable food, with minimum environmental impact. The Department offers integrative training in food chemistry, food microbiology, food processing and in the chemical, physical and sensory aspects of food.

http://foodscience.ucdavis.edu
http://greenrmi.ucdavis.edu/bldg/foodsci
http://greenrmi.ucdavis.edu/bldg/brewery

Viticulture and Enology (V&E)

The V&E Department combines the sciences of viticulture and enology in a single research and teaching unit that encompasses all of the scientific disciplines that impact grape growing and winemaking. For over one hundred years the University of California has maintained an active and productive program in research and education in viticulture and enology. The continuing excellence of the Department has enabled California growers and vintners to develop practices that have allowed the Golden State to achieve its potential and become a premier wine-producing region.

http://wineserver.ucdavis.edu
http://greenrmi.ucdavis.edu/bldg/winery

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