

COLORADO BUSINESS REVIEW

A publication of the Business Research Division
Volume 79, Number 2, 2013

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Former Secretary of Energy Federico Peña talking with students on April 2 about U.S. energy independence.

Address by Former Secretary of Energy Federico Peña

“Achieving U.S. Energy Independence in Our Lifetime”

Keith Stockton

Former Denver mayor and Secretary of Energy Federico Peña presented his plan for U.S. energy independence to an audience of more than 150 students on April 2. The event, cosponsored by the Leeds School of Business and the College of Engineering and Applied Science, represents an example of CU-Boulder's expanding interdisciplinary offerings and marks a growing collaboration between the two academic units. “Achieving energy independence is a realistic objective,” said Peña. “Business and engineering students need to anticipate the opportunities available to them by thinking and planning for a changing energy future.”

According to the Energy Information Administration, the United States is energy

independent in all energy segments except one—liquid fuels. The nation has sufficient resources to meet its domestic electricity demands for decades. With the recent advances in horizontal drilling, hydraulic fracturing, and offshore production, the United States is producing more natural gas than ever. These advances also allow the United States to economically replace high emission (e.g., carbon dioxide, sulfur oxide, nitrous oxides, mercury, and particulate matter) coal-fired electricity generation with significantly cleaner natural gas generation. In a surprising turn of developments from just five years ago, the natural gas discussion now focuses on whether the United States should export liquefied natural gas to other countries or use it domestically for production of higher value commodities such as fertilizers and petrochemicals.

Consequently, in his plan for U.S. energy independence, Peña outlined an eight-step plan to make the nation independent of all liquid fuel imports (including those from friendly countries such as Canada and Mexico) by 2030.

In 2013, U.S. liquid fuels consumption is 19.2 million barrels/day (MMBPD). Domestic production totals 11.0 MMBPD, consisting of crude oil, 7.0 MMBPD; natural gas liquids, 2.4 MMBPD; refinery processing gain,¹

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CU Cleantech New Venture Challenge

Candace DeWitt Mitchell

From the Editor

As the world looks for innovative solutions to the growing demand for energy, Colorado's research universities, nonprofits, and business community are increasingly poised to be solution creators. CU Cleantech, the New Venture Challenge, and the Energy Frontiers Conference, as well as CU engineering and business programs, underscore the University of Colorado's commitment to education, collaboration, and outreach related to energy. The articles in this issue of the *Colorado Business Review* describe the current energy environment, and highlight creative ideas from CU students and faculty and local companies working in this space.

Our next issue will review Colorado's economy six months into the year. Look for it in your inbox this summer.

Please contact me with any comments at 303-492-1147.

Richard Wobbekind

During his April 19 visit to the CU Boulder campus, Acting Secretary of Energy Daniel Poneman commended student teams that were competing in the National Clean Energy Business Plan Competition (a.k.a., New Venture Challenge [NVC]) for tackling difficult issues. "The National Clean Energy Business Plan Competition allows the best and brightest to use their entrepreneurial skills to tackle the energy challenges our nation continues to face," said Poneman. "These innovative business strategies can expand the use of clean energy technologies and compete on a global market." Poneman reinforced the importance of not shying away from the tough problems as the world looks for solutions to the increasing demand for energy.

Following his remarks, Poneman announced the top three teams and presented the \$100,000 prize to the first place team—Inviroment from Brigham Young University in Provo, Utah. Inviroment created a patent-pending technology that biodegrades all types of plastic found in landfills. The team will go on to compete in the national competition June 11–12 in Washington, D.C. In addition, the second place team is invited to the national competition. The first, second, and third place teams were presented with an award for commercialization assistance from the National Renewable Energy Lab (NREL) and complimentary registration to its annual Industry Growth Forum.

Two key sponsors discussed the partnership opportunities between the competition and their organizations. Richard Adams, manager of the Innovation and Entrepreneurship Center at the National Renewable Energy Laboratory, spoke to the group about the partnership with the NVC. Richard Franklin, cochair of the Rocky Mountain chapter of the Cleantech Open, spoke regarding the opportunity to compete in the Open and further advance the student teams' businesses. The Cleantech Open, which is a not-for-profit organization that runs the world's largest accelerator for cleantech startups, also waived the entrance fee into its program for the top three teams.

The second-place winner, BioElectric, is a company that removes salts from water while generating electric current. Students at the University of Colorado Denver developed the technology, partnering with MBA students from CU-Boulder. Third place went to NanoSynth, a University of Utah company that developed a process that helps biodiesel producers turn waste into usable products. Also competing in the competition were Superior Ecotech, comprised of students from CU-Boulder and Iowa State, and Ebullient, formed by CU-Boulder students.

CU Cleantech, which operates out of the Deming Center for Entrepreneurship in the Leeds School of Business, hosted competing teams and their guests, along with faculty, staff, and students from across the campus and community members, at the Stadium Club at Folsom Field for the



L to R: Acting Secretary of Energy Daniel Poneman and Inviroment team members Devan Bennion, Nathan Parkin, and Brock Bennion

awards reception. Attendees spoke with the teams regarding their technologies during an open poster session. Daniel Poneman was welcomed to the event and introduced by Chas Eggert, CEO of OPX Biotechnologies. Located in Boulder, OPX Biotechnologies produces bio-based chemicals and fuels. The company is an example of a university technology moving into the commercial market. University research facilities and the national labs are ideal sources of the types of technologies in development that could be strong competitors in the NVC.

Prior to the regional finals, CU Cleantech held a first round of evaluations. A broad group of local judges reviewed business plans and team videos to select the five semifinalists. At the regional finals, teams presented to a panel of judges comprised of industry experts, CEOs, and venture capitalists. In their feedback to the teams, judges highlighted strengths, opportunities for improvement, and additional considerations the team might make as they continue with their business plans.

CU Cleantech was selected to host the Rocky Mountain regional competition for the National Clean Energy Business Plan Competition (NCEBPC). The CU


Cleantech NVC saw a 50% increase in applications this year and looks to further increase its reach across the region for next year's competition.

Last year's regional winner, Navillum Nanotechnologies from the University of Utah, also won the regional competition for the Cleantech Open. It was recently awarded a \$150,000 SBIR grant and moved into an incubator facility in Salt Lake City.

As a part of the Obama administration's commitment to support the next generation of energy leaders, the competition aims to promote entrepreneurship in clean energy technologies that will boost U.S. competitiveness, bring cutting-edge clean energy solutions to the market, and strengthen U.S. economic prosperity. As a part of President Obama's Startup America, which was launched in 2011, the NCEBPC is funded by a \$2 million Energy Department grant that aims to inspire and promote entrepreneurship. The initiative is comprised of six regional organizations across the country and is run by a nonprofit or university that works with student teams. Each of the winning regional teams receives \$100,000 to continue plans to commercialize the products. The teams then go on to compete in the national

competition, which is held in the summer in Washington, D.C., for the grand prize.

The institutions that are supported by the grant and host regional competitions are the Clean Energy Trust, the California Institute of Technology, the University of Colorado Boulder, the Massachusetts Institute of Technology, the University of Maryland, and Rice University. This initiative is facilitated by the Energy Department's Office of Energy Efficiency and Renewable Energy (EERE), which invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil.

To learn more about the competition, visit nvc.culeantech.org. Student teams that are interested in competing next year are encouraged to contact Candace DeWitt Mitchell with CU Cleantech at the address below. Engaging in the process early ensures CU Cleantech can provide adequate coaching and mentoring to the teams. 

Candace DeWitt Mitchell is the CU Cleantech Student Initiatives Program Manager in the Deming Center for Entrepreneurship in the Leeds School of Business. She may be contacted at candace.dewitt@colorado.edu.

Leadership Roles for Colorado's Energy-Water Nexus

Mike Freeman

What exactly is this energy-water nexus? While we hear several definitions of energy-water nexus (especially in Colorado), the most straightforward way of explaining it may be from the National Conference of State Legislatures: "Water and energy are critical, mutually dependent resources. The production of energy requires large volumes of water and water infrastructure requires large amounts of energy." The Massachusetts Institute of Technology sums it up nicely: "It takes a great deal of water to produce energy, and a great deal of energy to produce clean water. And these relationships will become

more significant as the world's growing population demands more of each resource."

Colorado can lead in this space

What does this have to do with Colorado? First, many think the state is at the heart of all issues surrounding energy and water. Gas availability in the United States and in Colorado has been analyzed and the consensus seems to be there are decades of natural gas reserves. In Colorado, the two largest oil and gas companies working in Colorado's Niobrara oil fields say it is likely they will be drilling new wells 20 years from now. The two issues facing this reality are public acceptance of fracking and the

availability of water in a state not known for an abundance of excess water for any use, much less using water for hydraulic fracturing. Welcome to Innosphere's version of the energy-water nexus.

How can Colorado take a leadership role in this area? At Rocky Mountain Innosphere, a 501(c)(3) nonprofit technology incubator in Fort Collins, we are working with Colorado-based companies at the forefront of addressing these issues. Our view is that technology solutions need to be developed, tested, validated, and deployed across the oil and gas industry in order to gain the "social

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Energy Frontiers Conference 2013

Craig Konz

As energy issues continue to demand attention on both the global and local levels, the CU Energy Club hosted its annual Energy Frontiers Conference on April 4, themed “The Next Decade.” The conference considered the policy and technical challenges of energy that are becoming more apparent as the world’s demand for energy increases. Attracting students, professionals, and community members interested in learning about the rapid evolution of ideas taking place in this legacy industry, the program included student research displays, keynote presentations, and panel discussions. It concluded with a career fair.

The morning poster session showcased groundbreaking research being conducted by CU and CSU graduate and undergraduate students in the fields of engineering, science, and business. The students displayed and discussed their work, competing for prize money across the multiple categories. The research spanned a wide range of ideas—from energy storage solutions via atomic layer deposition that improves lithium ion batteries to technical improvement devices that simplify complex building controls and reduce energy consumption. Judges from national energy labs and research universities awarded more than \$2,000

to winners, one in each of the five categories, with the overall award going to a team of undergraduate mechanical engineering students for their work on developing a test system measuring the stiffness of wind turbine bearings. The fact that the winner focuses on incremental benefits to a proven technology recognizes the importance of research offering opportunities for rapid deployment.

The events continued with a lineup of keynote speakers and panel discussions by industry and academic experts. First was **David Gardiner**, policy consultant and former executive director of the White House Climate Change Task Force. He explained how a combination of policies could drastically reduce greenhouse gas emissions and economically advance the nation, especially policies that economically account for energy-specific negative externalities, such as the impact of carbon emissions on the environment and human health. This could help even the playing field between renewable energy with variable and uncertain subsidies and fossil fuels that enjoy tax credits grandfathered into the tax code. While there is no silver bullet to solve energy issues, Gardiner encourages policies that further emphasize renewable portfolio standards and energy efficiency programs.

Echoing what students heard earlier in the week during former Secretary of Energy Federico Pena’s visit to CU, Gardiner emphasized the need for young voters to make their voices heard as these important discussions occur. He also explained how new politics and players could engage to make a difference—pointing out that while clean energy coalitions and businesses have historically driven change in this field, rural business, such as farming, ranching, and forestry, have an increasingly important seat at the policy discussion table. He ended with the encouraging news that 59% of Fortune 100 companies have greenhouse gas reduction or renewable energy implementation targets, perhaps foreshadowing political motivation and policy goals.

Michael Potts, CEO of Rocky Mountain Institute (RMI), a Colorado-based “think and do tank,” presented next. His presentation focused on the crucial need for the efficient use of energy. He drew the audience in using interesting statistics, explaining that the U.S. individual daily energy consumption is equivalent to having 300 able-bodied humans show up on our doorsteps each morning. Potts illustrated how our lives are much easier as a result of fossil fuels. He then said that if the twentieth century was a race to consume fossil fuels, the United States won. From his perspective, the challenge of the twenty-first century is to create the best lifestyle with the

Poster Session Winners

Overall winner: Determination of Wind Turbine Bearing Stiffness—The system is capable of loading test bearings in five degrees of freedom, exerts loads exceeding 20,000 lbs., and can measure bearing deflection with an accuracy of better than one micrometer.

Energy Generation and Storage: Understanding the Mechanism of Electrochemical Supercapacitance using Atomic Layer Deposition and Computational Chemistry

Fuels and Transportation: Targeted chemical mechanism modification for Bio-Alcohol/FAME and Bio-Alcohol/Alkane Blends for use in traditional and advanced combustion applications.

Economics, Policy, and Sociology: An Empirical Study of the Sulfur Dioxide Emission Trading Program in the U.S.

Energy Management: Stochastic Model Predictive Control of Building Systems

most efficient use of resources, and he led the rally cry for the United States to win that challenge, too.

Potts highlighted the encouraging effect of pivotal concepts in the transportation, buildings, industrial, and electricity sectors. He explained that utilizing efficiency within a supply chain can bring dramatic effects. For instance, end-use efficiency can remedy excessive upstream losses from motors, drivetrains, pumps, transmissions, and power plants, resulting in compound savings that ultimately reduce initial capital costs. This concept was illustrated with the example that currently only 6% of the total energy in the fuel used by vehicles actually moves the vehicle. By using lightweight materials, vehicle fuel efficiency can be tripled and done so in a relatively inexpensive way. This concept, dubbed *lightweighting*, is a possible disruptive technology, currently being implemented by two European automakers—BMW and Volkswagen. These examples are some of the reasons that RMI's analysis shows that utilizing efficiency, renewables, and smart techniques to reduce greenhouse gases 80% by 2050 will actually save \$5 trillion in net present value. Effective long-term strategies reducing harmful waste and promoting safe sustainable energy will result in a healthy economy.

Panel discussions followed the two keynote presentations. The first, titled "Competition vs. Cooperation between the U.S. and China in Energy

Policy," featured **Mark Safty** from Holland & Hart, **Clay Stranger** from RMI, **Ted James** from the National Renewable Energy Laboratory (NREL), and **Adam Reed** from the Renewable and Sustainable Energy Institute (RASEI). The panel focused on differences between the political process in the United States and China and the impact of those differences on the implementation of energy policy. It stressed the need for a collaborative approach to energy policy between the nations. Panelists reported their firsthand experience with the colossal smog that engulfs China's major cities, caused by the huge upswing in fossil fueled electricity production and vehicular travel. This air emissions crisis reportedly caused 1.2 million deaths in China in 2010 alone, spurring Chinese law makers to increase China's solar power generation target to 50 gigawatts by 2020 and to continue with the policy of doubling wind generation capacity as the nation has each of the last five years.

Panelists noted that China's political structure and culture of long-term strategic policy planning supports large-scale changes in energy. Specifically, China's political structure allows lawmakers to determine policy every five years, including evaluation and implementation of energy goals. Long-term plans often extend more than 100 years out. In

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CU Energy Club Overview

The CU Energy Club is one of the largest student groups on campus. It is an interdisciplinary club, with members from engineering, business, environmental studies, arts & sciences, law, and more. Many members are also students in the undergraduate and graduate energy certificate programs offered through the Renewable and Sustainable Energy Institute (RASEI), a joint institute of the University of Colorado Boulder and the National Renewable Energy Laboratory. CU Energy hosts numerous energy-related events and programs throughout the year. In addition, it works with a variety of groups and organizations on campus to connect students to the energy industry via:

- Job and internship opportunities
- Energy Frontiers, an annual conference held at CU
- Professional mentorship programs
- Energy Talks, a weekly lunch discussion series
- Career fairs and networking events
- Energy field trips
- Monthly meetings featuring knowledgeable speakers



L to R: Jake Aho, Matt Aitken, Kayla Weston, and Jeremy Halperin

contrast, U.S. energy policy is often adopted on a year by year basis or less, and federal energy policy currently implements change only as necessary and at the margins. Despite these differences, the two nations both face political challenges at the state or provincial level. In China, this local politicking is particularly apparent in the subsidization of China's enormous solar manufacturing industry. It is this propping up of Chinese solar manufacturing that led to the oversupplied market and low solar prices that ravaged U.S. solar manufacturing while increasing worldwide adoption of solar with more favorable end prices to the consumer.


In terms of lessons from China that could benefit the United States, Ted James from NREL observed the gigantic, near incomprehensible scale of manufacturing in China, and that U.S. manufacturing could achieve a similar scale to improve cost and efficiency.

The tone of the panelists was optimistic, with all believing that collaboration between the United States and China would be beneficial to both nations. Many lessons could be learned by studying and understanding each country's policies. Panelists noted that collaborative efforts are likely to work best if they are initiated and led by China as they may be weary of being told what is in their own best interest.

The second panel, titled "The Future of Energy Storage and Implications for the Electric Grid," featured **Paul Komor** from the University of Colorado, **Paul Denholm** from NREL, **Peter Lilienthal** from HOMER Energy, **Cody Hill** from Xtreme Power, and **Sam Jaffe** from Navigant Research. The discussion began by acknowledging that today's energy storage capacity of 100 gigawatts is mostly pumped hydro, which is necessary as a load shifting technique for the constant output of nuclear generation.

The conversation quickly turned to the future of battery storage and how batteries can compensate for the expected increase in variable renewable electricity generating sources. Currently, battery storage in the United States is primarily being used in locations with small electrical grids and high electricity prices, such as Hawaii and Alaska. However, some battery storage facilities are located in the contiguous United States, such as the 36 Megawatt Notrees project in Texas, and many are expected to be built in California as pending legislation with storage requirements is passed. Economic feasibility of battery storage may include end users in the next decade depending on sustained R&D efforts, economies of scale, and the continued installation of storage projects in

the near-term to further the learning curve. Current and future value streams for battery storage include reserve margins, frequency response, ramp control, and firming (*firming* is "using storage to 'fill in' gaps in intermittent renewable power generation so the power supplied looks somewhat to very constant," GE Energy Storage, <http://geenergystorage.com/glossary/glossary/26/firming>). Panelists agreed that there is no magic number for a percentage of renewables that would necessitate mass storage facilities, but that better communication and control technologies across larger areas will dramatically improve the balance of electrical generation and load. Utilizing available best practices will allow much room for the expansion of renewables on the current grid, and the inevitable economic improvements in battery storage and technology will serve to further solidify mass adoption of renewables in the not so distant future.

The day capped off with a well-attended energy career fair featuring 26 local and regional energy companies. Students took full advantage of networking opportunities throughout the day. With the success of another Energy Frontiers Conference, overwhelming support from the energy community, and a never-ending supply of committed students, the CU Energy Club is poised for continued growth. 

Craig Konz is an MBA 2013 Candidate in the Leeds School of Business and the Vice President of the CU Energy Club. He may be contacted at craig.konz@colorado.edu.

Joe Pettus—Managing Energy Operations at Safeway

Paul Stella

When it comes to finding the best mix of energy solutions at Safeway Inc., nothing is off the table. The supermarket chain, which has 1,641 stores across North America, has moved aggressively over the past decade to take greater control over its energy operations.

Joe Pettus, senior vice president of fuel and energy at Safeway, acknowledges that supermarkets are among the largest commercial consumers of electricity. Under his leadership, Safeway constantly looks for ways to best manage its energy usage from both a cost-effectiveness standpoint and from a sustainability perspective.

One of the novel approaches he introduced basically turned Safeway into its own utility. On behalf of the company, he applied to the Federal Energy Regulatory Commission for a wholesale-energy marketing license. In California and certain other locations across the country that allow such a practice, Safeway is able to bypass the retail market to purchase its electricity.

“But rather than just go buy the electricity, we took it a step further and decided to buy our own natural gas,” explains Pettus. “We went out and found the most efficient power generating plants—which are natural gas powered, combined cycle gas-fired generators—and said, ‘Look, we’ll bring you the natural gas. You just turn it into electricity.’ And they did that. So now we take it from them at the power plants and schedule it to arrive at our stores.”

Pettus says it has resulted in “significant cost savings” for the company. Also, by using natural gas, Safeway eases the burden on traditional power plants by generating its energy through these more efficient plants.

“By doing that we reduced our carbon footprint by over 10% nationwide,” he claims.

But Safeway is not free to pursue similar solutions in all of the markets it serves. For example, individuals and entities in Colorado do not have the right to select their own utility, and Pettus would like to see that change.

“You have the right to pick whatever cellular provider you want, but in many locations you don’t have the right to pick your

energy provider,” he explains. “You go to the utility, and it’s a monopoly. This is a message that’s very important to us, to open up the markets and let business dictate within the rules that are established to innovate and find new energy solutions or more effective ones, other than what the utilities may provide.”

As a result, Pettus advocates for open markets. He stays active in the legislative arena in hopes of building momentum for greater competition. He cites the favorable impact that will have on Safeway’s key stakeholders—which includes shareholders, employees, and customers—and the overall economy.

“It’s very important that we reduce our energy costs, or at least manage them. That in turn keeps the cost of our products down and allows us to hire more employees and grow the company. It’s very important to us on the legislative side—both at the state and federal levels.”

Safeway has also intensified its focus on tapping alternative sources of energy. Pettus says the company is actively involved in advancing solar power. Three stores in the Denver area that operate on solar recently went online, and plans for a fourth store of that type are in development.

“The solar panels we put on the rooftops directs that energy straight into our stores. The stores’ demand is much greater than what the solar panels can produce even at their peak, so we do not hook up to the grid and sell back to the utilities as you see from a lot of other entities. We own all of what is called ‘green credits’ for the renewable energy portfolio. We retain all the rights to retain those as green energy for ourselves.”

Safeway also just built two windmills near its distribution center in Tracy, California. Each one stands about 300 feet high, and Pettus states the generators located above are each about the size of a school bus. The windmills successfully power that distribution center, producing more than 80% of the load the facility requires.

Wind is an important component of Safeway’s energy portfolio as well. The chain has purchased enough wind energy to offset




the needs of its three stores in Boulder, as well as outlets in San Francisco and several other locations. Even hundreds of Safeway’s fuel stations across the country are wind powered. Sustainable outcomes are a key part of the company’s strategy.

“Safeway is the only retailer in the world to have signed a legally binding contract to reduce its carbon footprint. We joined the Chicago Climate Exchange years ago and remain the only retailer to do so. We committed to reducing our carbon footprint by 6% over four years, and we achieved 10%.”

Pettus credits his interest in sustainability to his time spent as a student at the University of Colorado Boulder. He graduated in 1970 with a dual degree in civil engineering and business.

“When you leave Boulder, you have a tremendous appreciation for the environment. Boulder breeds that and it never leaves you. I think I took that with me.”

With the cost of alternative energy forms beginning to decline, Pettus sees great promise for the future. The key, he believes, is access to a broad array of energy solutions.

“I think the biggest thing on the horizon as far as reliability and greenhouse gas reduction, and maybe even sustainability, is natural gas,” he says. “It is such a clean burning product to make electricity. I see nothing but great opportunities for all of those things going forward.” 

Paul Stella is the former Director of Communications and Alumni Relations in the Leeds School of Business. He may be contacted at paul.stellavision@gmail.com.



license to operate” with Coloradans. Innosphere knows Colorado has the resources to dominate this industry by building on the state’s strength in cleantech and taking the lead in technology solutions.

What are steps we can take now to get us to the future we envision?

Consider this vision of the future in the short term:

Technologies are deployed that address environmental concerns with fracking. Colorado then becomes one of the top producers of natural gas, accelerating the transformation from coal to gas-fired power plants. This enables transportation to both electrify in the case of smaller vehicles and gasify (i.e., run on natural gas). Water resources are thus returned to a pristine condition, helping to address the state’s water shortages. Renewable energy makes a comeback to fuel home electric vehicles, and Colorado becomes known as a top place to incubate or locate a business in the broad energy-water sector, leading to job creation and investment, and keeping Colorado economically healthy.

Incubating technologies that positively impact the energy environment of tomorrow

How do we make this a reality? Innosphere has deployed three basic strategies to effectively work in this space: aligning with major research universities, engaging strategies in oil and gas to get an understanding of the issues and market drivers, and broadcast-

ing that Innosphere is ready to work in this water-energy space. Do we see progress being made? Yes, earlier this year we signed an MOU with a significant oil field services company to scout water-related technologies for them. Most important, Innosphere is seeing our client companies positioning themselves to address these complex issues.

Here’s a sample of companies and visionaries working with Innosphere that you probably have not heard of...yet. This is how

they are exploring and addressing the energy-water nexus.

Avivid Water Technology

Avivid just received its water purification patent, which protects the intellectual property around their revolutionary stand-alone water purification process for the minerals extraction industry. Avivid’s breakthrough process, Turbo-Coag, builds on the proven purification technology known as *electro-coagulation*. This process has the capability to treat up to 600,000 gallons per day per system while rapidly removing up to 99% of heavy metals, suspended solids, and biological contaminants from water.

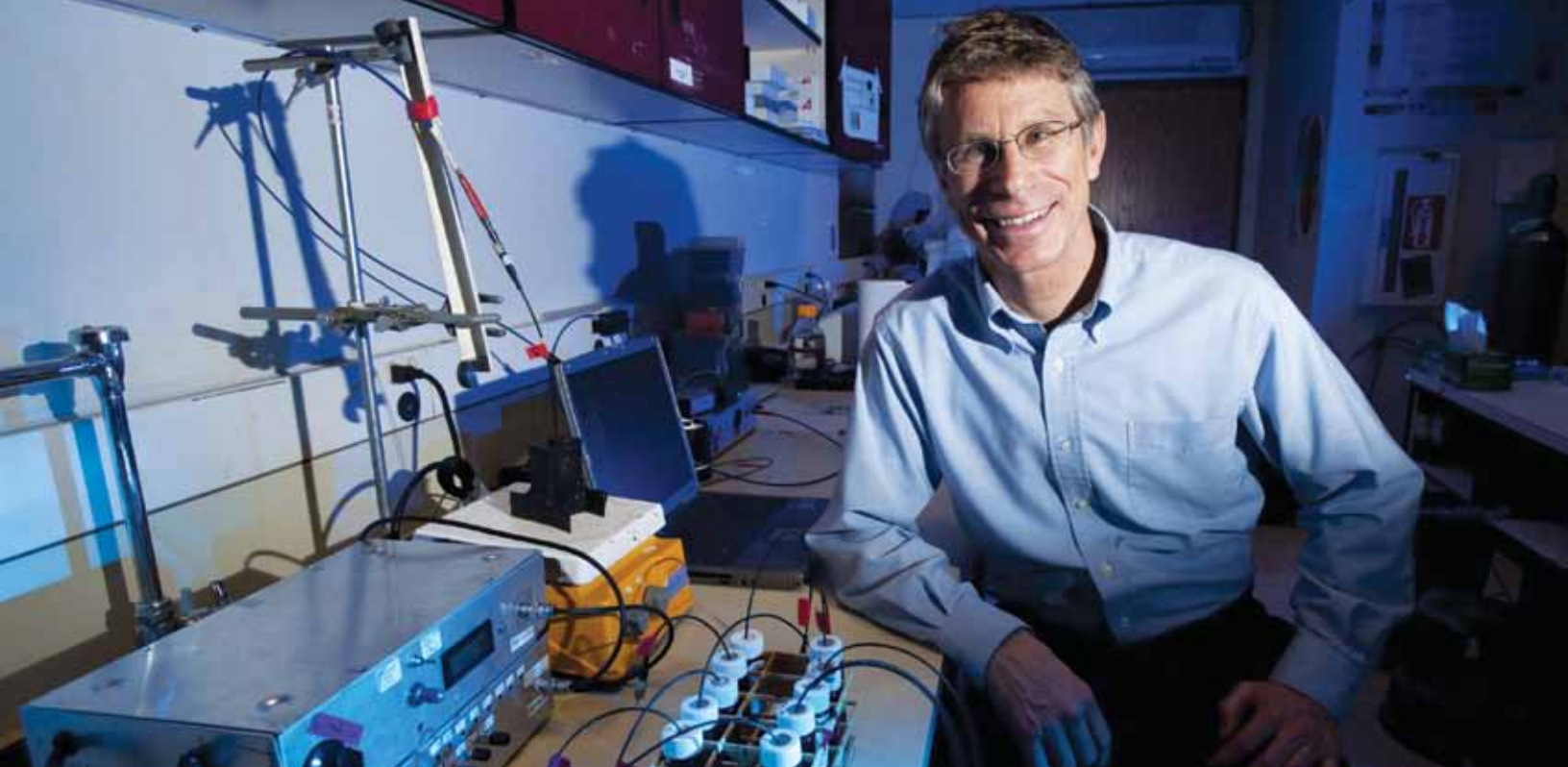
Avivid is also collaborating with industry partners to build pilot scale and field-ready systems to bring its technology to the marketplace. Avivid’s business model is to lease its systems to end users and charge for clean water as an ongoing revenue stream.

Logimesh

Fort Collins-based Logimesh developed a patented intelligent sensor platform that utilizes “energy harvesting” by scavenging engine heat to power an autonomously operated sensor network to track critical machine health attributes. The small sensor motes, called Logimotes, are designed to be intrinsically safe (operate safely in an explosive environment) and mount directly to each cylinder of large 2,000 horsepower internal combustion engines that are commonly used on drilling rigs and natural gas compression units.

Logimotes measure, analyze, and report such critical attributes as exhaust valve temperature and vibration data for each engine cylinder, providing an “edge-computed,” real-time monitoring solution. Applying analytic rules via an on-board microprocessor, Logimotes transmit “actionable smart data” that can be used to potentially save companies millions of dollars of unplanned maintenance costs, equipment repairs/replacement, and lost production revenue. Through the unique integration of innovative technologies, such as energy harvesting, ultra-low energy wireless networks, and microprocessor powered algorithms, the oil and gas industry can employ predictive data





Ken Reardon, CSU faculty founder and CTO of OptiEnz Sensors

analytic methodologies to a high-quality data set in order to optimize operations while maximizing revenue and profitability.

OptiEnz Sensors

OptiEnz sensor systems use enzymes and fluorescent chemicals to quantitatively and continuously measure the concentration of specific organic chemicals in water. This is a platform technology because enzymes can be selected to detect many different chemicals, including petroleum hydrocarbons, chlorinated solvents, alcohols, halogenated pesticides, and organophosphates. Measurements with these biosensors are simple and require no reagent or pretreatment: the tip of the biosensor is simply placed in the sample to be measured.

Boulder Electric Vehicle, Inc.

Boulder Electric Vehicle (BEV) builds and sells 100% electric trucks. BEV sells five models of light and medium commercial trucks that hit the sweet spot where the capabilities of current technology meet the urgent needs of corporate fleets, government fleets, and smaller businesses that make local deliveries and provide local services. Early customers include significant fleet operators FedEx and UPS. BEV provides customers with the following advantages:

- Fuel costs of 5 cents per mile versus 48 cents for diesel trucks
- The trucks use a small fraction of the number of parts diesel trucks use, are far simpler

to maintain, and reduce maintenance costs by 75%.


- Truck ROI within two years, without tax incentives.
- Zero emissions performance and certification for all models. BEV trucks reduce carbon emissions by 40%–90% compared to alternatives.

Ward Alternative Energy

Ward Alternative Energy (WAE), based in Colorado, began offering services and products in the natural gas vehicle (NGV) and compressed natural gas (CNG) industry in early 2012. With its acquisition of FuelTek in early 2013, WAE brought in-house an operation that dates back to 1990, when FuelTek was part of Natural Fuels Company—the leader in developing CNG fueling facilities in Colorado. The principals and key personnel of the company have many decades of experience in the natural gas and CNG industry with construction and operation of most of the CNG sites built in Colorado since 1990 to its credit (e.g., six fueling locations at DIA). Ward Petroleum, a WAE affiliate, has 50 years of experience in the natural gas industry, including exploration and production of natural gas, gas gathering and marketing operations, and field compression services. WAE is not an Innosphere client company but a key collaborator.

The Rocky Mountain Innosphere is identifying and working emerging technologies that address the energy-water nexus and is further embracing cleantech by partnering with the CU Cleantech program, Colorado State University, and the National Renewable Energy Laboratory. We are excited for the potential of Colorado to lead in this arena and are working to keep Colorado in a strong position across the entire clean technology spectrum.

Even with a terrific business plan, specialized facilities, and mentor support, an entrepreneur needs a lot of resources to be successful in cleantech. The Innosphere would not exist without the support of volunteers, community partners, and investors. We invite you to join our entrepreneurial ecosystem and share your time and talent (advisors, mentors, executive coaching) and your treasure (invest in Innosphere, invest in the Fund for Innovation, become an angel investor).

Colorado can be a leader in the energy-water nexus—but you need to engage to make it a reality. 

For more information on how to be involved, please contact Innosphere CEO, Mike.Freeman@rmi2.org, 970-221-1301.



The *CBR* is a quarterly publication of the Business Research Division at CU-Boulder. Opinions and conclusions expressed in the *CBR* are those of the authors and are not endorsed by the BRD, the Leeds School of Business faculty, or the officials of CU.

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1.1 MMBPD; and ethanol, 0.5 MMBPD.² The challenge, according to Peña, is to eliminate the 8.2 MMBPD gap between consumption and production. His plan consists of six efficiency efforts, one increased production goal, and one fuel switching strategy.

1. Enhance corporate average fuel efficiency (CAFE) automobile fuel economy standards leading to an U.S. fleet average of 54.5 mpg
2. Improve tire pressures/engine lubrication and other routine automobile maintenance
3. Enhance medium and heavy duty vehicle fuel efficiency
4. Increase adoption of plug-in hybrid vehicles (e.g., Chevrolet Volt)
5. Utilize more fuel efficient aircraft (e.g., Boeing 787/737 MAX, Airbus A320neo)
6. Double public transportation ridership through enhanced affordability and convenience
7. Increase production of advanced biofuels (e.g., cellulosic ethanol, biodiesel)
8. Convert vehicles, especially long-haul vehicles, to liquefied or compressed natural gas

The two biggest factors reducing the 8.2 MMBPD gap are increased biofuels production (2.3 MMBPD) and higher CAFE standards (1.8 MMBPD). The total of all eight steps equals 7.5 MMBPD, nearly enough to

close the entire 8.2 MMBPD gap. Peña also sees increased petroleum production of 1.5 MMBPD from federal onshore and offshore development, under rigorous environmental and safety regulations. This increased petroleum production, along with the eight steps, would effectively eliminate the gap and allow the United States to achieve 100% energy independence by 2030.

A second key element of Peña's address outlined a plan to isolate the United States from petroleum price shocks the world has seen in the past (e.g., the Arab Oil Embargo, the 2008 petroleum price bubble). The plan consists of two components. The first is to develop the ability for consumers to fuel switch, for example, by building automobiles that can run on gasoline, ethanol, electricity, natural gas, or any combination of these fuels. Under this proposal, if oil prices spike, then consumers could switch to ethanol, natural gas, or electricity (for short ranges).

The foundation of the second component of Peña's plan to isolate the United States from oil price spikes can be seen in today's natural gas market. Because of the dramatic increase in North American natural gas production, its price is substantially lower compared to the rest of the world. For example, natural gas in Japan is 5 to 10 times higher than in the United States. Creating a NAFTA-style petroleum market among Canada, Mexico, and the United States could lead these countries to be independent of oil price spikes caused by OPEC production cuts or other potential black swan events. 

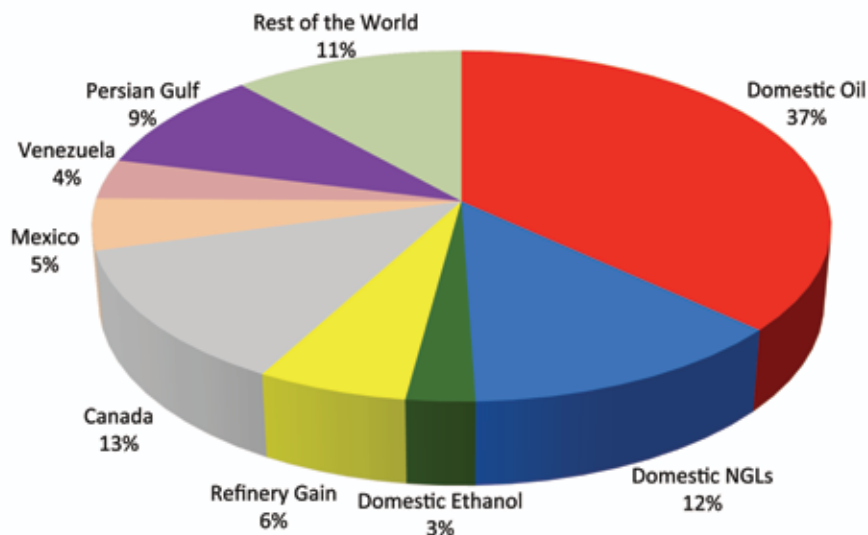
The Leeds School of Business and the College of Engineering and Applied Science thank both Peña for his address and the attendees. The Leeds school and the College of Engineering look forward to future collaborations that address the complex business and engineering issues facing the world.

¹ Refinery processing gain is the amount by which total output volume is greater than the volume of crude oil and other feed stocks. This difference is due to the processing of crude oil into products that, in total, have lower specific gravity than the crude oil processed.

² In January 2013, ethanol production equaled 804,000 barrels per day. However, ethanol has two-thirds the energy content of petroleum so this ethanol production level is the equivalent of 536,000 petroleum barrels per day.

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U.S. Liquid Fuel Upstream Suppliers, January 2013



Source: Department of Energy/Energy Information Agency.

Total = 19.2 MMBPD