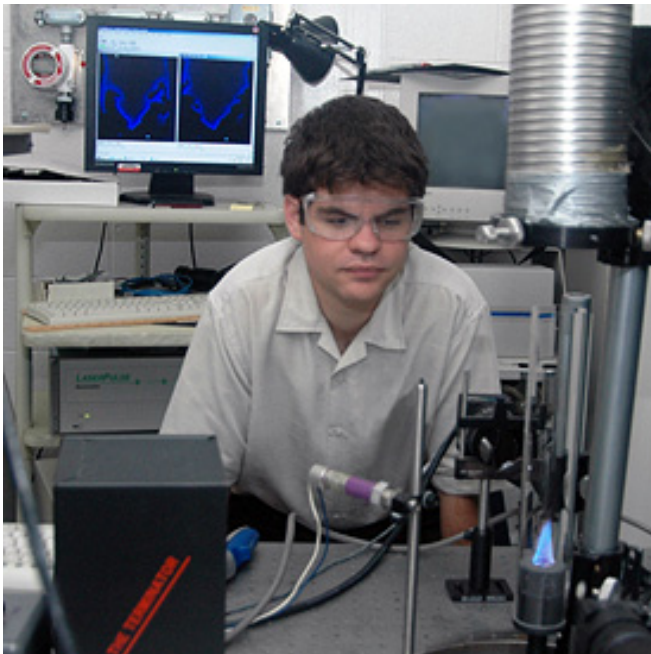


Career *currents*

Exploring Today's Energy Careers with the NEED Project

Vol. 4, No. 1 Oct. 2008

Career Currents provides educators and students with resources to introduce energy careers. Each issue focuses on a different sector of the energy industry. No single issue is meant to be all-inclusive to either the sector profiled or all careers in energy. This issue focuses on the diversity of careers and professionals working in the Appalachian Region.



Justin Weber, summer intern in 2008 at the National Energy Technology Laboratory, peers at a biogas flame stabilization method. Photo credit: NETL.

course in the basics of combustion, working on a fuel flexibility project. We were trying to see how effective a particular flame stabilization method, called a low swirl injector, was at stabilizing biogas flames.

Yes, biogas at a primarily fossil energy-oriented facility. NETL was tasked by DOE's office of Energy Efficiency and Renewable Energy to develop and study fuel flexible burners. In other words, to find a burner design that can stabilize flames at different gas compositions; whether it's natural gas, biogas, hydrogen or all these gases mixed together. This is a rather daunting task. As the gas compositions change, the flame could become unstable causing the flame to go out, or cause damage to the combustor.

The low swirl injector was developed by Robert Cheng at Lawrence Berkeley National Laboratory in California. This burner design is a fairly simple design with good benefits such as fuel flexibility, low cost and low nitrous oxide (NOx) output, which is a contributor to smog.

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Studying Biogas

at the National Energy Technology Laboratory

By Justin Weber

As an aspiring mechanical engineering student attending Pennsylvania State University (Penn State), I had the opportunity to work this summer at one of the country's top national labs—the U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL). This was an invaluable experience. Better than any class I have ever taken, and I probably learned more from this two-month adventure than two semesters taking classes.

I had the opportunity last summer through the Technical Career Intern Program between Penn State and the DOE's Office of Fossil Energy to work in Washington, DC at DOE's headquarters. I got to see the policy side of energy while experiencing Washington.

I liked this summer better, working with NETL's Energy System Dynamics Group in Morgantown, WV. I had a crash

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Biogas is gas that comes from the anaerobic (no oxygen) breakdown of organic matter. This gas is produced at landfills, sewage treatment plants and specifically designed anaerobic digesters. Biogas is primarily made up of about half methane and half carbon dioxide. Unfortunately, carbon dioxide poses a threat to stable combustion. As you probably have heard by now, carbon dioxide likes to trap heat. As the carbon dioxide interacts with the flame, this could potentially cool the flame down enough that it becomes unstable and blows out.

We simulated biogas by combining methane and carbon dioxide at different dilution levels. Then we compared that to dilution with nitrogen, which is inert and should not affect the flame.

After doing numerous test runs, we came to the conclusion that this low swirl injector can effectively stabilize the biogas simulated flame. The carbon dioxide does affect the flame, both through cooling, as expected, and its effect on the physical reactions taking place. The nitrogen dilution has no effect on the flame.

The low swirl injector is fuel flexible, depending on the definition of fuel flexibility, because it can stabilize methane flames, natural gas flames, hydrogen flames, and now biogas flames. This burner can now be used to stabilize these flames in industrial processes such as cement making.

The eventual goal is to use this burner design with microturbines to produce electricity from biogas and other fuels. However, more information is needed to study how this burner design adapts to the turbine environment.

In the end, this has been a very productive summer. I learned a great deal of information while helping to secure energy for the future.

This fall, I head back to Penn State to conduct research on oxygen enhanced combustion of coal in a fluidized bed reactor. I am also taking a class titled *Intro to Combustion*. After this summer, I may not have to study as hard for that class.

Article courtesy of the National Energy Technology Laboratory.

The National Energy Technology Laboratory (NETL) assures that U.S. fossil energy resources can meet increasing demand for affordable energy without compromising the quality of life for future generations of Americans. Two of the lab's state-of-the-art facilities are located in Appalachia; in Morgantown, WV and Pittsburgh, PA. Approximately 1,100 Federal and contractor employees work at NETL.

NETL's research focuses on key energy and environmental issues, including secure and reliable energy, future roles for hydrogen, clean power generation from coal, global climate change, and critical infrastructure assurance.

For more information, visit www.netl.doe.gov.



*A NETL employee conducts research.
Photo credit: NETL.*

The Appalachian Region

The Appalachia region of the U.S. includes 13 states—all of West Virginia and portions of Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee and Virginia. The region follows the spine of the Appalachian Mountains and covers 200,000 square miles. About 23 million Americans live in this region, with 42 percent of the population living in rural areas. Historically, the region has been an energy exporter of coal.

When immigrants first settled the Appalachian region, they survived with small subsistence farms. Timber became an important export for the region in the early 1900s, while coal mining developed into one of the largest Appalachian industries. Historically, geographic isolation and the lack of roads and railways caused the Appalachian region to fall behind the rest of the nation, both in terms of economic development and prosperity.

By the 1960s, one out of every three residents lived in poverty. Today,

unemployment rates in the region are higher than the national average, even though education rates are similar to the national average. The main reason is the lack of job availability.

In the past, the main sources of jobs for Appalachian residents were in the coal, tobacco and manufacturing industries. Coal mines in this region currently produce 35 percent of the nation's coal output. Unlike most of the nation, Appalachia is actually an energy exporter. Residents use less electricity than the region produces. While coal is still a very important resource for the area, it is no longer the major source of jobs. This is because improvements in mining technology have replaced the need for some workers.

Appalachian residents are currently looking toward renewable sources of energy to revitalize the region. The potential for wind, solar, biomass, and hydropower exists throughout Appalachia.

The ridge lines of the Appalachian Mountains hold great wind power

potential. Even though there are currently only 528 megawatts of installed wind power in Appalachia, there is the potential for 11,000 megawatts more.

Solar power, like in much of the eastern United States, can be used for both residential and commercial applications. Solar power's greatest potential lies in the southern Appalachian areas.

Biomass resources in Appalachia include corn and soybeans. They have the potential to produce 500 million gallons of biofuels annually.

Hydroelectric capacity is currently a largely underdeveloped resource in Appalachia. There are several major rivers that could be used for small-scale and low-flow technologies which do not rely on dams.

Besides the available resources for increased renewable energy use, Appalachia has a long history of industrial manufacturing which pairs well with the renewable energy economy. The region offers manufacturing job opportunities in areas of wind turbine components, solar components and photovoltaic panels, as well as in biofuel plants. Developing even more links in the renewable energy manufacturing chain could produce more jobs in the region.

The resources of Appalachia play an important role in our nation's energy economy and manufacturing industries. As the energy needs of our country grow and change, the people of Appalachia are adapting, using their resources to create job opportunities that will give the region a more prosperous future.

For more information, visit the Appalachian Regional Commission's website at www.arc.gov.



On the map above, the Appalachian Region is shown in white. Source: Appalachian Regional Commission.

Career Chats

With professionals who live and work in the Appalachian Region

Deputy Director

Laura Marlino is Deputy Director of the Power Electronics and Electrical Power Systems Research Center at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. Laura has a bachelor's degree in Electrical Engineering from the University of New Mexico and a master's degree in electrical engineering from the University of Tennessee.

How did you come to live and work in the Appalachian Region?

When I moved to Oak Ridge to go to graduate school, I had every intention of returning to New Mexico after I completed my schooling. I had previously worked there for Honeywell Aerospace and Marine and loved the work. I was involved with the design of cockpit displays for military aircraft. However, when I graduated there was a recession and there were no jobs back west. I interviewed several places and received a few offers, one of which was from ORNL. I had always been interested in power electronics and I knew there would be a lot of opportunities in it. I also knew that power electronic engineers could command a pretty high salary. So, I took the position figuring I would stay a few years and then move on. I am still here after over 15 years.

Describe what you do.

In my group, the research focuses on electronics and motor technology development for hybrid, plug in hybrid and fuel cell vehicles. We work on new topologies (circuit configurations) and motor innovations that bring down the cost, size,

and weight of these components for future automotive applications. We want to make hybrid and fuel cell vehicles more competitive in the market, to reduce our country's dependency on foreign oil and to reduce pollutants.

I oversee the technical aspects of projects for the FreedomCAR program at Oak Ridge National Laboratory. I work with Program Managers to determine project budgets and prioritize projects for funding. I decide on the worth of the research, guide the research, follow each project's progress to ensure the work is going in the right direction, on time and on budget, work with industry to come up with projects that will benefit them, and write proposals for funding. I also attend conferences to remain cognizant of the state-of-the-art in power electronics and electric machinery research. I often present progress reports to DOE (Department of Energy) and automotive OEMs (Original Equipment Manufacturers such as Ford or General Motors), make presentations to update industry and DOE on the progress of projects throughout the year, and I organize and schedule presentations given by ORNL PIs (Principal Investigators) at various events and tech team meetings. Finally, I assist DOE and the EETT (Electrical and Electronics Technical Team) in the development of roadmaps (long term plans) and research timelines for each project we're working on.

My typical day of work is hectic. I'm always "fighting fires" between Washington, Detroit, and with the PIs here at the lab. Most days I'm tied to the computer.



Laura Marlino in the dynamometer test lab at the Power Electronics and Electrical Power Systems Research Center at ORNL.

Are there challenges working for a government lab versus industry?

One of the biggest challenges of doing research in a government funded lab is overcoming the government bureaucracy and paperwork, rules, regulations, and audits that go along with being a government subcontractor. For example, ORNL performs nuclear research, and although I am not involved in it, everyone at the lab must adhere to strict security rules and regulations.

Another frustration is that compensation levels here fall below what is offered in industry. The other side of the coin is that the lab gets to do innovative, out of the box R&D (research and development), which is done less and less in industry today due to economic constraints. We have the freedom to develop new ideas and determine our own research.

Please share an interesting project you've worked on.

I've been involved with many exciting projects. Working at the lab can involve a lot of out of the norm type projects. Once, I worked on a weigh in motion project that enables trucks to roll through weigh

stations on the interstate and wirelessly transfer their weights to authorities without stopping, saving them time and gas. This involved a lot of field work at a test setup at an interstate weigh station. I love getting out in the field and working on things...getting out of the lab and seeing what you've worked on put to the test in actual practice.

What's the most rewarding part of your job?

The most rewarding part of my job comes when we get accolades from industry. When we successfully test a new circuit or motor and achieve the targets we set out for it.

What does your future hold?

In 10 years I hope to be retired, sitting on the beach in my ocean front house, driving a zero emission car that uses electrical and alternative fuels to gasoline.

Any advice for students?

There is a critical need to get away from our dependency on foreign oil, from a security perspective and a health perspective. Energy efficiency is going to be forefront in our work in the future. Not only do we need to solve problems related to transportation issues but we need alternatives to coal for powering our national grid. We also need more energy efficient appliances and products as the world's population grows. Renewable alternatives will be important, but ways to lessen the energy requirements are drastically needed.

American engineering graduates are critically needed. We are not producing enough. Right now, the only graduate students we can get in power electronics are mainly from China, India and Japan. Engineering graduates with an emphasis in motor technology are extremely hard to find. I would advise any students thinking of going into these difficult fields to

grit their teeth, hunker down, and make it to the finish line. They will be rewarded in their careers financially and can be satisfied knowing they are doing critical work that is necessary to better not only their own lives but also the lives of their future children and grandchildren.

What is FreedomCAR?

FreedomCAR is a partnership between the U.S. Council for Automotive Research (Chrysler, Ford and General Motors), the Department of Energy, and five energy companies (BP America, Chevron Corporation, ConocoPhillips, Exxon Mobil Corporation and Shell Hydrogen). It is supported by numerous suppliers, research institutions and universities.

Their main goal is to examine and advance collaborative research and development of technologies to enable high volume production of affordable hydrogen fuel cell vehicles and the national hydrogen infrastructure to support them. Other key advanced automotive technologies include internal combustion engines and emission control systems; lightweight materials; power electronics and motor development; high-power/energy battery development; and alternative fuels. Each of these advanced technologies also has the potential to dramatically reduce oil consumption and environmental impacts in conventional, hybrid and/or hydrogen fuel cell vehicles.

Learn more about FreedomCAR's program and research at www.uscar.org.

Customer & Distribution Services Manager

Delinda Borden works as a Customer & Distribution Services Manager for Kentucky Power, in Ashland, KY. Delinda graduated from Michigan Technological University with a bachelor's degree in Electrical Engineering.

How did you come to live and work in the Appalachian Region?

When I started my courses in electrical engineering, I knew I loved math. As I progressed in my area of study, I quickly learned what courses I enjoyed, and this led me to studying power systems. This career path ensured I could move anywhere in the country.

I was fortunate to find employment with Kentucky Power when I graduated. The power systems option I chose in college included the courses I needed to succeed at an electric utility.

Describe what you do.

I am responsible for ensuring that Kentucky Power provides safe, reliable, affordable electricity to our customers in a timely manner. This includes overseeing the design, construction and maintenance of our facilities along with making sure we collect the revenue due, through reading the meters and ensuring the revenue is collected.

As a manager, it is my responsibility to make sure the work gets done. The Ashland District has 61 employees. I am responsible for all of them. I have three supervisors working under me that handle most of the day-to-day activities.

Kentucky Power has a strong safety culture. We ensure our employees receive the proper training and that they understand and follow our safety practices. We not only have

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to build new power lines to our customers, but repair them when they are damaged.

I love the path I have taken. It has allowed me to use my technical skills while working with people.

The energy industry is constantly changing with the introduction of new technologies. We are always looking for better ways to do the same job. I find it very satisfying to be able to meet and exceed our customers' expectations. When a storm comes through our area, we all focus on restoring power to our customers. It can mean several days of having different shifts working around the clock.

Describe your typical day of work.

Every day is different, but on a good day, I will start my morning on the loading dock with our line crews. We do a safety huddle every day. From there, I may hold a staff meeting to ensure everyone knows what everyone else is doing and be ready to meet customers' service dates. I may attend a community meeting during lunch time. I review data to see how we can improve our processes, and review our budget to make sure we don't spend too much money. My favorite part of the day includes going out to the field to visit a line crew as they work. I do field visits to make sure our safety policies are being followed.

Tell us about an exciting experience.

My career enables me to work directly with customers and employees. As a young engineer, I worked directly with customers. I was the commercial and industrial point of contact. So, anything they needed, I coordinated on their behalf. Customers don't always have a good grasp of what they need. It can be a challenge trying to get all the necessary information in order to provide service to a customer.



Delinda Borden works as a Customer & Distribution Services Manager for Kentucky Power, in Ashland, KY.

I have had a lot of fun over the years, going to new locations with customers. This has involved "four-wheeling" up the side of mountains, or walking up in some cases. I have had the opportunity to visit all of my customers' facilities, from preparation plants to deep mines. One customer took me to his surface mine site, and drove under the track of a large shovel as they were moving it to a new location. The track we were under was several times larger than our SUV. I have had the opportunity to go underground in a mine and ride in a customer's helicopter and air plane. However, some of these I passed on!

What challenges do you face working in the energy industry?

Early in my career the biggest challenge I faced was being a female—or so others thought. I never saw it as a hindrance.

When a coal miner told me he wasn't going to work with "no woman," I said, "OK, so what size fan motor did you say you are putting in?" By ignoring what others thought was a barrier or challenge,

and simply working hard, I never saw a problem.

As a manager, one of the biggest challenges of working in the energy industry is the aging workforce. We need people coming out of school skilled to take jobs. A large number of our field jobs require a two-year technological degree in electricity. As every industry does, we work to keep up with the technology and the government regulations that are imposed on us.

Are there benefits to working for an electric utility company?

Working in the energy industry, you know you are helping people. Without our customers, we would not be here. A big benefit is job security. You know that people are always going to need electricity. Most of us feel fortunate to be able to work in an industry that provides us with a decent wage and good benefits.

What is the most surprising aspect of your job?

I was always surprised to find out how much accounting an engineer needs to know. Engineers tend to manage projects, people and budgets. Or, in previous positions, I managed customers and helped them understand their electricity bill and how to use electricity more efficiently.

Another surprising part of my job as an engineer is how important customer and employee relationships are. You truly accomplish more if you are working together.

Does your job affect the public?

Working in the energy industry, what we do affects the quality of life for our customers. Can you imagine a life without electricity? When you get up in the morning you turn the light on, you enjoy the hot water in your shower, and the heat or air conditioning in your home. Can you

imagine not having electricity to run the TV or your computer?

Is there an exciting technological tool you have used?

You will laugh, but in my freshman year of college I had a calculator that added and subtracted and I actually used a slide rule to do more complicated math functions. Most of you probably don't know what a slide rule is, so I would say I find using computers and calculators exciting. The computer has opened up the world to us.

What does your future hold?

In 5-10 years both of my children will be out of college. At that time, I will probably retire, build a house on a small lake, and do volunteer work in my community. If I am blessed, I will have grandchildren to enjoy.

Any advice for students?

If you are considering a career in the energy field, I would advise you to take all the math and science courses you can. The energy field is going to continue to need people with four-year engineering degrees and with two-year technological degrees. The demand for people with technical degrees will continue to grow as "baby boomers" retire. As we go forward, we are going to have to find new and more efficient forms of energy. We cannot support our energy needs with just energy sources such as wind and solar. We are always going to need energy to heat and cool our homes. It takes energy to make our cars go. Just about everything we do takes energy.

Appalachia Offers Unique College Programs

There are many colleges and universities located within the Appalachian Region. Each offers an array of majors and specialties. If you're considering an energy related degree program, here are a few suggestions:

The Ohio Coal Research Center is part of the Department of Chemical Engineering at **Ohio University**, located in Athens, Ohio. The center creates new technologies for the clean use of coal in existing power plants and develops more efficient processes for converting coal to electricity, liquid fuels, and even biofuels. Some current areas of research include: coal gasification, extracting toxic gases through electro-static precipitation, using microalgae to bioremediate carbon emissions from flue gas, reducing the amount of carbon dioxide produced by power plants through carbon sequestration, and adapting fuel cells to use the power of coal to support energy independence. For information about the degrees offered through the Ohio Coal Research Center, visit: www.ohio.edu/ohiocoal.

Several universities in the Appalachian Region offer degree programs in mining. Information about **Virginia Tech's** Department of Mining & Minerals can be found at www.mining.vt.edu. Virginia Tech is located in Blacksburg, Virginia. Information about **West Virginia University's** Department of Mining Engineering can be found by visiting: www.mine.cemr.wvu.edu. West Virginia University is located in Morgantown, West Virginia.

Pennsylvania State University, located in State College, Pennsylvania, offers a degree program in Mining Engineering as well as undergraduate programs in Energy Business and Finance, Energy Engineering, Environmental Systems Engineering, and Petroleum and Natural Gas Engineering. Visit www.eme.psu.edu/mng for information about these programs.

Hocking College, located in Nelsonville, Ohio (<http://ac.hocking.edu>), offers an Alternative Energy and Fuel Cells Program with several two-year certifications and degree programs available. Hocking College's Energy Institute, a training facility for technicians in the renewable energy arena, is set to open in the fall of 2009. It will feature green building design aspects and hands-on learning labs for students studying alternative energy, fuel cells, and hybrid vehicles.

According to Hocking College, graduates of their Automotive Hybrids Technology program find jobs as fleet technicians, automotive service technicians, in sales and marketing of vehicular diagnostic equipment, and as vehicular laboratory technicians. They also have the skills necessary to work as technical assistants in fuel cell and alternative energy research and development. Their beginning annual salaries range from \$35,000 to \$53,000. Graduates of their Alternative Energy and Fuel Cells Technology program work as technicians in the field of non-fossil fuel energy applications. Their beginning annual salaries range from \$28,000 to \$33,000.

Finally, if taking courses in biofuels technology, sustainable transportation, photovoltaic system design and construction, and wind and hydropower technology sounds interesting, consider the undergraduate program in Appropriate Technology at **Appalachian State University** in Boone, North Carolina. Visit www.at.appstate.edu for more information.

Vernon Kimball Joins NEED Staff



Vernon Kimball is a graduate of Bayfield High School in Colorado. After attending Adams State College, earning a BA in Chemistry in 1973, he returned to Bayfield, this time as a teacher and coach. Science and coaching have been an integral part of Vernon's career.

Over the past 34 years, Vernon coached boys' and girls' teams in a variety of sports earning many coaching accolades. He served as the science department chairman at Bayfield High School for the past 23 years, where he taught chemistry, physics, earth and space science, and mathematics. He was named teacher of the year at Bayfield High School several times and he received the Yale University Teaching Award in 2006. In 2008, he was named Colorado's Teacher-Coach of the year. Vernon served on many committees in his school district, including chairman of the building committee for construction of both the high school and the athletic stadium.

Vernon retired from teaching and coaching in the Spring of 2008. He recommends a teaching career to anyone who enjoys working with people. He says that even with the low salaries in teaching, his life has been rich beyond belief because of teaching and coaching. Vernon has been married to his wife Sherry for 30 years. They have three children and two grandchildren.

Welcome, Vernon! Vernon will be supporting both the training and curriculum development activities at NEED—facilitating workshops and providing assistance in curriculum development. This fall, he will facilitate En Cana sponsored workshops in Colorado and other workshops throughout the west.

