



Bluegrass Advantage in Clean Technology

November 2016

Introduction

In response to rising concerns about energy independence and costs of traditional energy sources, the clean technology (“clean tech”) industry has received considerable attention in the last few years. Clean tech uses technologies, processes, or services to minimize the environmental impact of production, energy consumption, and power generation. Renewable energy and energy efficiency are core to clean tech. Clean tech refers to practices and products in any industry and is not easily categorized by standard industry classification systems, such as the North American Industry Classification System (NAICS) which organizes businesses based on economic activity rather than technologies and practices.

Renewable energy uses environmentally sustainable energy sources to reduce the environmental impact of energy production, such as solar panels, geothermal heat, wind turbines, biofuels, and non-polluting machinery. Renewable energy sources replenish themselves and are not exhausted when consumed. Energy efficiency maximizes the usefulness of the minimum amount of energy needed for a service, production, task, or goal, such as water conservation, green buildings, and battery technologies. Common examples of energy efficiency are insulation in a building, using fluorescent instead of incandescent lights, and aerodynamic cars.



Alltech's Winchester facility, alltech.com.

Lexington's Growing Clean Tech Industry

While Alltech is known primarily as an industry leader in animal health and nutrition, Alltech expanded into the renewable energy field in 2011 with the purchase of a \$14 million algae fermentation facility here in the Bluegrass, one of the largest algae facilities in the world. Algae are expected to become a crucial area of development as the United States pursues renewable sources of energy to power the country in

the coming decades. Algae contains lipid oils that can be converted to biodiesel and biofuels that are cleaner, more efficient, and easier to cultivate and produce than crude oil-based energy sources like petroleum. Alltech's algae venture was so successful that Alltech expanded to a second facility in Brazil.

Entrepreneurs at 3H Company, LLC, a local clean tech startup housed in Lexington's Coldstream Research Campus, have developed a ground-breaking carbon (CO₂) capture technology. 3H's patented system will improve energy efficiencies by using 80% less energy than current state-of-the-art technology for capturing CO₂ emissions from coal manufacturing and other forms of combustion energy production. Furthermore, this method can use the captured CO₂ to extricate more oil and natural gas from depleted wells.



University of Kentucky entrepreneurial scientists created and patented a process to recycle coal manufacturing byproducts and produce innovative building materials. Their company, NuForm Materials, captures and reuses discarded coal ash, a byproduct from coal production, to manufacture lightweight and durable ceramic materials for the automotive and aerospace industries. NuForm Materials co-founder Dr. Thomas Robl is the Associate Director, Environmental and Coal Technologies at the University of Kentucky's Center for Applied Energy Research. Although NuForm Materials is not located in the Bluegrass Region, these researchers' innovation and production success are a testament to the many ways that the University of Kentucky and Lexington's environment of innovation and entrepreneurship are contributing to the growing cluster of clean technology and renewable energy companies.

nGimat, LLC is a nanomaterials R&D and manufacturing company in Lexington that produces high performance nanomaterials for lithium-ion automotive batteries and energy storage components for electrical smart grids. nGimat is developing advanced insulation to extend battery life with applications in the energy, electronics, automotive, consumer, and biomedical industries. nGimat's facility has a highly advanced x-ray laboratory, a battery prototyping lab, a pilot-scale wire coating facility, and four pilot-scale and one commercial-scale nanopowder production units. nGimat has over 40 U.S. patents.

Culture of Innovation and Entrepreneurship

In May 2016, the University of Kentucky became a founding member of the University Coalition for Fossil Energy Research (UCFER), a six-year, \$20 million project to develop advanced fossil fuel-based technologies. Funded by the Department of Energy's National Energy Technology Laboratory (NETL), UCFER research will develop cleaner, more efficient uses of fossil fuel resources that have environmental impacts and carbon emissions. Research will focus on advanced energy systems and infrastructure, including gas turbines, carbon dioxide capture and storage, sensors, lead detection, and other technologies.

Assisting companies with commercialization and technology transfer on the University of Kentucky campus are the ASTeCC/AgTeCC campus incubators, which provide lab space for start-ups and help connect researchers and entrepreneurs to economic development activities such as commercializing and licensing. In addition, Lexington is home to the only research and development business park in the state of Kentucky – UK's Coldstream Research Campus. Coldstream, a 735-acre office park, was specifically

designed for recruiting high-tech and biotech companies, as well as university centers and start-ups. Coldstream offers intellectual capital and resources from UK, as well as infrastructure for existing and new companies.

To further the progress of assisting entrepreneurs, Commerce Lexington Inc., the University of Kentucky, and the City of Lexington formed the Bluegrass Business Development Partnership (BBDP), which is funded by the City of Lexington. The Bluegrass Business Development Partnership's goal is to be a one-stop, super-service provider, linking entrepreneurs with the information they need to be successful, including assistance in financial planning, business plans, funding sources, real estate, and service providers.

Kentucky's Cabinet for Economic Development, Office of Entrepreneurship funds the Kentucky Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Matching Funds program to help create, recruit, and retain small businesses, including high tech and biotech. The SBIR/STTR Matching Funds Program is an innovative initiative that provides matching funds up to \$150,000 for Phase I and up to \$500,000 for Phase II for Kentucky businesses. To date, more than 230 Kentucky SBIR/STTR Matching Funds have been granted to small Kentucky businesses, totaling over \$57 million in state funding and leveraging another \$102 million in federal funds. Small businesses and startups can also find help from the Bluegrass Angels, a local group of venture capitalists willing to provide seed capital and management guidance to local regional startups and new businesses. The BBDP has attracted over 25 new companies to Lexington because of the state match program, UK research assets, and great quality of life.

The University of Kentucky Department of Biosystems & Agricultural Engineering (BAE) has been making significant research headway in green energy. UK researchers are creating energy efficient agricultural precision machines, developing new bioprocesses for biofuels, creating mathematical models of bioprocesses, and designing buildings such as greenhouses, homes, and animal facilities, to reduce energy use and incorporate efficient energy and renewable energy into building design and operations. Faculty and students within the department focus on food, energy, and agricultural, biological, and environmental systems that reduce environmental hazards and protect natural resources. The program offers bachelor's and advanced degrees in biosystems engineering and technical systems management, with bioenvironmental, controlled environment, food and bioprocessing, machine systems, pre-biomedical, and pre-med/pre-vet focuses.



Center for Applied Energy Research (CAER), courtesy of Dan Melanson.

Many partners work alongside UK's research and development of clean and renewable energy sources, developing a culture of innovation and entrepreneurship. The Center for Applied Energy Research (CAER) is a multidisciplinary energy technology research center to improve the environment. Multiple specialized research facilities are part of the CAER, including an algae greenhouse to produce biofuels and bioproducts from algae, an engineered fuels lab that uses low-value or waste from coal and to create high-value

fuel briquettes and pellets, a fuels-processing development facility to develop fuels from a petroleum substitute, and a renewable fuels lab focused on biofuels. More than 100 professional scientists and engineers staff the CAER and work closely with faculty and students. Like many research centers at the University of Kentucky, the CAER not only produces world class research and technologies but also offers support services to others, such as analytic testing, technical problem-solving, and collaborative research.

Local Attributes

The City of Lexington has numerous local attributes to support the growing renewable and clean energy industry, and Lexington's workforce is at the forefront. The 2015 Census data ranks Lexington the 11th most educated city in the nation among cities with populations of at least 300,000 people, with 41.6% of the population 25 years or older holding at least a bachelor's degree. Even more impressive, 18.9% have an advanced degree, ranking Lexington #9 in the nation. These high levels of educational attainment are at least partially due to the 10 colleges and universities within 40 miles of Lexington. Nearly 70,000 students are enrolled in these institutions, graduating over 15,000 annually. Lexington has received numerous



The Arboretum, State Botanical Garden of Kentucky

accolades for its educated population, including being ranked the World's 24th Smartest City by *National Geographic* in 2014 and #6 Best Large College City by *WalletHub* in 2015. With programs like the University of Kentucky's Center for Applied Energy Research and Department of Biosystems & Agricultural Engineering, Lexington attracts and retains the best talent and brightest innovators in the workforce.

Lexington also has a high quality of life that makes the city a great place to work and live, consistently receiving recognition from a variety of publications, such as #16 Best Large City to Live In by *WalletHub* (2016), #22 Best Job Opportunities in America by *Niche* (2016), and #1 Best Large City for First Time Homebuyers by *WalletHub* (2016). Lexington and Kentucky have one of the lowest costs of doing business in the eastern United States. In fact, KPM ranked Lexington #7 Lowest International Businesses Location Costs in the U.S. Northwest/Canada Region (2014) and *Site Selection Magazine* ranked Kentucky #8 Top State Business Climate. Lexington has also been recognized for its innovative climate that supports small businesses and entrepreneurs, ranking #8 City with the Lowest Startup Costs by *Smart Asset* (2016) and #44 Best Large City to Start a Business by *WalletHub* (2016).

With an educated workforce, access to top colleges and universities, a strong commitment to renewable and clean energy research and development at the University of Kentucky, Lexington is an ideal location for the clean tech industry.

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