



## Bluegrass Advantage in Clean Technology

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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.

### Lexington’s Growing Clean Tech Industry

Entrepreneurs at 3H Company, LLC, a local clean tech startup housed in Lexington’s Coldstream Research Campus, have developed a ground-breaking carbon dioxide (CO<sub>2</sub>) capture technology. 3H’s patented system will improve energy efficiencies by using 80% less energy than current state-of-the-art technology for capturing CO<sub>2</sub> emissions from coal manufacturing and other forms of combustion energy production. Furthermore, this method can use the captured CO<sub>2</sub> to extricate more oil and natural gas from depleted wells.



University of Kentucky (UK) 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. 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.



Engi-Mat Co 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. Engi-Mat is developing advanced insulation to extend battery life with applications in the energy, electronics, automotive, consumer, and biomedical industries. Engi-Mat'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. Engi-Mat has over 40 U.S. patents.

Lexington's most recent addition to the clean technology industry, EnerBlu, Inc., offers a wide range of products including the lowest cost, advanced high-power density battery on the market, pre-engineered hybridization systems, and DC/DC distributed battery energy solutions. On top of providing solutions for generating and storing energy, the company produces a line of all-electric commercial trucks, vans, and buses using their proprietary eLTO™ battery technology. In 2017, EnerBlu chose to relocate their headquarters and R&D lab from Riverside, California to Lexington with an initial investment of \$40,000,000 and 110 jobs. EnerBlu's decision to move from California supports the fact that high-tech companies can be better off by utilizing Lexington's high, innovation capacity and highly educated workforce while simultaneously gaining a better cost of living and excellent quality of life.

### **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 251 Kentucky SBIR/STTR Matching Funds have been granted to small Kentucky businesses, totaling over \$61 million in state funding and leveraging another \$112 million in federal funds. Small businesses and startups can also find help from the Bluegrass Angels, a local group of investors willing to provide seed capital and management guidance to local regional startups and new businesses. The BBDP has attracted over 28 new companies to Lexington because of the state match program, UK research assets, and great quality of life.

The UK 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,



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

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.

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 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 2017 Census data ranks Lexington the 14<sup>th</sup> most educated city in the nation among cities with populations of at least 300,000 people, with 41.8% of the population 25 years or older holding at least a bachelor's degree. Even more impressive, 18% have an advanced degree, ranking Lexington #11 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 17,000 annually. Lexington has received numerous accolades for its educated population, including being ranked the World's 24<sup>th</sup> Smartest City by *National Geographic* in 2014, #6 Best Large College City by *WalletHub* in 2015, #1 Best Midsized City for New College



*The Arboretum, State Botanical Garden of Kentucky*

Grads Starting Careers by *Onlinedegrees.com* in 2016, and #2 Best Midsized City for New Grads by *Onlinedegrees.com* in 2018. 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 #5 Best City for 20-Somethings by *Move.org* (2016), #1 Best Large City for First Time Homebuyers by *WalletHub* (2016), #3 Best City to Raise a Family

by *Zumper* (2018), #6 City with the Best Work-Life Balance by *SmartAsset.com* (2018), and #8 Best City to Live in America by *Money* (2018). Lexington and Kentucky have one of the lowest costs of doing business in the eastern United States. In fact, KPMG ranked Lexington #7 Lowest International Businesses Location Costs in the U.S. Northwest/Canada Region (2014) and *Business Facilities* ranked Kentucky #5 Best Cost of Doing Business (2017). 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* (2017), #8 Best City to Start a Business by *HeroPay* (2017), and Top 10 Best Cities for Entrepreneurs by *The Penny Hoarder* (2018).

With an educated workforce, a culture of innovation and entrepreneurship, and 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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