

Green Biologics Pursues A Biobased Meeting Of The Minds

U.S. and U.K. firms join forces to commercialize biobased 1-butanol

By [Melody M. Bomgardner](#)



BREWING BUTANOL

A Green Biologics scientist works on a fermenter in the firm's U.K. research laboratory.

Credit: Green Biologics

Biobased chemicals firm [Green Biologics](#) is on the cusp of opening a large U.S. plant that will make 1-butanol and acetone from corn sugar. The firm, which raised roughly \$100 million from investors in a little more than a year, owns a corn ethanol plant in Little Falls, Minn. It is converting the facility to produce the renewable chemicals for personal care products, food applications, and paint.

But the company's success so far might not have been possible had it not been for the work of Louis

Pasteur, the backing of an Ohio pizza baron, and the failure of some factories in China.

In 1862, Pasteur first discovered a butanol-producing *Clostridium* microbe. Fifty years later, scientists developed a process to make acetone, butanol, and ethanol (ABE) using *Clostridium acetobutylicum*. Production surged: Acetone was a key ingredient for the cordite munitions used in World War I.

So-called ABE fermentation plants thrived around the world until the 1960s, when they began to lose ground to the petrochemical industry. In the early 2000s, interest in butanol as a biofuel inspired some scientists and investors to take another look at the abilities of *Clostridium*.

In Ohio, butanol proponent David E. Ramey of Ohio State University and successful pizza restaurateur [Jim Grote](#) felt the pull of a new opportunity. The two met through a local business networking group and formed a company called Butylfuel. They built a pilot fermentation plant near Columbus, Ohio, in 2007 and scaled it up to 40,000 L.

In the U.K., meanwhile, ethanol fermentation expert Edward Green had founded Green Biologics in 2003 with an eye toward making butanol. Green's colleague and friend Tim Davies, who leads technology development for the firm, recalls that era as a time of excitement and funding for biofuels.

"We thought higher alcohols might be of interest," Davies explains. "So putting it all together, we began applying modern methods of biology, metabolic engineering, biochemistry, fermentation, and process engineering to reinvent the ABE process."

While Butylfuel was working on its Ohio pilot plant, Green Biologics developed an important relationship in China. The country was home to six ABE plants made idle by the deregulation of corn prices. One firm in China's Northeast sought to make the chemicals from corn stems and leaves, but it required a strain of *Clostridium* that could consume the mixture of sugars that arise from breaking down cellulose. Green Biologics agreed to license a strain from its library of modified microbes. The process worked and generated sales as well as test samples of butanol for Green Biologics' customers.

By 2011, Green Biologics and Butylfuel were both in the midst of growing operations and finding new investors. They found each other and merged in 2012, with an emphasis on chemicals, not fuels. "Butanol as a chemical has a sizable market, and we anticipated there would be biobased demand," says Joel Stone, president of Green Biologics' U.S. operations.

Green Biologics has also benefited from the advice and steady support of an early investor, the U.K.-based venture capital firm [Oxford Capital Partners](#). "We were really backing Edward and his vision," says Oxford partner David Brister. "Over time, our primary focus has been to get the people things right—to evolve and develop the board and executive team with the appropriate skills."

Stone says he is confident that the company's genetically modified microbe, coupled with its advanced fermentation process, has mainly solved the problems of old-school ABE—namely low yield and low concentrations. Typically, butanol yields from corn are half that of ethanol, and the microbes can only survive at butanol concentrations of up to 2%.

"**Our microbe is a true athlete**—it gets the right environment, training, food, and supplements" for high productivity, Stone says. And he describes the firm's manufacturing method as a hybrid of batch fermentation and a continuous process that removes butanol along the way.

Davies says he is keeping a close eye on other firms' experiences as they work to scale up. U.S. start-up [Cobalt Technologies](#), for example, plans to build a commercial-scale butanol plant.

[Gevo](#), which is developing the sister branched alcohol isobutyl alcohol, has run into problems scaling up, but Green Biologics may have an advantage, suggests Julia Allen, an analyst at [Lux Research](#). "They have a unique approach to commercialization since they have already licensed some technology and demonstrated it in China at commercial scale," she says.

And Green Biologics' consumer market targets are good ones, she says. "Most people won't recognize 1-butanol but will notice if the product they buy at the drugstore or hardware store is significantly biobased." The company would face serious challenges, however, if it tried to compete in industrial markets where cost is king, Allen warns.

Green Biologics now employs more than 100 people in the U.K. and U.S. Davies says the company has plans to adopt cellulosic feedstocks and make additional chemicals. "If our forebearers could commercialize this technology 100 years ago," he says, "we should be successful with new technology on our side."

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