

Fulcrum BioEnergy: Biofuels Digest's 2015 5-Minute Guide

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Fulcrum BioEnergy has developed a “game-changing process for converting municipal solid waste that would otherwise be landfilled, into renewable transportation fuels including syncrude, jet fuel and diesel”. The company has successfully proven and demonstrated this process for converting MSW to fuels utilizing its proprietary, innovative, clean and efficient thermochemical process. Fulcrum has secured long-term, zero-cost MSW feedstock agreements with two waste services partners and has entered into fuel and product offtake agreements with Cathay Pacific Airways and a large oil refining company.



Fulcrum’s innovative business model combines large volume MSW feedstock agreements with a demonstrated thermochemical process to produce jet fuel and diesel at an estimated production cost of well less than \$1.00 per gallon.

The first phase of construction is underway on the company’s first commercial project, the Sierra BioFuels Plant, which will convert MSW into a renewable Fischer-Tropsch syncrude, which will then be refined into jet fuel and diesel. The Sierra BioFuels Plant is scheduled to begin commercial operations in 2017 with the production of more than 10 million gallons of renewable transportation fuel.

Rankings

50 Hottest Companies in Bioenergy: #37, 2014-15

Biofuels Digest Awards

2015 Advanced Bioeconomy Partnership of the Year (Fulcrum BioEnergy, Navy and Cathay Pacific)

The Situation

2014 was a defining period for Fulcrum BioEnergy. The company successfully completed integrated demonstration testing, at scale, of its waste to fuels process. Fuel produced from the demonstration plant meets ASTM requirements for use as commercial or military jet and diesel fuels. Fulcrum’s technology success has been reviewed and confirmed by numerous third parties including independent engineers, the U.S. Department of Agriculture and the U.S. Department of Defense.

In 2014, Fulcrum BioEnergy entered into a first-of-its-kind strategic partnership agreement with Cathay Pacific Airways Limited, a leading global airline. This strategic partnership included a large jet fuel offtake agreement for fuel from Fulcrum’s first five plants and a strategic investment into Fulcrum by Cathay Pacific. In 2014, Fulcrum was also awarded a \$70 million grant by the U.S. Department of Defense as part of its national security strategic fuels program.

In 2014, the company also secured the necessary project debt and equity financing to begin construction of the Sierra BioFuels Plant. In addition, Fulcrum entered into fuel product offtake agreements and advanced negotiations of a fixed-price EPC wrap for the construction of Sierra.

Fulcrum has secured sufficient MSW feedstock to support its large growth program to construct and operate plants across North America. With the first phase of construction underway on the Sierra BioFuels Plant, Fulcrum is advancing development activities on seven more projects. These first eight projects are expected to have the cumulative capacity to produce more than 300 million gallons per year of syncrude, jet fuel and diesel at plants across

North America.

Renewable syncrude, jet fuel and diesel produced at Fulcrum's plants will provide numerous economic, social and environmental benefits. By diverting MSW from landfills, the company's facilities will help cities and communities solve their growing waste disposal problems. The fuel produced at Fulcrum's plants will reduce greenhouse gas emissions by more than 80% compared to traditional petroleum fuel helping companies achieve sustainability goals without increasing costs. With a true zero-cost MSW feedstock supply, Fulcrum BioEnergy will produce a new source of refined oil products at a lower cost than the same petroleum products and with positive sustainability attributes.

Fulcrum's process will have a tremendous impact globally. Garbage will be converted into drop-in syncrude, jet fuel and diesel, which will help solve waste and landfill issues in the United States and around the world. With abundant supplies of low-cost MSW located near large population centers, which in turn are located near densely populated fuel consumers, the company's ability to quickly, efficiently and economically turn waste into fuel positions Fulcrum as a leader in the advanced biofuel sector.

Major Investors

Fulcrum BioEnergy is a private company that was founded in 2007 by US Renewables Group. Shortly after this, Rustic Canyon Partners became a major investor in the company. Fulcrum has also focused on developing strategic relationships with industry leaders throughout the renewable fuels process chain. Two of Fulcrum's strategic partners became equity investors in the company, Waste Management in 2011 and Cathay Pacific in 2014. In 2014, the U.S. Department of Defense became a project investor with a \$70 million grant for Fulcrum's first commercial plant.

Technology

Fulcrum BioEnergy has developed and demonstrated its three-step, proprietary process that converts MSW feedstock into low-carbon renewable transportation fuels.

Feedstock Processing

The feedstock used in the company's process will consist primarily of the carbonaceous material recovered from MSW. This MSW will be delivered to Fulcrum's Feedstock Processing Facilities by waste services companies where it will be processed in order to extract commercially recyclable material and inorganic waste before delivering a prepared MSW feedstock to the Biorefinery. Fulcrum's Feedstock Processing Facilities will utilize commercially available waste processing equipment that is currently in use throughout the waste industry.

Gasification System

Fulcrum BioEnergy has licensed a highly efficient and economic gasification system from ThermoChem Recovery International for the conversion of the prepared MSW feedstock to syngas. During the gasification process, the MSW feedstock rapidly heats up upon entry into the steam-reforming reactor and almost immediately converts to syngas. The syngas is then cleaned to safely remove any contaminants before being converted to liquid fuels.

Fischer-Tropsch Process

The company will utilize a conventional Fischer-Tropsch process that has been commercially operational at projects around the world for several decades. In the FT process, the clean syngas is processed through a fixed-bed tubular reactor where it reacts with a proprietary catalyst to form FT syncrude. The FT syncrude can then be upgraded to jet fuel and diesel that can be sold directly into the existing transportation market with no engine modifications.

Feedstock

Fulcrum BioEnergy's projects will utilize the carbonaceous material found in MSW as feedstock. The company has successfully executed on its strategy of securing large volumes of MSW by entering into a number of long-term

agreements with its waste services partners for the supply of fixed, zero-cost MSW feedstock throughout North America. Under these long-term, zero-cost agreements, Fulcrum eliminates feedstock commodity supply and pricing risk.

Fuel Type

Fuel produced from Fulcrum's process is very valuable in the refining, jet fuel and diesel markets. Fulcrum's fuel is drop-in, ASTM certified, will reduce greenhouse gas emissions by more than 80% compared to fossil fuel and is produced at an operating cost well below \$1.00 per gallon.

Past Milestones

- Completed and passed a stringent U.S. Department of Agriculture 120-day continuous, integrated MSW-to-fuel demonstration test, validating yield and reliability.
- Entered into a significant strategic relationship with Cathay Pacific Airways, which included an equity investment in Fulcrum and a 10-year jet fuel offtake agreement.
- Awarded a \$70 million grant from the U.S. Department of Defense to fund a portion of the construction of the Sierra BioFuels Plant.
- Executed a conditional commitment with the U.S. Department of Agriculture for a \$105 million loan guarantee of project debt for the Sierra BioFuels Plant.
- Began construction activities for the first phase of the Sierra BioFuels Plant.

Future Milestones (2015 – 2017)

- Complete construction and commence commercial operations of Fulcrum's flagship facility, the Sierra BioFuels Plant.
- Advance activities on the company's development program and begin construction on two additional waste to fuel plants.
- Continue to grow Fulcrum's strategic alliances throughout the waste-to-fuels value chain to further strengthen the company's growth and future value.

Business Model

Fulcrum BioEnergy is a developer, owner and operator of facilities that will convert a waste product into a drop-in transportation fuel that competes directly with fossil fuels. Fulcrum's business model is based on a disciplined project finance approach to project development. This ensures each project has sound fundamentals, feedstock contracts, committed customers, proven technology, good EPC suppliers and strong cash flows to ensure success and attract investment and debt capital.

Competitive Edge

Fulcrum's business model provides the company with significant competitive advantages and growth potential. The company's renewable fuel is low cost, low carbon and has lower emissions than fossil fuels. By securing large volumes of MSW feedstock at fixed, zero-cost and securing fuel offtake agreements with established commercial customers, Fulcrum eliminates much of the market risk from its business.

Feedstock

MSW represents an ideal feedstock for the production of syncrude, jet fuel and diesel because it exists in large volumes with existing infrastructure for the collection and transport of the MSW already in place. In addition, MSW is a true waste product that has no competing uses. Fulcrum has executed 20-year, fixed, zero-cost MSW feedstock

agreements with its waste services partners for its plants across North America.

Technology

Fulcrum BioEnergy has selected gasification and Fischer-Tropsch technologies that are fully demonstrated, proven and ready for commercial deployment.

Low-Cost Producer

With zero-cost MSW feedstock, the company has eliminated the largest and most volatile portion of the cost of producing renewable fuels. Fulcrum will be able to produce renewable fuel for well less than \$1.00 per gallon. Fulcrum's stable, low-cost structure allows it to enter into fixed-price off-take contracts or hedges to secure attractive and stable project economics for investors.

Large Development Program

Fulcrum is advancing on a large North American development program at locations that are strategic to the company's fuel offtake partners and close to where Fulcrum has secured zero-cost MSW feedstock. Fulcrum's project plans, both business and technical, are easily replicated at locations across North America and around the world.

Alliances and Partnerships

Fulcrum BioEnergy has created a strategic partnership model where major industry companies throughout the company's value chain have committed capital, entered into long-term feedstock and fuel offtake agreements and have a vested interest in Fulcrum's success. These partners include Waste Management, Waste Connections, Cathay Pacific Airways, the U.S. Department of Defense and a large North American oil refiner.