

Biomass Boiler Reduces Natural Gas Consumption at Food Processing Facility

Project Overview

Boilers are a critical element of industrial operations in the United States, consuming roughly 20% of the natural gas used in the manufacturing sector. Within the U.S. manufacturing sector, the food processing industry alone utilizes over 10,000 boilers to serve its heating and power needs. More than 70% of these boilers consume natural gas, amounting to an annual consumption of 237 trillion Btu.

As part of this project, Burns & McDonnell Engineering Company demonstrated an innovative biomass boiler at Frito-Lay's Topeka, Kansas, food processing facility. The project received \$1.6 million in U.S. Department of Energy funding, with Frito-Lay—a subsidiary of PepsiCo—providing cost share. The installed 60,000 lb/hr stoker-fired (saturated steam) boiler is fueled by a combination of wood waste and tire-derived fuel (TDF) sources.

Through combustion and emissions controls optimization, packaging engineering, scaling development, and economic analysis, the goal of this project was to offset the majority of the natural gas consumption necessary to produce steam at the Frito-Lay facility. Additional research was performed to assess alternative renewable fuel sources, particularly on-site food processing waste streams, alternate feedstock combustibility, boiler sizing, and controls and process system integration issues to promote wider replication and adoption of the technology within Frito-Lay's facilities and wider food processing industry.

Benefits for Our Industry and Our Nation

The project had major energy, cost, and environmental benefits, including the following:

- Significant reduction in natural gas consumption at the Frito-Lay facility
- Significant cost savings to Frito-Lay through avoided natural gas purchases and reduced food processing waste handling costs
- The diversion of industrial and commercial waste streams from landfills to provide useful work as a biomass fuel source

Applications in Our Nation's Industry

It is estimated that up to 20% of the 10,000 boilers currently utilized in the food processing industry can be replaced by the proposed biomass boiler technology. Furthermore, the reference design developed in this project will be utilized to proactively



An innovative 60,000 lb/hr stoker-fired biomass boiler operates at Frito-Lay's Topeka, Kansas, processing facility.

Photo courtesy of Frito-Lay, Inc.

introduce new biomass boilers into all U.S. manufacturing industries that operate industrial boilers.

Barriers

- Extremely fast and significant process heat turndown requirements
- Scaling down of stoker-fired biomass boilers to meet industry requirements
- Biomass fuel supply availability, contracting, and economics



The installed boiler is fueled by wood waste and tire-derived fuel waste. *Photo courtesy of Frito-Lay, Inc.*

- Environmental controls, requirements, and permitting

Pathways

Based on the preliminary concept, development efforts, and assessment of biomass boiler technology options, Frito-Lay installed a 60,000 lb/hr stoker-fired (saturated steam) boiler to serve a significant portion of the process and building steam demand at its Topeka facility. According to biomass fuel sourcing studies, the boiler was designed to accommodate wood waste and TDF fuel sources, with potential for incorporating packaging and other on-site food processing-related waste into the boiler fuel stream. The boiler consumes approximately 35,000 tons of wood waste and TDF per year.

Milestones

This project started in 2009 and was completed in 2012.

- Year 1: Preliminary design, including sizing and specification development, controls and instrumentation specifications development, the commencement of permitting activities, and the finalization of fuel source contracts
- Years 1–2: Final design and installation task, including final design packages development; the selection of vendors; and the completion of all site permitting, site preparation, and boiler installation
- Year 2: System commissioning, including plant staff operations and maintenance training
- Year 2: Full system operation
- Years 2–3: Performance assessment, including documenting the project’s ability to continuously serve the process and build heating loads with a biomass fuel source.



The 60,000 lb/hr stoker-fired biomass boiler serves the process and building steam demand at Frito-Lay’s Topeka, Kansas, food processing facility. *Photo courtesy of Frito-Lay, Inc.*

Accomplishments

The Topeka facility has been recognized as a model throughout the food processing industry by companies looking to cost-effectively use biomass boilers to decrease their natural gas consumption and adopt sustainability practices. The American Council of Engineering Companies of Kansas recognized the Frito-Lay biomass project with a 2011 Engineering Excellence Award. The Topeka facility was the first manufacturing site in Kansas, and the second food production facility nationally, to receive LEED Existing Building Gold Certification.

Commercialization

The project sought to develop technologies that enable the system to be able to meet the demands of different food processing applications. To achieve this, the biomass boiler was designed to be scalable to match different thermal loads, and adaptable controls and instrumentation were developed. In addition, system components were packaged to ease installation and reduce capital and maintenance costs. The project partners are supporting each other to replicate the success of this project both within the Frito-Lay and PepsiCo organizations as well as externally through the partners’ own sales channels.

Project Partners

Burns & McDonnell Engineering Company, Inc.
Kansas City, MO

CPL Systems, Inc.
Lafayette, LA

Frito-Lay, Inc., a subsidiary of PepsiCo
Topeka, KS

Oak Ridge National Laboratory (ORNL)
Oak Ridge, TN

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Project final report available at
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