

Project Title: Biomethanation with Power Generation Project
Agreement Number: G100359

Project Leader: Shannon Fehr, P.Eng
Lead Institution: Slave Lake Pulp, a Division of West Fraser Mills Ltd.
Project Partners: West Fraser, CCEMC, Government of Alberta
CCEMC Advisor: Xaiomei Li

Project Completion Date: **31-MAY-2016**

CCEMC Funding: \$ 5,000,000
GOA Funding: \$10,000,000
West Fraser Funding: \$25,000,000
Project Budget: \$40,000,000

Report Submission Date: **25-JUL-2016 (3-AUG-16 REV1)**

Project Summary

The Biomethanation with Power Generation Project (the Project), is a \$40M investment at Slave Lake Pulp (SLP), a Division of West Fraser Mills Ltd. The primary objective of the Project was to install an anaerobic digester, two biological biogas cleaners and three dual fuel Gensets to produce approximately 4 MW of green power using Bleached Chemi-Thermo Mechanical Pulp (BCTMP) mill effluent. The Project was co-funded by West Fraser (\$25M), the Alberta Government (AESRD, \$10M) and the CCEMC (\$5M), and was completed on May 31, 2016. GHG offsets are created by generating power from biogas which offsets power purchased from the grid. Non-GHG benefits include a decrease in chemical use and sludge generation in effluent treatment operations. This is the first installation of its kind in the western hemisphere.

Project Goals

The goals of the Project can be divided into two parts; Biomethanation & Power Generation.

The goal of the Biomethanation portion of the Project was to install an anaerobic pre-treatment system to increase effluent treatment capacity, decrease load on the energy intensive aerated effluent treatment plant and thereby decreasing effluent treatment electrical intensity, decrease secondary sludge volumes and nutrient useage, and finally to produce methane-rich biogas for utilization.

The goal of the Power Generation portion of the Project was to produce green power for use by the pulp mill to offset coal-generated electricity by burning conditioned biogas in reciprocating engine gensets, and to utilize waste heat (exhaust) to displace natural gas in the flash dryer.



The primary goals of this new and novel Project were to decrease SLP's electrical and GHG intensities and improve the economic competitiveness of SLP in the global BCTMP market, which is significantly trade exposed.

Project Execution

The definition phase of the Project was extensive and included bench, lab and mill-scale pilot testing, visits to operating facilities in China, Thailand and Canada, a comprehensive open-bid process for the two major Project contracts, preliminary and detailed engineering by West Fraser and third-party engineering firms, and contract development phases prior to final Project approval by West Fraser.

The Project was executed in three major parts; the Biomethanation Project was awarded to a single EPC (Engineering, Procurement, Construction) vendor who installed a low-rate anaerobic digester, two biological biogas cleaners, one biogas incinerator and required auxiliaries. The Power Generation facility was awarded to another EPC vendor who installed the Gensets, a custom designed power plant structure and auxiliaries. Finally the Balance of Plant (BOP) was managed by West Fraser including site preparation and access, interconnecting process lines and utilities to both EPC plants, biogas conditioning systems, medium-voltage electrical system upgrades, and controls systems.

Commissioning of the new facility was staged, starting with the anaerobic digester. The large volume reactor took 1 year to construct and then required a 6 month period to ramp and stabilize operation, which started in September 2014. Next the Power Generation facility was completed and commissioned in September 2014. The biogas scrubbing systems were subject to construction delay and were commissioned one year late in December 2015. Commissioning of the Gensets on biogas followed and extended into 2016. The Project was completed in May 2016 and is currently in operation.

Project Achievements

The anaerobic digester has been ramped to 85% of total influent flow and is meeting the design efficiency of 65% soluble chemical oxygen demand (COD) reduction. Biogas production is on target and scrubbed biogas contains the expected 60% methane content. A technical paper was written on the first 6 months of digester operation called "SLAVE LAKE PULP BIOMETHANATION WITH POWER GENERATION PROJECT", Bertoldo et. al, 2015 and presented at the PacWest Technical Conference.

The biogas cleaners are operating and have achieved 99.9% or greater H₂S removal efficiency. Biology based biogas cleaning technology is well suited to facilities that operate biological effluent treatment systems, generate no waste and have very low operating costs. Overloading of the biogas cleaners has resulted in lower than planned utilization arising in-part from more frequent than planned cleanings. A technical paper was written on the first 6 months of biogas cleaner operation called "BIOGAS TREATMENT AND UTILIZATION FOR SLAVE LAKE PULP BIOMETHANATION AND POWER GENERATION PROJECT", Fehr et. al, 2016 and presented at the PacWest Technical Conference.

Green power generated from biogas averages 3.5 MW to 4.5MW depending on pulp mill operation (grade) and can be as high as 6 MW. Trials for use of gensets exhaust in the flash dryers were successful in reducing natural gas consumption but resulted in impacts to final product quality. It is expected that heat recovery economics will be more favourable when natural gas price increases.



In the first year of operation of the Project, it is expected that approximately 30,000 MW of green energy will be produced, and GHG offsets generated will be between 25,000 and 30,000 MT (Metric Tonnes) of CO₂e. In future years, it is expected that up to 35,000 – 40,000 MT of CO₂e/year will be displaced. West Fraser is committed to the continuous improvement of Project operations and installation of additional equipment and processes to improve or enhance biogas utilization, power generation and waste heat utilization.