NEW ENGLAND

CHP TECHNICAL ASSISTANCE PARTNERSHIPS

PROJECT PROFILE

Maine Woods Pellet Co.

8 MW Organic Rankine Cycle CHP System

Site Description

Located in Athens, Maine, Maine Woods Pellet Co. (MWP) produces 100,000 tons of wood pellets per year using an 8 MW Turboden Organic Rankine Cycle (ORC) Combined Heat & Power (CHP) system installed in 2016. The ORC CHP system converts heat to power and is fueled by 105,000 tons of sustainably sourced biomass per year.

Quick Facts

LOCATION: Athens, Maine
MARKET SECTOR: Wood products
FACILITY SIZE: 1.2 MW plus export up to 7.1 MW
EQUIPMENT: 8 MW Turboden 80 HRS
FUEL: Biomass
USE OF THERMAL ENERGY: Process heat
CHP TOTAL EFFICIENCY: 63 %
ENVIRONMENTAL BENEFITS: Renewable energy
ANNUAL ENERGY SAVINGS: $3.1M
PAYBACK: 11 Years

Excess power of up to 7.1 MW is sold to Central Maine Power (CMP) via a Power Purchase Agreement (PPA). The system qualified for and received support from the Maine New Markets Capital Investment tax credit program.

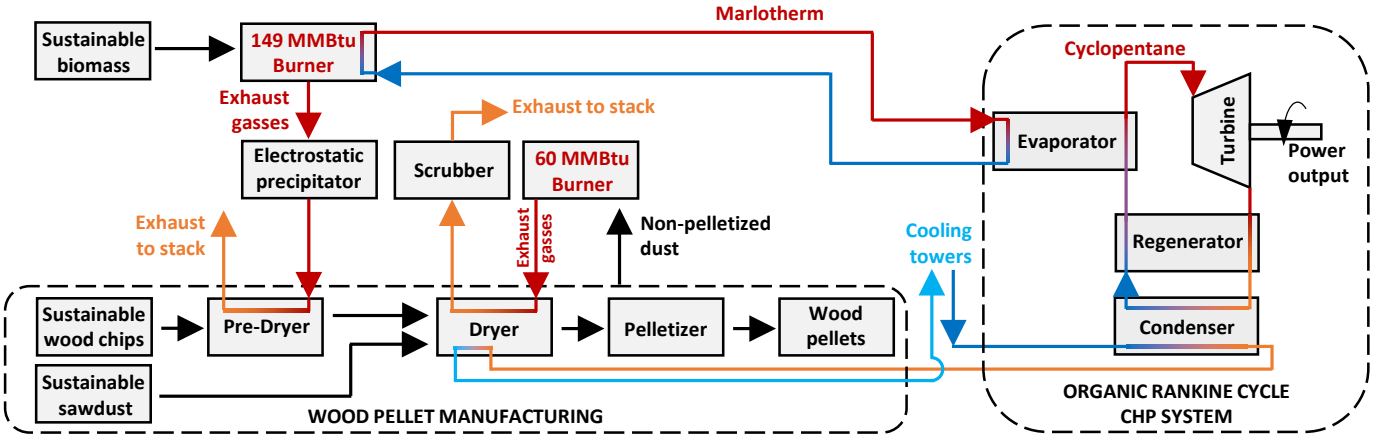
Reasons for CHP

Maine Woods Pellet's process is an ideal candidate for CHP due to consistent and concurrent electrical and thermal loads. When installing a new CHP system in 2016, MWP chose an Organic Rankine Cycle (ORC) CHP to replace their existing steam turbine CHP to reduce operating costs and increase reliability. Cost reductions occurred as the result from using waste heat to pre-dry the pellet wood chip feedstock, reducing wasted energy superheating the turbine's working fluid and reduced operating costs. Increased reliability resulted from reduced turbine pitting and subsequent repairs.

CHP Equipment & Configuration

When installed in 2016, the 8 MW ORC unit was the largest Turboden turbogenerator of its type in the world. The system works by burning locally sourced, sustainable biomass to heat marlotherm, a thermal oil with a boiling point of approximately 300°C. Heat is exchanged from the marlotherm to the ORC CHP's working fluid, *i.e.*, cyclopentane, through an evaporator. As shown in the schematic, the cyclopentane travels in a clockwise direction in a closed loop within the ORC CHP system. Starting at the top of the cyclopentane closed loop, heated cyclopentane expands through a turbine to generate power, passes through the regenerator and condenser to cool before being pressurized by a pump (at the

location of the blue arrow head). The cyclopentane is then re-heated within the regenerator and evaporator. Waste heat from the ORC CHP condenser and the 60 MMBtu burner's exhaust gases dry the wood pellet feedstock.



Schematic of Maine Woods Pellet's pellet manufacturing and ORC CHP system

CHP Operation

Maine Woods Pellet's CHP system reliably operates 24 hours per day, 7 days per week with a combined efficiency of approximately 63%. Since the ORC CHP system's cyclopentane working fluid operates at lower pressures than a steam system's pressure, there is no requirement to have licensed operators on duty during CHP operation. Although the burning of biomass emits carbon dioxide (CO_2), the growth of biomass captures a nearly equivalent amount of CO_2, thus resulting in a near carbon-neutral fuel source.

Lessons to Share

Placement of Electrostatic Precipitator: Prior to installation, the placement of the electrostatic precipitator (ESP) was a concern. In particular, would the wood chip feedstock emit particles when dried via exhaust gas, and should the ESP be placed between the pre-dryer and the stack or between the burner and the pre-dryer? After petitioning for permission and placing the ESP between the burner and the pre-dryer, exhaust gas emissions were measured after the ESP and before the stack. Results indicated that exhaust gas emissions before and after the dryer were equivalent so the ESP could remain positioned before the pre-dryer.

Iron levels in well water: Iron levels in the cooling towers' makeup well water were initially tested while the well was non-flowing. Once the tower water makeup water system was flowing, a retest indicated that the iron levels exceed the capabilities of the water treatment equipment. Iron levels were reduced via a chemical treatment system. The lesson to share is to always test water conditions while the system is running.

For More Information

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Date produced: June 2019

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