



# Ingredion Inc.

## 8.4 MW CHP Biomass System

### Site Description

Ingredion, formerly Corn Products International, operates a facility in Winston-Salem, North Carolina that refines corn to yield a variety of useful ingredients including sweeteners, starches, oils, nutrition ingredients and biomaterials. These processes are energy intensive and require steam at various stages of the refining operation including steeping, drying, and distilling.

The Winston-Salem facility installed a biomass fueled combined heat and power (CHP) system in the mid-1980s to reduce energy costs. Over the years, the system has been expanded and upgraded to increase power generation and steam output to support production.

### Project History

When initially built in the early 1980s, the facility purchased electricity from the utility and operated a natural gas fired boiler to provide thermal energy to the manufacturing process. In 1985, a plant expansion led to increased steam demand and the first CHP system was installed. The system was composed of a Keeler hybrid suspension grate boiler and a 7.5 MW backpressure steam turbine. The boiler, fueled by a mix of wood chips and coal, produced 194,000 lb/hr at 960 psi and the backpressure steam turbine dropped the pressure to supply a 150 psi process steam header.



Ingredion Facility in Winston-Salem, NC

### Quick Facts

- LOCATION:** Winston-Salem, North Carolina
- MARKET SECTOR:** Food Processing
- FUEL:** Wood mostly, some natural gas and coal
- GENERATING CAPACITY:** 8.4 MW
- MAX THERMAL OUTPUT:** 350,000 lb/hr of steam
- IN OPERATION SINCE:** 1985
- EXPANSION:** 1993
- EQUIPMENT:**
  - Keeler solid hybrid suspension grate boiler
  - Steam and Control Systems, Inc. wood boiler
  - 7.5 MW backpressure steam turbine
  - 900 kW backpressure steam turbine
- USE OF THERMAL ENERGY:** Steeping, drying, distilling
- USE OF ELECTRICAL ENERGY:** On site
- INSTALLED COST (EXPANSION):** \$380,000
- ANNUAL SAVINGS (EXPANSION):** \$170,000
- SIMPLE PAYBACK (EXPANSION):** 2-3 years
- ENVIRONMENTAL BENEFITS:** CO<sub>2</sub> and NO<sub>x</sub> reduction
- EMISSIONS CONTROLS:** Electrostatic Precipitator, Multicyclone, Continues Emission Monitoring System (CEMS)

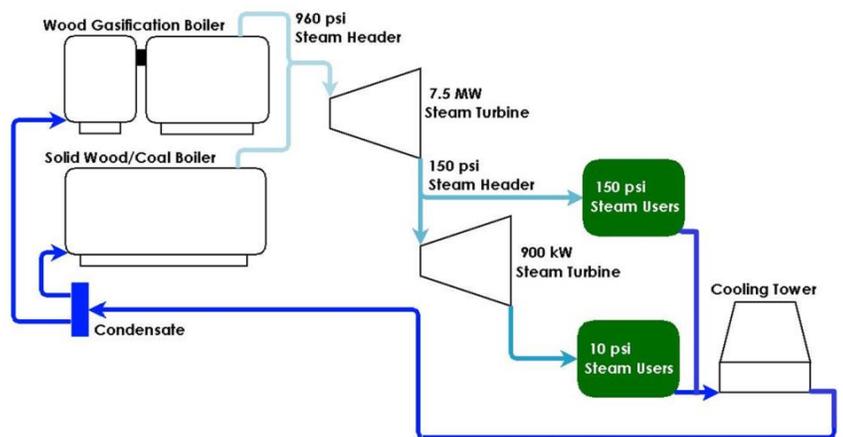
In 1993, a single stage 900 kW Coppus backpressure steam turbine was installed to replace a PRV supplying 10 psi steam and increasing onsite power generation. Together, the 7.5 MW and the 900 kW turbines generate around 45% of the electrical power for the site. In 1998, the facility installed a second biomass boiler to supply 165,000 lb/hr of 960 psig steam.

The majority of the fuel for both boilers consists of wood chips supplied from within a 70 mile radius of plant.

## Project Overview - PRV Replacement

The initial CHP design utilized a pressure reducing valve (PRV) to supply low pressure steam to the system from the 150 psig steam header. The pressure normally reduced in a PRV now powers a 900 kW steam turbine generator.

The backpressure turbine generator was installed in parallel with the existing PRV. The paralleled installation of this new system allows for bypass to assure a continued supply of low pressure steam during routine maintenance of the new turbine. The budget for the project was \$380,000 with an expected 2–3 years simple payback. The project success is attributed to thorough engineering resulting in minimal issues during installation, startup and normal operations of the new backpressure turbine.



Ingredion Combined Heat and Power System Diagram

## Operation

The CHP system normally operates at a rate that satisfies 100% of the manufacturing thermal load, however the site can also maximize electricity production when pricing makes it economical. This way the facility can generate more electricity to utilize on-site when utility electrical prices are higher. Currently, the site uses approximately 90% woody biomass and 10% coal, with natural gas available for backup. The newer Steam and Control Systems, Inc. gasification boiler burns only biomass, while the older Keeler boiler requires a wood-coal mix to maintain proper combustion of the fuel. The use of biomass is a very important part of the production economics, as the cost of woody biomass energy is less than \$3/MMBtu. The biomass supply also supports local businesses and jobs, circulating money in the state economy.

The Ingredion CHP facility operates 24/7 with a 3 person crew including a control room technician, field tech, and woodyard operator to keep the CHP system running. An annual week-long shutdown is performed for maintenance and inspections.

## Lessons Learned

The highly efficient CHP system at Ingredion lowers the pollutants emitted by the local coal fired utility generating plant. So far, the system has been in continuous service with downtime as required to perform normal preventative maintenance and minor repairs. The reliability and performance of the system has exceeded original expectations with minimal operation/maintenance issues and no process interruption.

## For More Information

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