NORTHWEST

CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

PROJECT PROFILE

# Alaska Gateway School District
# Tok School

## 120-kW Biomass CHP System

## Site Description

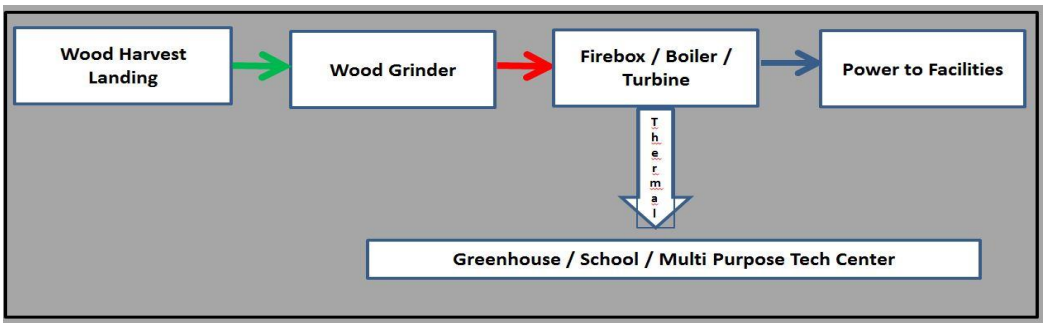
The remote community of Tok, Alaska (population 1,400) is situated approximately 200 miles east of Fairbanks on the Alaska Highway and is surrounded by the 8.5 million acres of the Tok Management area of the Tanana Valley Forest, with 40,000 acres in the Tok Basin specifically identified for Wildfire Remediation*. Much of this is continuous black and white spruce "dog hair" forest (trees that rarely mature beyond 3" caliper in size). Like most remote small Alaskan communities, the economic impact of high fuel and electricity costs ($.427/kWh) was adversely affecting the community's economy, notably the school district (staff cuts and double duties assigned). A phased-in biomass boiler/CHP project approach began in 2010 with the installation of a biomass boiler utilizing biomass from forest thinning projects.

**Aerial View Tok Alaska with Spruce Forests.**
PHOTO COURTESY OF: TOK ALAKSA CHAMBER OF COMMERCE

*State of Alaska Division of Forestry, Tok Area Community Wildfire Protection Plan (CWPP)

## Quick Facts

**LOCATION:** Tok, Alaska
**MARKET SECTOR:** Schools
**FACILITY SIZE:** 80,000 Square Feet
**FACILITY PEAK LOAD:** 120 kilowatts (kW)
**EQUIPMENT:** Messersmith Firebox / Hurst Boiler / Elliot Steam Turbine / Rotochopper wood grinder
**FUEL:** Wood "grinds"
**USE OF THERMAL ENERGY:** School and Greenhouse heating
**CHP TOTAL EFFICIENCY:** Estimated at 80%
**ENVIRONMENTAL BENEFITS:** Greenhouse gas emissions reductions (not calculated), reduction of wildfire danger to the community and uncontrolled emissions from wildfires. Annual realized diesel fuel offset of 59,000 gallons
**TOTAL PROJECT COST:** $4.3 million (match included)
**YEARLY ENERGY SAVINGS:** $146,000 heat only
**PAYBACK:** 8 years
**FULL CHP IN OPERATION SINCE:** 2013
**NOTE:** Greenhouse heating has allowed annual production of 20,000 pounds of fresh vegetables. Additional greenhouses to be added in future years.




**Timber Harvest, CHP System and Energy Usage Schematic**

> *"All of those BTUs, all of that energy, just went up in smoke. By the school using this material, it's saving me a minimum of $1,000 an acre." Jeff Hermanns (Tok area forester)*

## Reasons for CHP

- High heating fuel costs
- High electricity costs ( $.427/kWh)
- Readily available opportunity fuel – biomass from forest thinning component of the 2010 Community Wildfire Protection Plan (initially 3,000 acres)
- Reduce cost and increase availability year round of fresh produce through thermal heated greenhouses

## CHP Equipment & Operation

- 5.5 MMBtu/hr Messersmith firebox with Hurst Series N65 150 HP wood boiler with electrostatic precipitator
- Wood grind feed auger from covered 120 ton storage bunker
- 120 kW Elliott steam turbine
- Supporting thermal energy piping systems to school and greenhouse

The CHP system operates in "idle mode" at the 40 kW mark to meet minimal school and greenhouse thermal and electric needs and increases outputs as seasonal demands dictate up to 100 HP turbine output capable of providing up to 75% of Tok school electricity needs. Surplus heat is piped to the greenhouse for year round fresh produce – not normally available in many parts of rural Alaska. Plans exist to add two more greenhouses. The initial combined system had design problems due to a low feed auger rate, lack of steam volume and not meeting the desired 100 HP capacity for seasonal demand changes. Steps were taken to improve performance. The transmission on the feed auger was replaced to handle a larger volume of wood and additional air was added to the over fire area of the boiler. This combination of improvements has resolved full steam turbine performance issues resulting in over 269 MWh and 19,000 MMBtus of thermal energy since system component installation in 2010

## Lessons To Share

- Fuel quality and consistency is critical to stable system operation. Silica heavy pine needles and other contaminants can create "clinkers" (glass chunks) impacting combustion chamber efficiencies. Tok minimizes contaminants by careful transport and storage of biomass in dry, covered area with a concrete foundation
- When sizing a steam turbine for an isolated system, the electrical load should be based on the amount of needed heat. When Tok transitioned from heat only boiler system to a CHP system, there was an estimated 30-50% more heat generated than needed. This resulted in the greenhouse project and anticipated expansion.

> ***Demonstration projects like Sealaska Corporation's large-scale pellet boiler and the Tok School's chip-fired boiler have proven that biomass can significantly reduce the cost of energy in a community and has led to the start-up of other wood-fired boilers in Alaska.***
> ***http://www.akenergyauthority.org***

## For More Information

U.S. DOE NORTHWEST CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)

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