Alaskan Community to Benefit for Years to Come From Local Wood Energy Project

Students from the Tok School holding up woodchips that are used to fire the boiler. *Photo: DOF*

Alaska winter months are cold, but the children going to school in Tok are warmed by the very trees that have been removed to protect them, and wiser about the immense northern boreal forest surrounding the community.

On October 29, 2010, the woodchip-fired boiler at the Tok School was lit for the first time. Almost exactly three years after the project's conception, the boiler is an example of community determination and serves as a potential model for rural Alaska living. Its operation is also timely as temperatures drop and the days become shorter. If the school's heat wasn't coming from the woodchips, it would be coming from 65,000 gallons of fuel oil each year.

Three years ago, the price of fuel in Alaska sky-rocketed and costs for heating oil were well over $3.00/gallon. The greatest impacts were experienced in rural communities. Money that would otherwise be put towards the Kindergarten-12th grade education in Tok was being used in oil-fired boilers to provide heat and hot water at the school. The statewide economic concerns weighed heavily on Tok residents and created the momentum needed to combine large-scale community based forest management with hazard fuel reduction to create a useable product.

Alaska Division of Forestry (DOF) Area Forester, Jeff Hermanns, was living and working in Tok when state and local interests began to shift toward wood energy. The interest was accompanied by a widespread recognition of Alaska's abundance of biomass. Hermanns felt the need to pursue local wood energy options, but it was only one blade of a double-edged sword for Tok. While winter temperatures can dip to -60 Fahrenheit and the sun barely makes it over the horizon, summers are the exact opposite. Fire is at the heart of the boreal ecosystem, like few others in North America. Hot, dry temperatures and lightning busts, combined with a sea of mature white and black spruce trees, make for flammable, dangerous fire situations.

The forest does not end where the community starts; the wildlands continue through even the most developed parts of town, totaling almost 40,000 acres of continuous fuels that are ready to burn. Human-caused fires also pose a threat. Recreational fires, off-road vehicles, open burning, and a range of other human activities serve as sources of ignitions, especially in the wildland urban interface. Developing a use for the hazardous forest fuels significantly reduces the cost of fuel reduction treatments, enabling more acreage to be completed.

The road is a dividing line between a treated fuel reduction area on State land and the untreated forest on private land. *Photo: DOF*

Hazard fuel reduction efforts, carried out in many ways, have been ongoing in the Tok area and surrounding Alaska Native villages (such as Tanacross, Tetlin and Northway) for several years. The projects have been in conjunction with other agency and community partners, including the US Fish and Wildlife Service (FWS) Tetlin Wildlife

2010 Eagle Trail Fire. *Photo: Clinton Northway*

Refuge, the Bureau of Land Management, and the Bureau of Indian Affairs. Individual landowners are encouraged to create defensible space around their homes and other values. Additional agency support and guidance has been provided when necessary, including the Senior Citizens Defensible Space project. Large-scale fuel breaks have been created around Tok and Tanacross.

All of the efforts help, but are still not enough. In the past 25 years, nearly 2 million acres have burned in the area and portions of Tok have been evacuated a half a dozen times at a cost of over 60 million dollars in fire suppression activities. The 2010 season was no different, due to the Eagle Trail Fire that endangered Tok and Tanacross and required evacuations.

In 2006, a Community Wildfire Protection Plan (CWPP) was developed by DOF, FWS, the Tok Community Umbrella Corp. (a local Tok non-profit entity), the Tok Chamber of Commerce, the Tok Volunteer Fire Department and private citizens. In the CWPP, the school was identified as the community evacuation center, but it turned out to be one of the most dangerous places to send people because of the dense forest surrounding it. Nobody could grasp the full magnitude of danger bearing down on the school/evacuation center until the property was assessed for hazardous fuel removal and biomass per acre was quantified. Additionally, access was limited with only one point of entrance/exit. The School Board recognized that something had to be done and approved the thinning of 50 acres around the school. The FWS provided 55 thousand dollars to implement the project and DOF provided expertise.

Pre-thinned (left), post-thinned (right) forest. *Photos: DOF*

The double-edged sword became the motivation to slice through obstacles and set the stage for the boiler proposal to gain momentum, turning the liability into an incredible asset. Foresters knew that the woods surrounding the school were thick and fire hazard was extreme, but their knowledge of biomass availability was primarily based on models. Once they started taking measurements on the ground, they realized there was a lot more biomass than they anticipated. Inventory plots were established on the acres surrounding the school and, according to Hermanns, "the results were incredible. Our concept of how much fuel was out there was drastically off." The original estimate was that there would be about 5-6 tons/acre available for removal, however when accounting for whole tree utilization, down to the smallest diameter tree, there were 35-180 tons/acre. The University of Alaska Fairbanks (UAF) and USDA Pacific Northwest Researchers teamed up with DOF on projects in Tok to determine how much biomass is in the interior Alaska forest in the Tok area.

Additional groundwork needed to be completed before the woodchips would be accepted as an alternative for heating the school. Thinning around the school would provide fuel for a full year, and DOF already had several years' worth of wood stored up. However, the amount of biomass available for the long-term needed to be considered. "We identified all of the available wood that was around town that nobody had ever stopped to think about," Hermanns said. Other available sources that were identified for future use include: two local sawmills (the edgings, slabs, and other waste that is left after the milling process is enough to heat the school each year); leftovers from timber sales that otherwise have no marketable value and usually are burned on site; trees removed in land clearing that are either buried or burned; fire salvage; trees from individual landowner Firewise

projects that people bring to "the pit" at the DOF Tok Area Office where it used to be burned; and trees from large-scale future hazard fuel mitigation projects. The list goes on, and there is far more biomass available than this project will ever be able to use.

Hermanns feels strongly that "if you want to do a wood energy project, you have to go out and determine what your fuel is, and then design your project around it. Don't start by saying what boiler you want. The concept for ours was that the average tree size is only three inches in diameter. With that small of a tree, you can't handle it piece by piece, tree by tree. You have to be able to process whole trees and something like 20 at a time."

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- Jeff Hermanns, DOF

The conventional wisdom at the time of the project's start was that only bole-wood could be used while limbs, bark and other debris would have to be excluded. Through research and looking at other examples in the United States where industrial-size wood-fired boilers are operating, Hermanns discovered that whole-tree utilization, including slash and green fuel, is occurring successfully. After learning more about the existing possibilities, samples of ground-up Alaskan trees were sent to CTA Architectural and Engineering to be analyzed for density, moisture content, energy value and ash content. Results showed it to be a good source of fuel.


Steam released out of the boiler facility. *Photo: DOF*

Air quality also needed to be addressed up front. A system that generates a lot of smoke would not be a viable option in an environment that has the potential for smoke from summer fires, has an estimated 40-50 local home-heating outdoor wood boilers already installed in the area, and has the ability for air to be trapped by subzero inversions in the winter. Two other large, industrial biomass boilers are also in use within 100 miles of Tok: one at Dry Creek and one at Kenny Lake. When fed and operated correctly, steam is produced and there is little smoke. Findings with the Dry Creek and Kenny Lake boilers were consistent with those in the eastern United States. Back east, biomass boilers are used to heat public facilities and the big questions have already been asked. "We were not dealing with an unknown entity," Hermanns said. The Tok system uses technology that not only helps mitigate smoke output by keeping the boiler running efficiently, but also has a component that "zaps" smoke out of the exhaust. The technology utilized, known as electrostatic precipitation, electrically charges exhaust particles and removes them from the exhaust steam.


The Rotochopper processing whole trees and depositing the woodchips into the school's hockey rink for storage. *Photo: DOF*

Once initial research was done, Hermanns worked with the Executive Director and Superintendant for the Alaska Gateway School District (Tok School), the Alaska Energy Authority, and CTA Architectural and Engineering, to submit a successful application for a 2.5 million dollar renewable energy grant from the State of Alaska. The Tok Community Umbrella Corp., through Governor Palin's Administration and the Alaska Legislature, obtained a 500 thousand dollar grant in 2008 for a Rotochopper horizontal grinder and other heavy equipment to process the trees into burnable woodchips. Most recently, the Tok School received 345 thousand dollars from Governor Parnell's Administration and the Alaska Legislature for a reciprocating steam piston engine. The piston will be powered by steam from the boiler to generate electricity to run the boiler and other processing equipment. Additional electricity will be used to help meet the school's needs and work is being done with the local utility company to establish a power purchase agreement.

Left: The building that houses the woodchip-fired boiler and its equipment- under construction. *Right:* The completed facility. *Photos: DOF*

Woodchips. *Photos: DOF*

The facility was designed by CTA Architectural and Engineering from Montana, while the general building contractors were from Alaska. The facility contains custom designed conveyance and control systems, supplied by Messersmith Manufacturing, that feed a Hurst, 5 million BTU, high-pressure steam boiler. The system will offset all of the heat and eventually much of the electrical demand for the school.

Now that the Hurst boiler has been lit, it will produce 4.5 million BTUs/hour. It almost completely replaces the two oil-fired boilers; however, the oil-fired boiler system is fully intact and is set to come back online if the woodchip-fired boiler goes offline. The oil-fired boilers may also be required for limited heating on some of the coldest days of the year when temperatures can reach -60 or below. The woodchip-fired boiler will displace 90-95 percent of the oil usage and the money will be used for other purposes within the school district. This year, the school will save approximately 125 thousand dollars in the difference between the fuel oil and woodchips. The biomass transportation and processing also puts money directly into the local economy. Over the thirty year plus life of the system, this adds up to be significant dollars that are saved by the Tok School and kept in the local economy.

Hermanns and the boiler. *Photos: DOF*

The boiler in action! *Photos: DOF*

In a town as small as Tok (population of roughly 1,500), the school is also a community center. The project has created the opportunity to further educate students and community members about Firewise concepts and fire. The school is now a visual example of defensible space. Students are also learning about community/urban forestry concepts, healthy forest management practices, and forest science. They have not only seen trees being taken out of the forest and used for heating, they have also had the opportunity to grow seedlings and plant new trees. “We have made a concerted effort over the past four years to educate kids about the science of forestry- how a forest grows, how fire plays a role in the ecosystem, what we use wood products for. There are a lot of misconceptions, and we live in the midst of one of the largest forests in the world. Fires

Left: A new tree has been added to the school grounds. *Right:* DOF Community Forestry outreach opportunities help kids learn about tree planting, care and science. *Photos: DOF*

threaten our homes regularly," Hermanns said. "Taking kids outside to put their hands in the soil and plant trees helps them to understand the process. Forests grow back, and the kids have a sense of ownership because they planted those trees."

In addition to teaching people about the forest, two US Forest Service Forest forest health grants have been awarded for studies that are ongoing to monitor the effects of Ips perturbatus (ips beetles) and Dendroctonus rufipennis (spruce bark beetles) on thinned plots. There is a lot of variability, but preliminary studies have shown that no major outbreaks have occurred thus far.

Rural subsistence is an important aspect of life in Tok. Habitat enhancement is a component of the planning and has been accounted for through the forest stand conversions. The thick, climax white and black spruce forest now contains the aspen, birch, poplar and willow that moose and grouse prefer. Short biomass rotations are being studied by DOF and UAF, with 15-20 year rotations, and are being considered in regards to maintenance of the fuel breaks. The idea is to try to maintain species that are less inclined to carry fire and instead serve as a buffer between the community and the spruce.

The woodchip-fired boiler is just the beginning of an alternative energy movement in the community. It is a model of how local resources can be utilized, costs can be reduced, and the economy can be supported. It has also paved the way for additional projects to begin. After all, who wouldn't be motivated by saving millions of dollars over the course of the next 30 years, protecting a community and its school children, employing locals in the process, and promoting healthy forest practices and management? The once dangerous liability is now the power of Tok's future.

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