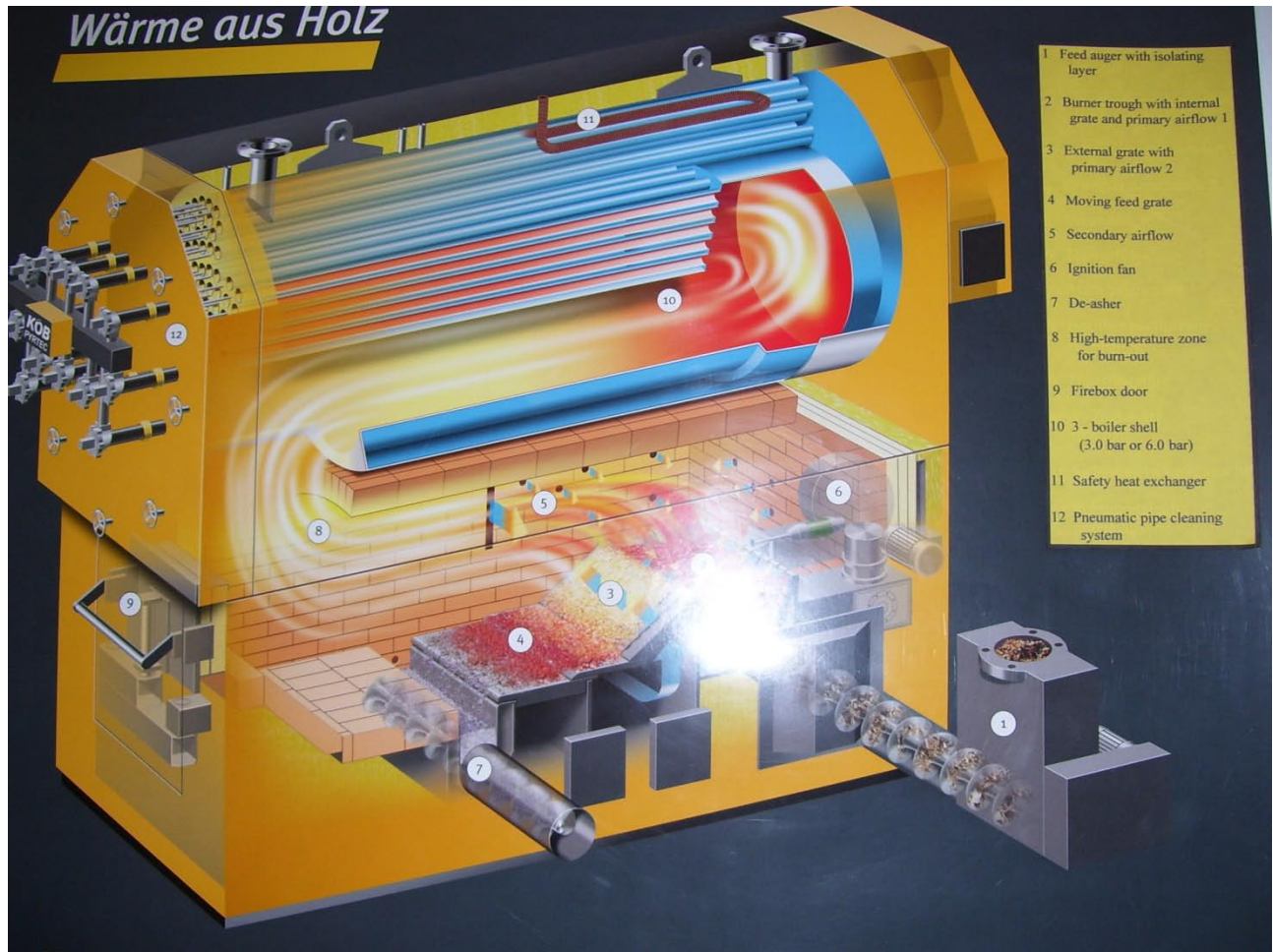


## USING WOOD-CHIP HEATING SYSTEMS IN MISSOURI SCHOOLS

By Peter Maki, Coordinator, Missouri Fuels for Schools Project



(Above: a cut-away showing how a wood-chip fueled boiler operates; photo courtesy KOB)

The Missouri Department of Conservation (MDC), in cooperation with the USDA Forest Service's State & Private Forestry program, recently awarded almost \$6 million in grants to seven public schools for "Fuels for Schools" projects. The grants are being funded through The American Recovery and Reinvestment Act (ARRA).

Grant recipients and amounts are:

Southern Reynolds R-II School District: \$970,000

Perry County 32 School District: \$970,000

Steelville R-III School District (Crawford County): \$900,000

Rolla 31 School District Junior High Building (Phelps County): \$760,000

Gainesville R-V School District (Ozark County): \$970,000

Eminence R-I Elementary (Shannon County): \$350,000

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Mountain View-Birch Tree Liberty High School (Howell County): \$850,000

“Fuels for Schools funds will help these schools and school districts install and operate boiler systems that use woody biomass from local and private forest land to heat and/or cool their facilities,” explained grant administrator John Tuttle, Forestry Field Programs supervisor for the MDC. “This technology should help reduce dependence on fossil fuels, reduce energy costs, create or retain jobs and support healthy forests and the state’s forest industry.”

The Fuels for Schools projects will help create a stronger market for woody material historically considered waste, such as unhealthy or small-diameter trees and wood debris left from logging,” he added. “These forest products currently have little or no commercial value so the Fuels for Schools projects can provide micro-markets for wood chips produced from them.”

Tuttle explained that the projects also will support forest health, a key part of the MDC’s mission, by making it economical to thin overcrowded forest stands and remove diseased and insect-infested trees.

According to the Fuels for Schools and Beyond website ([www.fuelsforschools.info](http://www.fuelsforschools.info)), “In general, fuel cost savings for projects that have replaced natural gas boiler systems have averaged at 25% while facilities replacing fuel oil systems have enjoyed savings of 50-75%.”

What makes this technology so attractive to a school, is the fuel cost savings the school will have in this era of tight budgets. The average fuel savings we calculate for the seven schools is 67%. A school such as Steelville, for example, will see its average fuel cost drop from \$61,953 per year to \$20,599 per year. Since the price of wood chips has been stable, unlike fossil fuel prices, there will be years when calculated savings will be more. Wood chips are our cheapest fuel at \$3.25 per million BTU’s, compared to propane at \$15.00 per million BTU’s, or electric heat at \$25.00 per million BTU’s.

Other benefits of wood-chip heating systems, is that the technology we are using allows for over 80% burn efficiencies. These systems have minimal emissions compared to what the schools presently use. When wood biomass replaces fossil fuels, there is a net reduction in greenhouse gas emissions.

The wood-chip heating system design has been refined over the last 40 years. A wood-chip furnace and chip storage are housed in a small building. The chip storage is designed for 1 ½ trailer loads of chips, so a full load can be delivered without running low on fuel. The chips are drawn from the bottom of the chip storage and fed automatically into the combustor. Most wood-chip furnaces have grates that support the burning fuel and allow for under-fire air to be blown up through holes in the grates. Under-fire dries the fuel, helps the solid fuel on the grates to “gasify”, and aids in burning fixed carbon on the grates. Over-fire air, which is often preheated, is blown in from above the grates to provide oxygen and turbulence, so the wood gases burn completely before passing into the heat exchanger. There are often separate fans for under-fire and over-fire air. The ashes fall below the grates and are removed by automatic ashing augers. School maintenance personnel are trained by equipment manufacturers to operate the systems and average ½ hour per day monitoring a system.

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### DESIGN PARAMETERS FOR THE WOOD-CHIP HEATING SYSTEMS

1. Automatic ash removal,
2. Automatic variable delivery fuel feeding system,
3. Fuel flexibility for materials with moisture contents for fuels ranging from 10% moisture to 50% moisture and fuels ranging from 4,500 Btu per pound to 9,000 Btu per pound (HHV),
4. Variable Frequency Drive forced air fans for under-fire and over-fire air,
5. PLC controls that monitor combustion temperatures and flue gas CO and provide feedback to vary fuel and air delivery to maximize the completeness of combustion,
6. Ability to program and control VFD pumps for delivery of heat to the HVAC systems,
7. Stack Emission controls using industry standard "Best Available Technology,"
8. A hot water combustion unit and boiler ASME rated at 250 degrees F and 30 psig able to operate continuously from 100% of rated capacity to 20% of rated capacity with a pilot mode or automatic restart,
9. Total system remote monitoring capabilities (web based),
10. Usable chip storage to allow delivery of 120 cubic yard walking floor trailer loads,
11. Monitoring and recording of thermal usage,
12. An integrated external hot water thermal storage tank,
13. Insulated hot water piping and distribution system including VFD pumps.

### COMMONLY ASKED QUESTIONS ABOUT BURNING WOOD CHIPS

Q: Doesn't wood burning involve a lot of labor?

A: In an automated wood-chip system, the operator never handles the fuel. The wood chips are loaded into the bin automatically, and the fuel is handled by completely automated equipment in the building.

Q: Isn't wood a dirty fuel that will make a mess at our building?

A: The wood chips are stored in a closed bin and burned in a boiler room, in a sealed combustion chamber. They never get out onto the grounds or into the rest of the building.

Q: Isn't there a danger that a large store of wood chips will catch fire?

A: Green wood chips are close to half water by weight, and it is next to impossible to set them on fire outside the controlled conditions of the combustion chamber.

Q: Will big trucks be coming and going every day?

A: Depending on the season and the size of the building, chip deliveries might be as infrequent as one truckload every two months, or as frequent as two loads per week.

Q: Is a wood-chip system noisy?

A: The building occupants usually never hear the wood-chip system unless they go into the boiler room.

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Q: Why should we experiment with an unfamiliar technology?

A: Burning wood chips and other forms of biomass for heat has been common in the wood products industry for decades. In the last 25 years, wood-chip systems have been successfully installed in hundreds of buildings, including schools, hospitals, government facilities, greenhouses, commercial buildings, hotels, and motels. The technology is well-proven, and there are a number of manufacturers with successful track records.

Q: Won't the system make our building look like a saw mill or a factory?

A: With careful attention to design, the wood-chip system will blend in with the building. The casual observer won't know it is there.

Q: Will the wood smoke be an air quality problem?

A: Automated, commercial-sized wood-chip systems burn much cleaner than the most modern home wood or pellet stove. They produce no creosote and practically no visual smoke or odor. In most cases, institutional wood-chip systems easily meet state air quality standards.

Q: Will the system produce airborne wood ash that will fall over the neighborhood?

A: No. This has not been reported as a problem in the neighborhoods of institutional and commercial wood-chip burners.

Q: Are the wood ashes toxic? Where and how are they disposed?

A: Wood ash from institutional and commercial heating plants is not toxic. In fact, it is an excellent soil additive for agriculture use. It can safely be put on gardens or lawns.

Q: Burning wood creates carbon dioxide. Won't that cause global warming?

A: All fuels contain carbon and create carbon dioxide when they are burned. Unlike the burning of fossil fuels, when wood is burned CO<sub>2</sub> in the exhaust is off-set by CO<sub>2</sub> absorbed from the atmosphere by living trees. As long as sustainable forestry practices are used when harvesting the trees, there is no long-term increase of carbon dioxide in the atmosphere from burning wood. If a gas or oil heating system is converted to wood, net CO<sub>2</sub> emissions are reduced by 75-90 percent, depending upon how much of the fossil fuel is displaced. For this reason heating with wood is a powerful tool for a community interested in meaningfully addressing climate change and renewable energy through its energy use.

Q: Will wood smoke cause acid rain?

A: The major sources of acid rain are sulfur dioxide and nitrogen compounds in combustion reactions (known as SO<sub>x</sub> and NO<sub>x</sub>). Unlike fossil fuels, wood has practically no sulfur and so produces virtually no SO<sub>x</sub> when it burns. Wood combustion does create NO<sub>x</sub>, but at levels comparable to fossil fuel combustion.

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Q: Aren't oil and natural gas so cheap that it doesn't make sense to burn wood?

A: This is not true for wood chips. Wood chips generally cost less than half as much as natural gas and no. 2 fuel oil. Most dollars spent on oil and gas leave Missouri, while wood dollars stay in the state economy, creating an additional economic benefit.

Q: If everybody starts burning wood chips, won't the price go up sharply?

A: The price of all fuels can be expected to go up over time. However, wood-chip prices are not directly connected to the world energy market. Wood is also a locally produced renewable fuel. For these reasons, it can be expected to increase less in price than other fuels. Wood prices paid by schools have increased gradually at about 1% a year over the last fifteen years.

Q: Is there enough wood to heat this facility in the long term?

A: Missouri has a large excess capacity of biomass available now, with an even larger reserve of unmanaged woodland that could be tapped on a renewable basis for energy production. Forestry officials in Missouri are looking for new markets for low-grade wood wastes from the forest, as a way to remove cull trees and improve forest health. Fossil fuels will eventually run out, but with proper forestry practices, the biomass resource base can be sustained indefinitely.

### CONTACT INFORMATION

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Kane, PA Area Schools wood chip heating system and chip storage building. Water vapor is coming out of the stack as 40% moisture chips are being burned. The garage doors open to receive walking-floor trailer loads of chips.



A traveling power-head pulls chips from the floor of the chip storage room onto the conveyor. Chips are then metered into the combustor. During the coldest part of the winter the system burns 38 tons of chips per week, producing a garbage can of ash per day.

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Wood chip storage room. A 25 ton load of chips can be unloaded in 5 minutes. The school will use 1300 tons of chips during a heating season with a calculated savings of \$50,000 per year, compared to natural gas.



Wood chip boiler at Kane, PA Area Schools. This is a 6.0mmBTU/hr. unit installed in 2009. The inclined auger is the chip feed. In the lower mid-section are two Variable Frequency Drive forced air fan units. The white pipe is part of the piping to deliver hot water to the different school buildings.