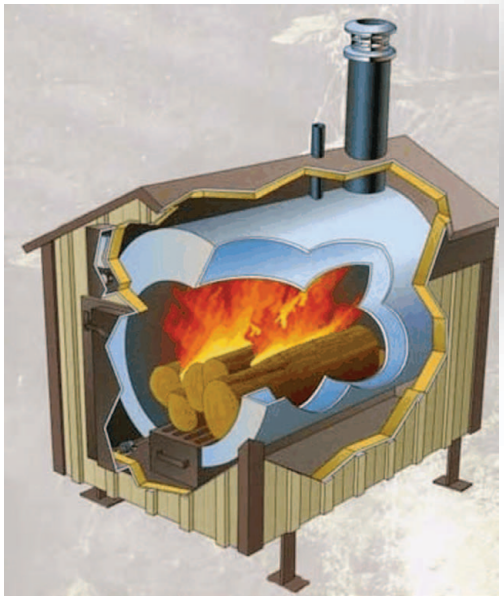
Wood as a Heating Fuel

Air Quality Issues and Options

October 2012



An increase in the use of outdoor wood-fired boilers in Wisconsin is raising concerns about the effect of wood smoke on human health. This fact sheet discusses some of the health and air quality issues raised by wood heating, and suggests steps you can take to minimize the impact of wood smoke in your community.

Wood Burning, Air Quality and Your Health

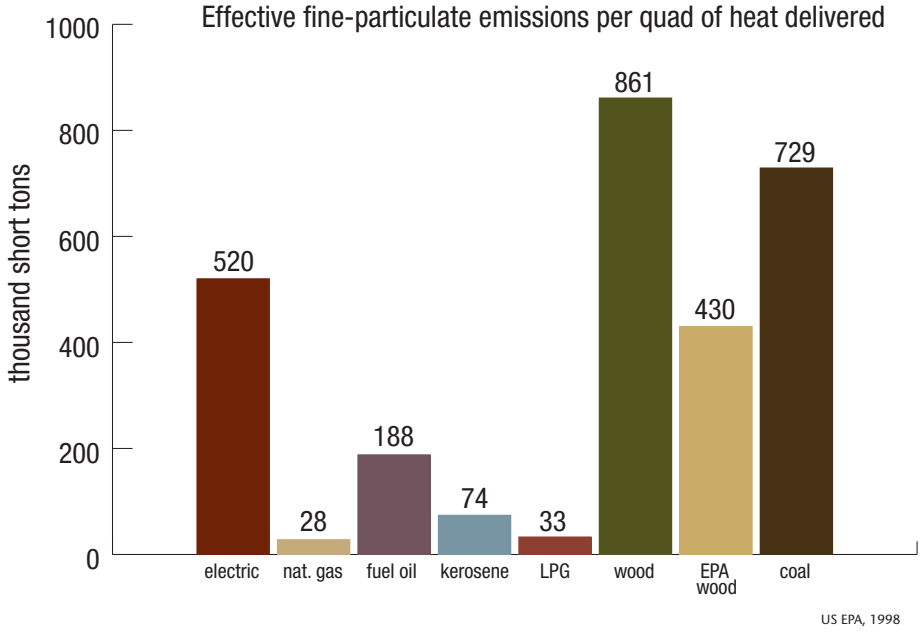
In 2002, the Wisconsin Department of Natural Resources began statewide air monitoring for levels of very fine particulates (PM2.5). Fine particles are produced any time that fuels such as coal, oil, diesel or wood are burned. Fine particles are emitted by power plants, motor vehicles and wood stoves and other combustion sources. High levels of PM2.5 usually result from specific weather conditions, and occur in both summer and winter. Daily air quality in Wisconsin counties can be found on the DNR Air Monitoring Network website:

dnr.wi.gov/topic/airquality/monitor.html

Breathing fine particles can cause a variety of serious health problems. Particles can aggravate heart diseases such as congestive heart failure and coronary artery disease. If a person has heart disease, particles may cause them to experience chest pain, palpitations, shortness of breath and fatigue. Fine particles have also been associated with cardiac arrhythmia and heart attacks. When exposed to fine particles, people with heart or lung diseases and older adults, are more at risk of hospital and emergency room visits. These effects have been associated with short-term exposures lasting 24 hours or less.

Fine particles also aggravate lung diseases such as asthma, emphysema and bronchitis, causing increased use of medication and trips to the doctor. If a person has lung disease, and is exposed to fine particles, they may not be able to breathe as deeply or vigorously as normal, and can exhibit respiratory symptoms including coughing, phlegm, chest discomfort, wheezing and shortness of breath. Fine particles can also increase a person's susceptibility to respiratory infections.

"Concentrations of certain air pollutants can be five times higher in winter than in summer"



Burn Barrels:
Open burning of woody material (both burn barrels and brush piles) is another source of fine-particle air pollution. When plastics and other non-wood materials are also burned, the amount of hazardous air pollutants can rise dramatically, greatly increasing health risks. In Wisconsin, burning garbage, plastics, treated lumber, rubber or asphalt is illegal.

Wood Heating and Air Pollution

In addition to fine particles, wood burning emits polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, carbon monoxide, volatile organic compounds and metals into the air we breathe. A study of ambient air quality in residential neighborhoods in Grand Rapids, WI found "...that exposure to fine particle pollution can be significant in some residential areas, particularly during the evening and early-morning hours when residents are likely to be at home." and, "....wood smoke was a key factor in the development of elevated fine particle concentrations."

While there are many sources of PM2.5, using wood as a residential heating fuel contributes more to fine particle pollution than any other type of heating fuel. The chart above shows that both older and new EPA-approved wood heaters are major sources of fine particles.

In 1988, USEPA introduced wood heating regulations that require indoor wood stove manufacturers to undertake emissions testing at an EPA-accredited laboratory, to certify that each wood stove model complies with a particle emission limit of 7.5 g/hr for non-catalytic wood stoves and 4.1 g/hr for catalytic wood stoves. However, these standards only apply to newly manufactured indoor wood stoves.

Outdoor Wood-Fired Boilers

An outdoor wood-fired boiler is a natural or forced-draft wood stove surrounded with a water jacket. Typically mounted some distance from the building, it is connected to a home heating or hot water system through underground piping. Heat output can be regulated by combustion air dampers, and the heated water stored in tanks for circulation on-demand.

Outdoor wood-fired boilers are typically hand-loaded with cordwood or split firewood, and allowed to burn around-the-clock. Because these boilers can burn over long periods with reduced draft, or use green or partially dried wood, they can produce 10 times the smoke of other wood burning heat sources (see: NY Attorney General Report). When outdoor wood-fired boilers are used in urban and suburban areas, excessive amounts of smoke and low chimney heights can create serious health concerns for neighbors. Currently, outdoor wood-fired boilers are not required to meet EPA emission standards.

How much wood will you burn?

The perceived economic benefits of outdoor wood-fired boilers for residential heating must be carefully examined. While the operating costs of these appliances can be lower than furnaces using higher-priced fuels (e.g. liquid propane), the high initial purchase price and installation costs can lead to long pay-back periods. Furthermore, the cost of wood as fuel can vary greatly depending on whether it is purchased from a vendor, or cut and dried by the homeowner.

Outdoor wood-fired boiler performance is also variable, and combustion efficiency claims by manufacturers may not be realized by the owner. Boiler design, operating procedures, and fuel moisture and BTU content, all play an important part in extracting the most useable heat from the fuel. These factors are also important for the amount of smoke and other air pollutants that are created when wood is used as a heating fuel.

Controlling Air Pollution From Wood Heating

Controlling air emissions from outdoor wood-fired boilers in order to maintain good air quality is problematic. Each owner-operator will have their own source of fuel and operating procedures. Without industry or federal standards for emissions, each manufacturer's boiler will create different amounts of air pollution.

The Wisconsin Department of Natural Resources does regulate air emissions from business and industry, but has limited jurisdiction over residential wood burning. Presently, there are prohibitions against burning recyclable materials (such as plastics and paper), and permit requirements for open burning of brush or other woody material. However, Wisconsin communities (towns, villages, cities and counties) are able to enact ordinances that control outdoor burning and outdoor wood-fired boilers.

Local ordinances have been enacted around Wisconsin to prevent the spread of fires, control nuisance smoke and prevent air pollution. Some of their provisions include:

- General prohibitions on open burning;
- Restrictions on the conditions when burning can take place (e.g. only when snow is on the ground, or not during an air pollution alert);
- Prohibitions against outdoor wood-fired furnaces and boilers within municipal boundaries;
- Specified setbacks, minimum lot sizes and stack heights for outdoor wood-fired boilers.

While these guidelines may help meet safety concerns, and serve to reduce neighbor conflict over wood smoke, the health impact of wood smoke plumes from nearby OWBs and other sources will continue as long as unregulated heating appliances are in use. Wood smoke degrades the air quality in our communities, effects our health and reduces the quality of life of too many Wisconsin citizens.

"Each owner-operator will have their own source of fuel and operating procedures"

Estimating Fuel Costs:
If 100 million BTUs is the amount of energy needed to heat a moderately sized insulated house in southern Wisconsin using a modern, efficient wood-heating appliance during a typical winter, about 4 full cords (128 cubic feet) of well-dried oak firewood will be consumed as fuel. When figuring wood fuel costs, be aware that fuel consumption can vary dramatically with wood species and moisture content.

Additional Information and Resources

USEPA

www.epa.gov/burnwise

Grand Rapids, WI wood smoke study

http://www.ladco.org/reports/pm25/wood_smoke/grand_rapids_wood_smoke_case_study_final_report_8_31_2012.pdf

New York State Attorney General Report (pdf)

Smoke Gets in Your Lungs: Outdoor Wood Boilers in New York State, October 2005

www.ag.ny.gov/environmental/reports

WI-DNR

dnr.wi.gov/topic/openburning/boilers.html

dnr.wi.gov/files/pdf/pubs/am/am356.pdf

WI-Dept. of Health and Family Services

dhfs.wisconsin.gov/eh/HlthHaz/fs/WoodBrn.htm

dhfs.wisconsin.gov/eh/HlthHaz/fs/waterstoves.htm

UW-Extension (pdf files)

www3.uwm.edu/Dept/shwec/publications/cabinet/p2/Woodburning2012.pdf

www3.uwm.edu/Dept/shwec/publications/cabinet/pdf/burnbarrel.pdf

UW Extension

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Photos courtesy of New York State Department of Law, Office of the Attorney General