

Assessment of Outdoor Wood-fired Boilers

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Executive Summary

This report was undertaken by NESCAUM (Northeast States for Coordinated Air Use Management) to provide policymakers with an assessment of concerns relating to the growing use of outdoor wood-fired boilers (OWB), also known as outdoor wood-fired hydronic heaters or outdoor wood-fired furnaces. The increased use of OWBs in populated areas represents a potential public health problem in the Northeast because of the severity of health effects associated with residential wood smoke inhalation.

This report 1) overviews unique features of OWB appliances, 2) estimates OWB appliance sales trends, 3) assesses emission considerations and potential health concerns of residential wood smoke, 4) presents results of OWB ambient monitoring and stack testing conducted by NESCAUM, and 5) provides recommendations for regulatory action.

Findings from this study show that:

- OWBs, generally, do not use catalytic or non-catalytic emission control devices that other residential, wood-fired combustion devices, such as indoor wood stoves, commonly employ.
- OWB use has become more prevalent, commonly replacing indoor wood stoves, and continued increases in sales are likely.
- OWBs emit significantly more particulate matter than other residential wood burning devices and short term particulate matter spikes can be extremely high.
- OWBs could contribute almost 900,000 tons of particulate matter by 2010.
- Local populations are likely subject to elevated ambient particulate matter levels from OWB smoke.
- Current regulations do not provide surrounding areas with adequate protection from the use of OWBs in residential applications.
- There is a lack of information relating to air toxic emissions, such as polycyclic aromatic hydrocarbons (PAHs), polycyclic organic matter (POM) and dioxin.

OWBs present unique issues, unlike other residential wood burning devices, based on the following factors:

- **Year Round Operation** – OWBs are designed to provide heat and hot water year round. Owners often use them in the warmer months not only for domestic hot water but also to heat their swimming pools and/or spas.
- **Cyclic Operation** - The cyclic nature of OWB operations, unlike EPA certified wood stoves, does not allow for complete combustion and creates an environment conducive to increased toxic and particulate emissions.

- **Short Stack Heights** – Stacks from OWBs, as per manufacturer's installation instructions, are usually less than 12 feet from the ground, resulting in poor dispersion of smoke and are more likely to cause fumigation within surrounding areas.
- **Oversized Firebox** – An OWB's large firebox is built such that a user could burn a variety of inappropriate materials that could not be burned in wood stoves or fireplaces. Enforcement programs have discovered OWBs burning tires, large bags of refuse, and railroad ties. Even when used properly, overall OWBs emissions are greater than other residential wood burning devices.

With funding from the Massachusetts Executive Office of Environmental Affairs (EOEA), NESCAUM measured emissions from an OWB unit in the field under real world conditions. The test data indicate that the smallest OWB is likely to have an average in-use emission rate of approximately 161 grams of fine particulate matter per hour, which is twenty times higher than the average in-use emissions of an EPA certified wood stove. This report utilizes a gram per hour measurement in order to understand the potential ambient impacts and to make comparisons to other residential furnaces and heating units such as oil-fired furnaces, natural gas furnaces, and residential wood stoves. Furthermore, NESCAUM believes that given the health impacts associated with wood smoke and their use in residential locations (near at-risk populations such as children and the elderly), it is critical to assess particulate emissions from OWBs on a mass per unit time basis to fully understand potential health risks and appropriate protections.

Based on the test results in this report, the average fine particulate emissions from one OWB are equivalent to the emissions from 22 EPA certified wood stoves, 205 oil furnaces, or as many as 8,000 natural gas furnaces. To put these emissions into perspective, one OWB can emit as much fine particulate matter as four heavy duty diesel trucks on a grams per hour basis. Cumulatively, the smallest OWB has the potential to emit almost one and one-half tons of particulate matter every year. Based on sales estimates, OWBs could emit over 233,000 tons of fine particulate matter nationwide in 2005. Considering sales trends, NESCAUM estimates that there could be 500,000 OWBs in place nationwide by 2010. Based on that estimate, emissions from OWBs would reach 873,750 tons of fine particulate matter nationwide per year by 2010.

The cumulative impact of OWBs to ambient air quality is only one part of the problem. Because OWBs are used primarily in residential applications, they have the potential to emit fine particulate matter and air toxics at levels that could create elevated risk to nearby populations. A second pilot study conducted by NESCAUM measured ambient PM_{2.5} within 150 feet of an OWB device. Relative to background levels, the study documented high 15-second average values (>1,000 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)) with spikes greater than 8,000 $\mu\text{g}/\text{m}^3$ throughout the course of normal daily OWB operating modes. These data suggest that buildings located near OWBs can experience high PM_{2.5} levels during typical boiler operating conditions. Health studies have found associations of acute and chronic exposure to wood smoke with adverse health outcomes such as increases in respiratory symptoms, decreases in lung function, visits to emergency departments, and hospitalization.

States have requested several times that the U.S. Environmental Agency (EPA) develop federal regulations for OWBs but EPA has yet to act. Critical to the development of a federal emissions standard is the need to develop a technology forcing standard that would require manufacturers to employ wood combustion controls commonly employed by other residential and industrial wood-fired devices. In addition, the increasing use of OWBs necessitates that action be taken as quickly as possible. Federal action would likely take five to seven years to put protective measures into place.

In the absence of federal action, states will need to act on this emerging issue in a timely manner. Given the significant health effects OWB emissions may pose and the lack of action on the federal level, NESCAUM believes that states should take action immediately to control OWB emissions by establishing technology-forcing standards that will lead manufacturers to develop cleaner burning OWBs.