OUTDOOR WOOD BOILER FACT SHEET

Why the concern about OWBs?
With increases in the cost of oil and natural gas, many people are turning to wood-fired appliances to provide heat and hot water. The recent increase in the use of outdoor wood boilers (OWBs) is of particular concern to public health and environmental agencies because the cumulative stack emissions from these appliances are usually significantly higher than other EPA-certified wood burning appliances and, unlike wood and pellet stoves, are currently unregulated.

In general, OWBs in residential or small commercial situations emit hundreds or even thousands times more fine particulate matter (i.e., pollutants) than produced from the burning of oil or gas. Research has shown that the fine particulates contribute to human health problems including cardiovascular disease, chronic lung conditions, and premature death. The most recent research has demonstrated that the health impacts of fine particulates are worse than previously realized, prompting the U.S. EPA to adopt stricter standards in 2006. Because most existing OWBs employ poor combustion design, they emit more fine particulates per energy produced than newer well-designed indoor woodstove or properly designed wood furnaces that typically emit one to four grams of particulate matter per hour.

Wood smoke also contains organic pollutants associated with the incomplete combustion of the wood. The toxic air pollutants that can result from this include benzene, formaldehyde, dioxin, and polycyclic aromatic hydrocarbons, all of which can cause cancer.

While wood is a renewable resource and can be global warming neutral if harvested in a sustainable manner, these attributes are negated if people use inefficient devices that emit high amounts of particulate matter and air toxics. The technologies to burn wood cleanly are available and in use.[1] The long term effects of large numbers of people using inefficient wood burning technologies, such as unregulated OWBs, will be increased pollution levels, increased health care costs, and unnecessary early deaths.

To put OWB emissions into perspective, NESCAUM estimates[2] that the current generation of OWBs emits at least twenty times more emissions than the current generation of EPA-certified woodstoves, and emits as much particulate matter as 50 to 500 diesel trucks (depending on the truck age and level of control).[3] States are requiring a number of particulate matter sources, such as diesel trucks, to reduce their emissions. States believe that OWBs should also be included because of their size and amount of emissions, as well as to level the playing field with other wood burning devices that are already subject to emission limits.

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[1] Based upon discussions with combustion experts, NESCAUM believes that OWBs have a great deal of flexibility and capability to use a variety of emission reduction techniques, in addition to those employed by indoor woodstoves.

[2] Estimates are based on an OWB field test. This test generated an emission rate of 161 grams per hour for a 250,000 Btu unit with approximately a 50 percent fuel charge.

[3] NESCAUM estimates that model year 2001 trucks emit 3 g/hr when idling, and that current diesel engines equipped with diesel particulate filters emit 0.3 g/hr when idling.

What are OWBs?
OWBs are known by various names: outdoor wood furnaces, outdoor wood-fired hydronic heaters, or waterstoves. They are often used to heat homes and buildings, provide domestic hot water, heat swimming pools and hot tubs, and heat agricultural operations, such as greenhouses and dairies.

- *What do they look like?* Most look like small freestanding metal tool sheds with stacks, but some are rectangular boxes or are cylindrical in shape.
- *How do they work?* Surrounding the firebox is a water jacket that can be heated. The OWB cycles water through the jacket to deliver hot water to a home, building, or other use. Water pipes run underground to deliver the hot water. OWBs have a cyclical operating pattern to control the fire and, in turn, the water jacket temperature. When the water temperature in the water jacket reaches the desired temperature, an air damper closes off air to the unit until the temperature drops and the air damper opens, creating an on/off cycle. When the damper is closed, the fire smolders and cools until the temperature of the water drops to a lower set point and the damper opens. These on/off cycles may go on for eight to 24 hours or more between fuel loadings, depending on the demand for heat.
- *What size building do they heat?* OWBs heat buildings ranging in size from 1,800 square feet to 20,000 square feet.
- *How big are they?* OWBs vary in size ranging from 115,000 Btu/hr up to 3.2 million Btu/hr, although residential OWBs tend to be less than 1 million Btu/hr. Typically, the dimensions of an OWB are three to five feet wide, six to nine feet deep, and six to 12 feet tall, including the height of the chimney.
- *How big is the firebox?* Firebox sizes will vary with each unit but tend to range in size from 20 cubic feet up to 150 cubic feet.

Issues unique to OWBs
OWBs have been a controversial form of wood heating in the northeastern and mid-western US and Canada for several years. The controversy is caused largely by the smoke and health impacts that the emissions from OWBs have on neighbors, but there has also been concern about the use of the units to illegally burn materials other than natural wood. Specifically, concerns unique to OWBs include:

- **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 swimming pools and spas.
- **Smoke –** Three design parameters in OWBs – 1) a water jacket surrounding the firebox, 2) large fireboxes, and 3) cyclic operation – create a unit that even when operated properly emits large amounts of smoke. These design parameters, unlike EPA-certified woodstoves, create an environment conducive to increased toxic and particulate emissions. In some cases, neighbors' indoor smoke and carbon monoxide alarms have been activated by the smoke from OWBs.

- **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 very smoky conditions within surrounding areas. Increasing the stack height may help with dispersing the smoke but will not decrease the overall impact of OWB emissions.
- **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.

What are the policy options available to state and local government to address new OWB units?

- *Do nothing* **–** Delay will result in additional uncontrolled units being put in place. These units have an estimated lifespan of twenty years so the uncontrolled units installed now will be in place for a long time, contributing particulate matter and other air toxics to the airshed and reducing air quality locally and regionally. In addition, some units may cause serious local nuisance conditions.

- *Zoning requirements* **–** This strategy would establish property line setbacks for OWBs to protect neighboring properties from nuisance smoke and odors. Preliminary modeling indicates that setbacks should be at least 500 feet away from neighbors, if the area does not have elevated particulate matter levels and the stack height is raised above the roofline of nearby buildings. In valley conditions, areas prone to thermal inversions or low wind speeds, these setbacks still may not be adequate to protect neighbors. Experience has shown that zoning requirements do not eliminate the problem and can be difficult to enforce. If jurisdictions adopt setback and stack height limits, efforts should be made to incorporate them into the building code.

- *Emission standards* **–** This strategy would require the development of an emission limit for OWBs and prohibit the sale or installation of any unit that did not meet the standard. There are three potential approaches to creating a standard for OWBs:

    - a simple particulate matter (PM) mass emission rate limit (grams/hour) regardless of an OWB's rated output or actual thermal output;
    - an emission rate limit that is tied to an OWB's rated output or actual average thermal output (pounds of PM/Btu or mg PM/megajoule); and
    - a limit on the concentration of the PM in an OWB's the stack (grams/cubic meter or grains/cubic foot of exhaust gas).

  Although all three of these approaches could reduce particulate emissions from OWBs, only the first approach (grams/hour) specifically addresses both the regional and local aspect of OWB smoke.

- *Bans* – This strategy would ban entirely the sales of all OWBs. Currently, only a limited of number of units have been tested that emit particulate matter at lower levels than the

units commonly sold on the market today. This strategy would reduce emissions from the older, dirtier OWBs and significantly reduce particulate emissions from these devices.

EPA's Voluntary Program

EPA has developed a voluntary program that encourages manufacturers of outdoor wood-fired heaters to make cleaner models available to consumers beginning in the spring of 2007. Under this agreement, the new models must emit no more than 0.6 pounds of particulate matter per million BTUs of heat input (i.e., wood burned). The models must be tested by an accredited third-party laboratory to verify that they meet these levels. The agreement requires participating manufacturers to make at least one model that meets the emission criteria. Initial estimates indicate that residential OWBs in this program could meet the emissions criteria with an overall emission rate of 95 grams per hour, more than twelve times higher than the emissions rate allowed for indoor wood stoves.

Model Rule

For agencies that wish only to allow the sale of cleaner units in their jurisdictions, NESCAUM, in conjunction with EPA and member states, developed a model rule to promote common standards across the states with additional provisions that can be tailored to address specific local situations. The model rule establishes emission limits and labeling requirements for new units and contains the following components for both new and existing outdoor wood-fired heaters. Specifically, the model rule:

- Recommends a Phase I emission limit of 0.44 lb/mmBtu (heat input) effective 3/31/2008.
- Recommends a Phase II emission limit of 0.32 lb/mmBtu (heat output) with no test run to exceed 18 g/hr for residential units and 20 g/hr for commercial units effective 3/31/2010.
- Recommends setback requirements 500 feet from property lines and requries stack heights five feet over the roofline of nearby structures and residences for units that do not meet the Phase II emission limit.
- Recommends distributor and buyer notification requirements.
- Recommends common requirements for unit testing, certification, and labeling.

What are the options for existing OWBs?

- *Limits on use* – The strategy restricts or limits the use of existing OWBs to certain periods of time, such as limiting use to the heating season only and/or limiting use based upon air quality conditions, such as when high ambient particulate pollution levels are likely to occur. This strategy would address high emission events but would not address the day-to-day contribution of pollution from OWBs to the ambient air or where an OWB causes nuisance conditions for neighbors.

- *Zoning requirement* – This strategy would require that existing OWBs meet a setback requirement. If the OWB cannot meet the requirement, removal of the unit would be required. The same factors regarding stack height and enforcement as described above for new OWBs apply to this approach.

- *Stack height requirements* – While increasing stack heights would not reduce the total amount of pollution emitted from an OWB, it may assist in dispersing smoke.

However, no testing has been done to determine how raising the stack height will affect stack emissions. Discussions with combustion experts indicate that a height change will likely affect air flow rates, which could increase overall emissions from the OWB. In addition, this strategy would not address broader regional pollution caused by OWBs.

- *Ban on use of polluting units* – This strategy would ban the use all OWBs that do not meet an emission requirement by a certain date.
- *Change-out upon transfer of property* – Another strategy would require a certification prior to the completion of a sale or transfer of any real property on or after a certain date that states all wood burning appliances not meeting an applicable emission requirement have been replaced, removed, or rendered permanently inoperable.