# ADVANCED WOOD HEAT DEMYSTIFIED

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# Overview

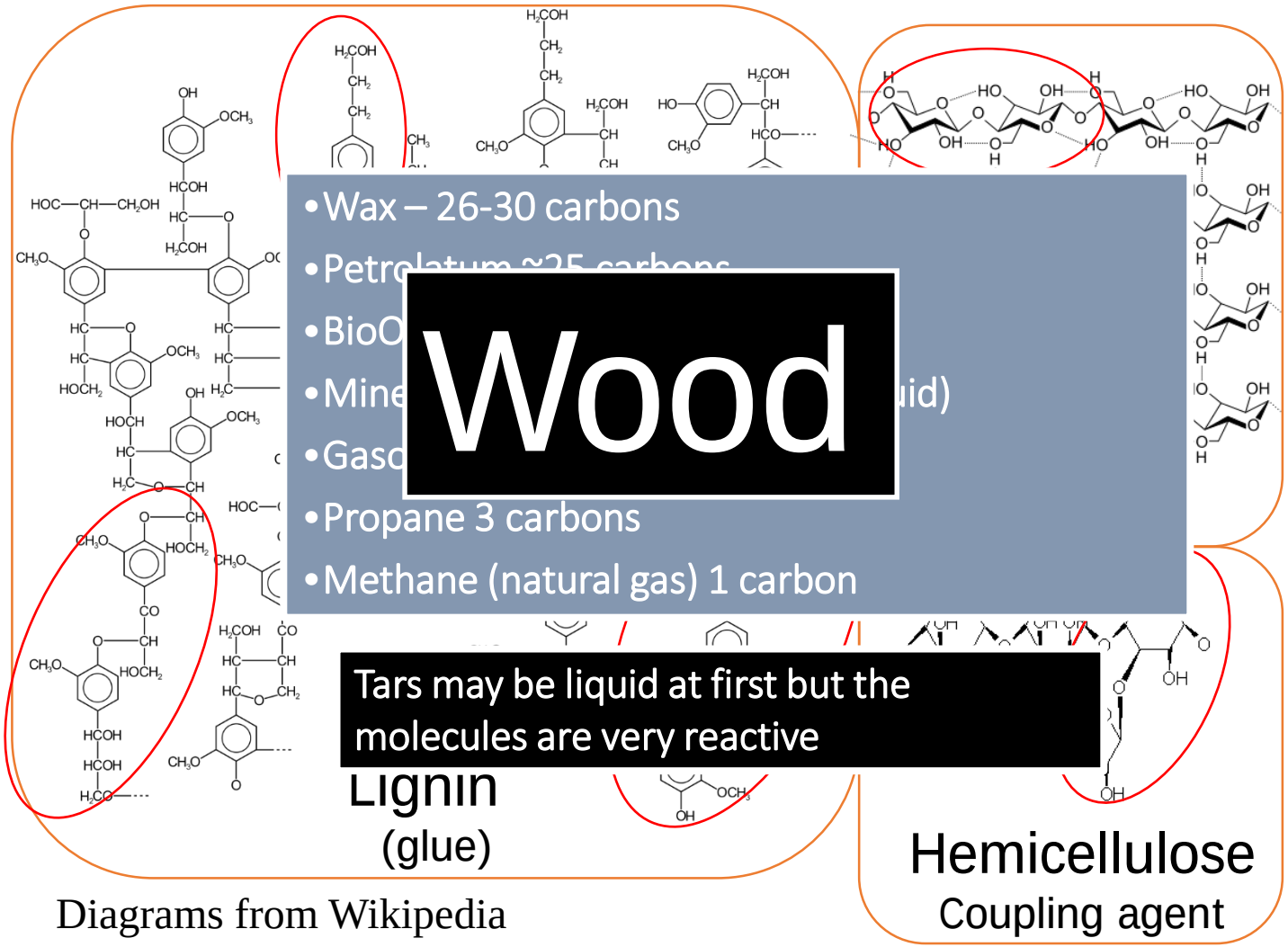
- Emissions
- Types or Burners
- Best Practices

# What are Particulates?

Tars, seen as creosote condensing on cool surfaces

What are Tars?

1st What is wood?




Diagrams from Wikipedia

# What are Particulates?

Tars, seen as creos

What are Tars?

You can't get tars from because the molecules are too sm u can get….

Soot, a mass of impure carbon particles resulting from incomplete combustion of gas phase products

# Particulates

Until 2020 stoves are limited to 4.5 g/hr

These two rules are equal at 31,000 btu

Until 2020 hydronic (Boilers) are limited to 0.32 lb/mmbtu

Then in 2020 stoves are limited to
2.5 g/hr for cordwood and
2.0 g/hr for crib or pellets

These two rules are equal at 36,743 btu

In 2020 hydronic (Boilers) are limited to
0.15 lb/mmbtu for cordwood and
0.1 lb/mmbtu for crib or pellets

These two rules are equal at 44,092 btu

Hydronic (Boilers) limits are increasing faster than stoves

# What's the next bad thing to have restrictions, but only requires monitoring now?

Exposure limits OSHA

50 ppm, 8 hrs

200 ppm, 15 minutes

Half life in fresh air - 5 hrs

CO

In stove exhaust

4,000 ppm CO

is not uncommon

Less than 10 ppm,

Is possible

400 ppm. Life threatening after 3 hours.

Not only poison, it’s wasted fuel!

# Cordwood Stove

Simplest to operate

Higher heating value (HHV)
efficiencies tend to range between 65% and 75%

Cost between $1,000 and $3,000

Courtesy Alliance for Green Heat

# Catalytic Cordwood Stove

More things to do (mostly just at startup)

They tend to be between 75%- 83% efficient (HHV)

Cost between $2,000 to $3,500

Can be fragile

Courtesy Alliance for Green Heat

# Pellet Stove

This one has 50 pound hopper capacity

Can be

3-1 turn down capability,

Thermostatically controlled, even auto light

Since pellets are dry it's much easier to burn cleanly (they fall apart if wet)

Since only a few are burning at any one time shutting down is relatively quick

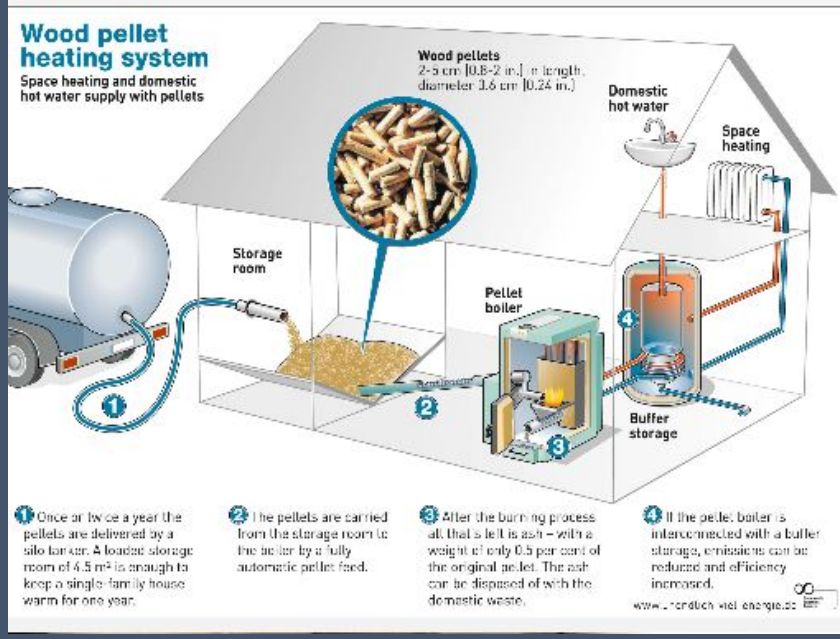
# Furnaces

Cordwood
&
Pellet

Indoor

A Range of Efficiencies

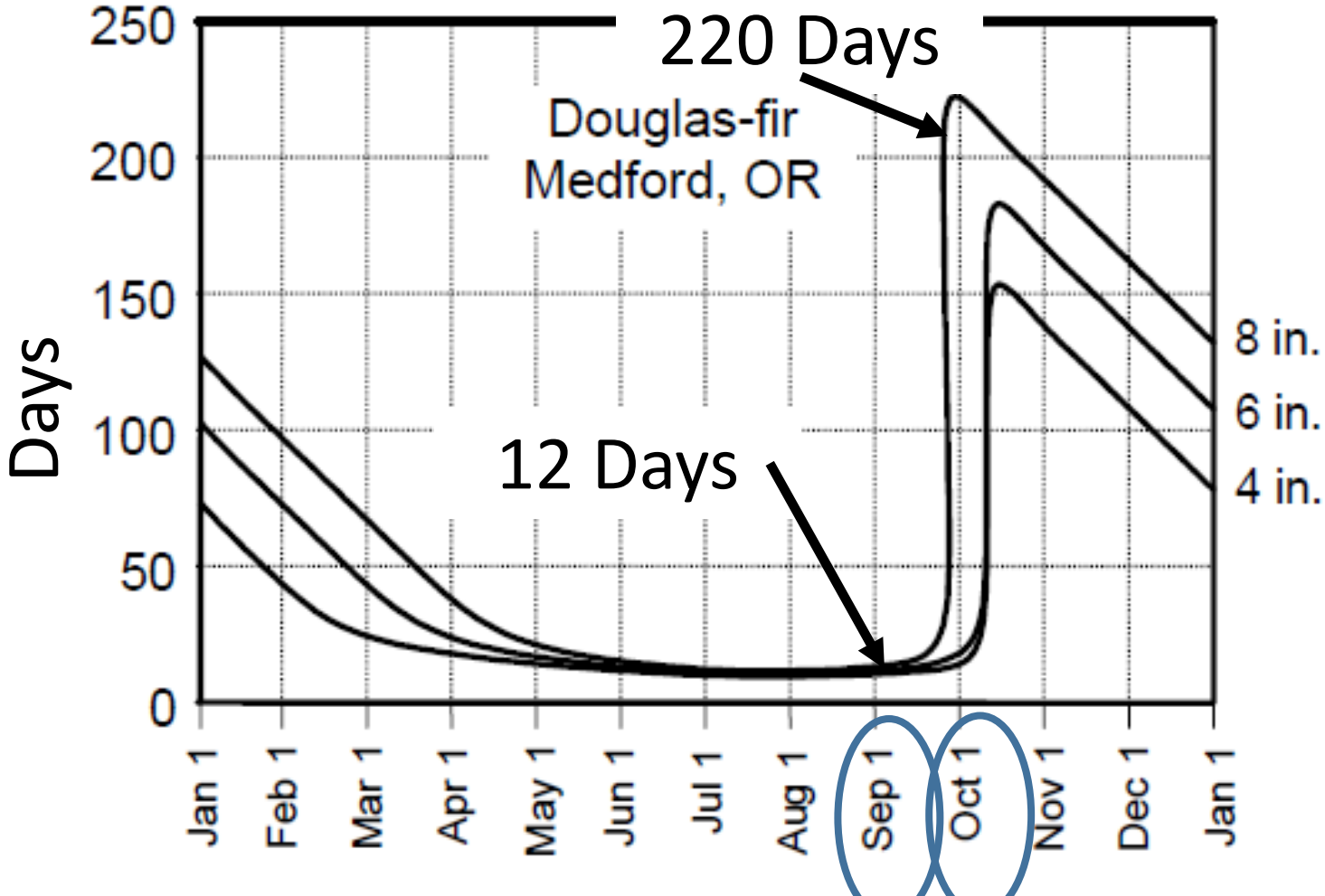
And they get big




Courtesy Alliance for Green Heat

# Best Practice

## 1) Use dry wood !



# Best Practice

2) Put kindling on top

3) Adjust air for complete combustion (next slide)

# Best Practice

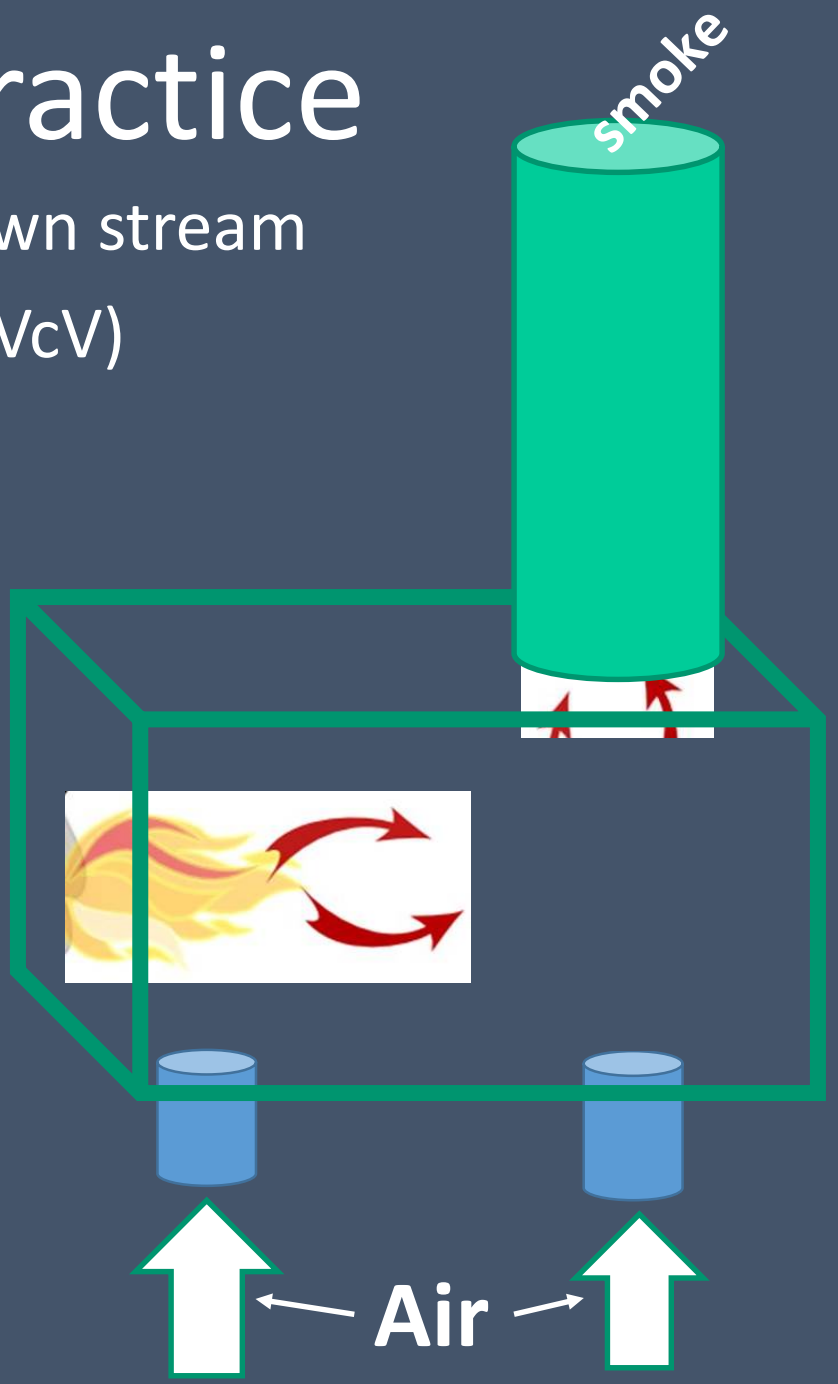
If it's smoking you need air down stream

The Venturi-Controlled Valve (VcV)
thevcv.com

Automatically adjusts air

Two valves $50

**CONTACT US:**
info@thevcv.com
PO Box 58 442
Botany
Auckland 2163
New Zealand



# Thermal storage – nothing better than water

5X better than sand per lb.;  3X better by gallon

It flows

Typically 1 to 6 gallons/kBTUh

Reduces cycling on and off, responds to variable load.

Reports that larger tanks will not improve performance but….

Design flaw if true - recharging the tank is a priority even when the system is calling for heat.

# All burning devices will be getting much better

## The future is warm

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About half of the weight of wood is carbon. No matter how a tree dies, that carbon goes someplace. With regard to atmospheric carbon dioxide, if a tree is turned into lumber it continues to be carbon negative until it burns or it rots. If it is burned for fuel it's a wash, since the carbon came from the air as CO2 and is then returned to it as CO2. If it is left to rot, a small portion of the carbon is converted to methane (CH4) which is a 15-60 times worse greenhouse gas than CO2. So if you cannot store wood out of the weather, or convert it to biochar (both carbon negative at least for a while), burning (especially if done well; i.e., completely) is the best option; this is especially true if the energy is used, so that the amount of fossil fuel consumed is reduced. You can burn trees for fuel for a thousand years, or a million, with no increase in atmospheric CO2. On the other hand, no matter how little fossil fuel you burn, atmospheric CO2 will be increased. It is true that, compared with wood, burning fossil fuel may produce less CO2 for the amount of energy received, but that is irrelevant when looking at the complete carbon life cycle.

**Table 4-1. 2015 and 2020 Standards and Compliance Dates**

| Affected Wood Heater | 2015 / 2016 / 2017 Standards | 2020 Standards |
|---|---|---|
| Adjustable burn rate stoves, single burn rate stoves and pellet stoves (Subpart AAA) | **PM emission limit ≤ 4.5 g/hr** (using crib, pellets or cord wood) On May 15, 2015 *See §60.532(a)* | **PM emission limit ≤ 2.0 g/hr** (using crib wood or pellets) On May 15, 2020 *See §60.532(b);* **Or PM emission limit ≤ 2.5 g/hr** (using cord wood) On May 15, 2020 *See §60.532(c)* |
| Hydronic heaters (Subpart QQQQ) | **PM emission limit ≤ 0.32 lb/mmBtu** heat output (weighted average) and a **cap of 18 g/hr** for each individual burn rate (using crib, pellets or cord wood) On May 15, 2015 *See §60.5474(b)(1)* | **PM emission limit ≤ 0.10 lb/mmBtu** heat output for each individual burn rate (using crib wood or pellets) On May 15, 2020 *See §60.5474(b)(2);* **Or PM emission limit ≤ 0.15 lb/mmBtu** heat output for each individual burn rate (using cord wood) On May 15, 2020 *See §60.5474(b)(3)* |
| Small forced-air furnaces, < 65,000 BTU per hour (Subpart QQQQ) | Work practice and operational standard on May 15, 2015 *See §60.5474(a)(3)* | **PM emission limit ≤ 0.15 lb/mmBtu** heat output (individual burn rate, using cord wood or pellets) On May 15, 2020 *See §60.5474(b)(6)* |
| | **PM emission limit ≤ 0.93 lb/mmBtu** heat output (weighted average, using cord wood or pellets) On May 16, 2016 *See §60.5474(b)(4)* | |
| Large forced-air furnaces, ≥ 65,000 BTU per hour (Subpart QQQQ) | Work practice and operational standard on May 15, 2015 *See §60.5474(a)(3)* | |
| | **PM emission limit ≤ 0.93 lb/mmBtu** heat output (weighted average, using cord wood or pellets) On May 15, 2017 *See §60.5474(b)(5)* | |

Notes page

| | Stove | hydronic | hydronic | stove calc | |
|---|---|---|---|---|---|
| | g/hr | lb/mmbtu | g/mmbtu | btu | fuel |
| 2015 | 4.5 | 0.32 | 145.15 | 31,002 | any |
| 2020 | 2.5 | 0.15 | 68.04 | 36,743 | cordwood |
| 2020 | 2 | 0.1 | 45.36 | 44,092 | crib or pellets |

https://www.epa.gov/sites/production/files/2015-05/documents/2015-small-entity-compliance-guide.pdf
https://www.epa.gov/burnwise
https://www.epa.gov/burnwise/process-developing-improved-cordwood-test-methods-wood-heaters
http://forgreenheat.blogspot.com/2015/03/what-consumers-need-to-know-about-new.html
http://www.forgreenheat.org/policy/epa_policy.html
https://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol6/xml/CFR-2011-title40-vol6-part60.xml

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## EPA REGS., WHAT'S HAPPENING?

May, 2015
**Step 1: Production Stop**
NSPS Becomes Federal Law. Step 1 limit of 0.32 lbm/mmbtu officially implemented in US. Mfr's must stop producing non-compliant equipment.Mfr's can still sell their existing inventory.
Jan., 2016 **Step 1: Sales Stop**
Mfr's CANNOT produce or sell equipment that doesn't comply with Step 1. Mfr's can no longer sell their existing inventory.
May 2020
**Step 2: Limit of 0.10 (crib wood) or 0.15 (cord wood)** lbm/mmbtu is Federal Law. Mfr's CANNOT produce or sell equipment that doesn't comply with Step 2.

**Boilers:** Like stoves, boilers must meet Step 1 emission limits by May 15. Retailers can still sell older, uncertified and unqualified boilers through Dec. 31, 2015. In 2020, they must meet stricter emission limits.

As of 2016, stoves must not emit more than 4.5 grams an hour of particulates and after May 15, 2020, 2 or 2.5 grams an hour.

In 2020, pellet stoves also have to emit no more than 2 grams an hour. Two thirds of pellet stove models already meet the 2020 standard.

**Carbon monoxide (CO):** The new rules do not limit the amount of CO that can be emitted but require that it be tested and reported.

On May 15, 2015 new wood heater regulations become law. As of May 15, 2015 wood and pellet stoves must emit no more than 4.5 grams per hour. Click here for key provisions of the new rules. These regulations underwent a public comment period in the spring of 2014.

## *EFFICIENCY NOTE:

We reduced GARN's efficiency ratings from the previously published values in January 2015 because ASTM reduced the heat content of wood.

| | OLD VALUE | NEW VALUE |
|---|---|---|
| | CHANGE | |
| LHV | 7,478 | 7,988 |
| | 7% | |
| HHV | | |

I need a mc of -6% to get the lhv/hhv ratio; 24.9% for the old values

The EPA ha… efficiency … Phase II qu… equipmen… artificially … comparing to EPA tested equipment add 7% to GARN's efficiency to get a comparable efficiency.