

Small Scale Biomass Heating Systems

Air Emissions In Context

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Smaller scale systems are new to the user to the regulators and we need to work together to share information. We are building a new energy sector and we can move forward in a more productive way if we all work together.


Topics to Cover

- **Air Emissions comparisons**
 - **Particulate Matter**
 - **PM 2.5**
 - **Stack Ht**
 - **Ambient Conditions**
 - **Wildfire vs. prescribed fire vs boiler**
 - **Greenhouse Gases**
- **Operation and Maintenance**



I am going to cover our programmatic approach in addition to information related to specific projects. If the people of Alaska want to move the use of woody biomass along it will take a coordinated concerted effort between multiple partners as well as successful individual projects.

Why "Use It"?

- **Reduce smoke from disposal burning**
 - Human/Enviro Health – SOX, NOX, GHG
 - Airshed Aesthetics – Haze
 - **Reduce GHG emissions**
 - **Reduce smoke from wildfires**
 - Smoke from wildfires doesn't count in regulatory setting
 - **The choice is NOT smoke or no smoke rather we can influence when and where and concentrations**
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It is very important to recognize there are multiple benefits some direct economic benefits and some are "amenity" benefits such as clean air, renewable energy, no GHG, no leaking tanks.

- Creates a use for traditionally non-commercial, small diameter woody debris left over from healthy forest restoration projects.
- Improves the health and vigor of forests, improving the forests' resiliency to insects and disease infestations, and to catastrophic wildfire.
- Providing an efficient and clean-burning, heat producing process.

Emissions are significantly improved over other options of biomass removal – open slash burning, or fueling large scale wildfires.

Improves other public/community values of forests – wildlife habitat, functioning watersheds, aesthetics, and recreational opportunities on forests.

- Creates a consistent, local market for biomass;

Acreage needed to provide chips for each project averages between 30 – 200 acres annually. In 2005-06, the current FFS projects will consume more than 10,000 tons;

As more Fuels for Schools projects are constructed, the number of acres to be treated increases.

#2 The Fuels for Schools program provides a renewable source of energy that reduces heating costs in public facilities.

- This provides benefits for tax payers and public facilities managers, who can realize savings in their heating costs of 30 – 70%.
- Biomass boilers utilize a renewable woody biomass fuel source in place of non-renewable, often foreign, fossil fuels.



White material coming from the stack is primarily condensing water vapor driven off of the wood as it is burned.

The choice isn't smoke or no smoke we have to look at the reality that we have living dynamic ecosystems and they provide the opportunity to sustain our society in the long-run

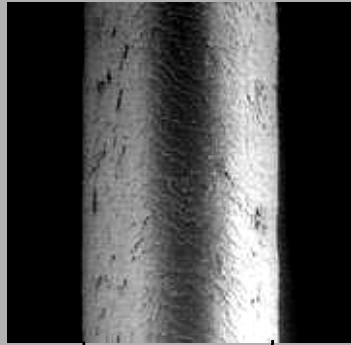
You can chose where you want wood products to burn, in the woods or in your stack. We want to do things in the right way; we don't want to expose kids or the community. The higher the stack the less emissions that fall down.

NAAQS for PM_{2.5}

- **24-hour PM_{2.5} standard = 35 µg/m³**
- **Annual PM_{2.5} standard = 15 µg/m³**
- **Non attainment Area**

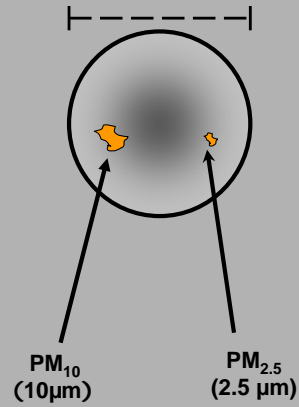
New standards the EPA established pursuant to the Clean Air Act and the states are responsible to implement. Nonattainment areas are designated if they exceed these thresholds.

WHAT IS PARTICULATE MATTER?

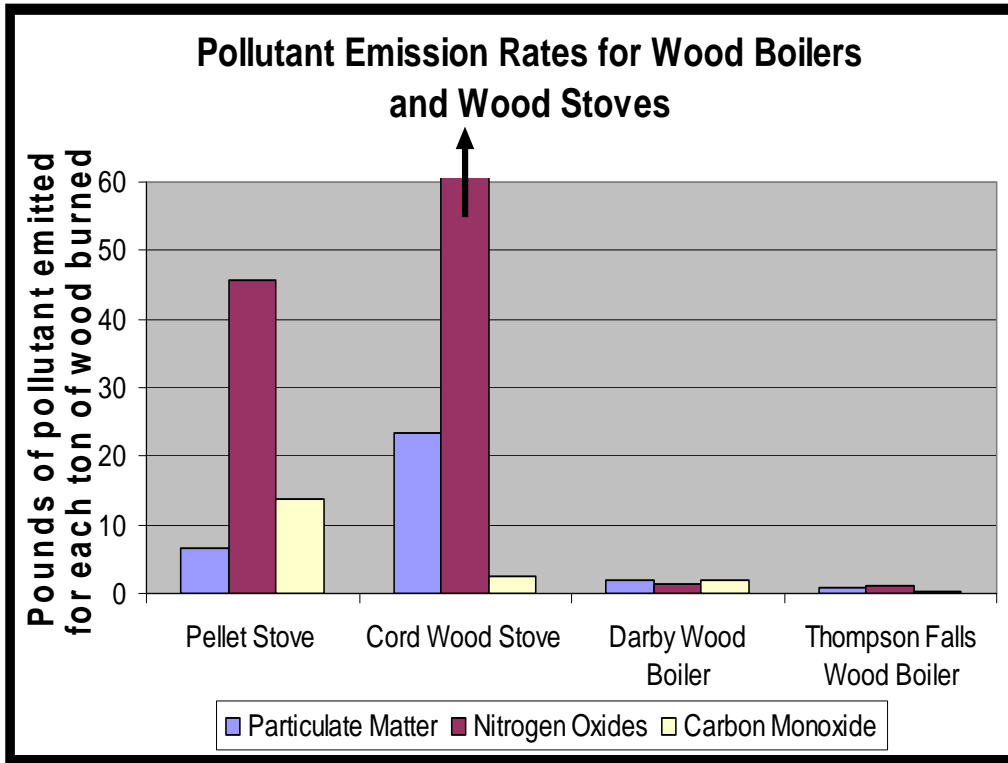


Human Hair (70 μm diameter)

Hair cross section (70 μm)

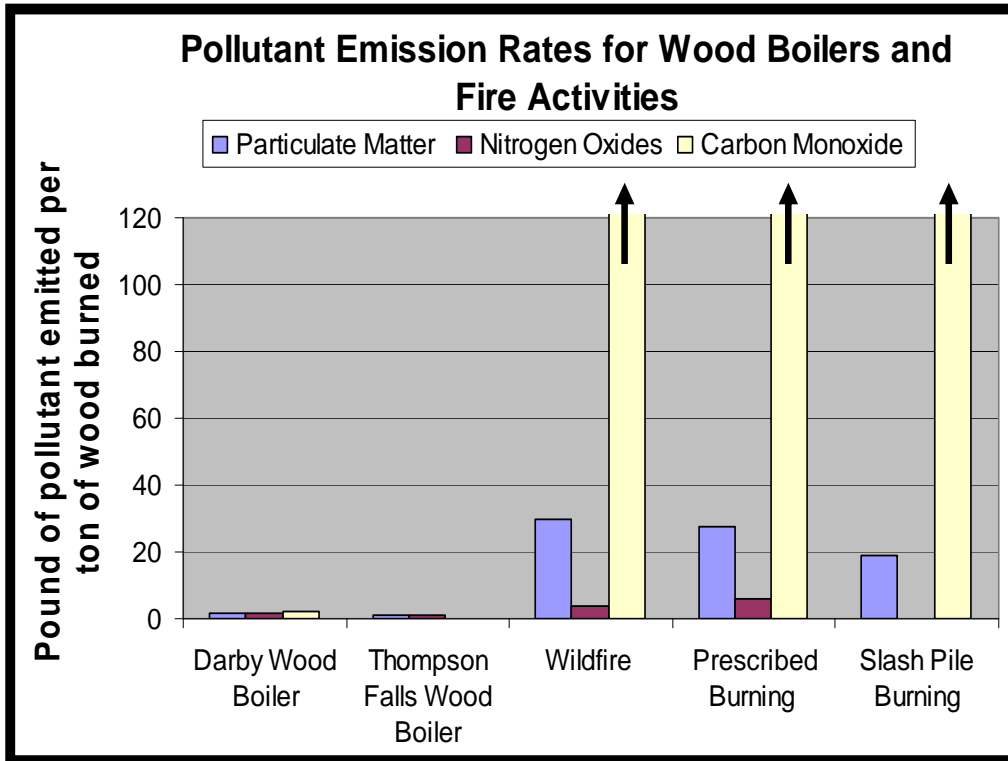


PM_{2.5} behaves more like a gas, it doesn't settle out and therefore the material diffuses throughout the airshed



It is important to understand that these are comparisons of AP42 averages for pellet and cord wood stoves, the new EPA approved stoves are much better and pellet systems continue to improve as well. I think it is important for EPA, the states and vendors to do additional monitoring to update the data base.

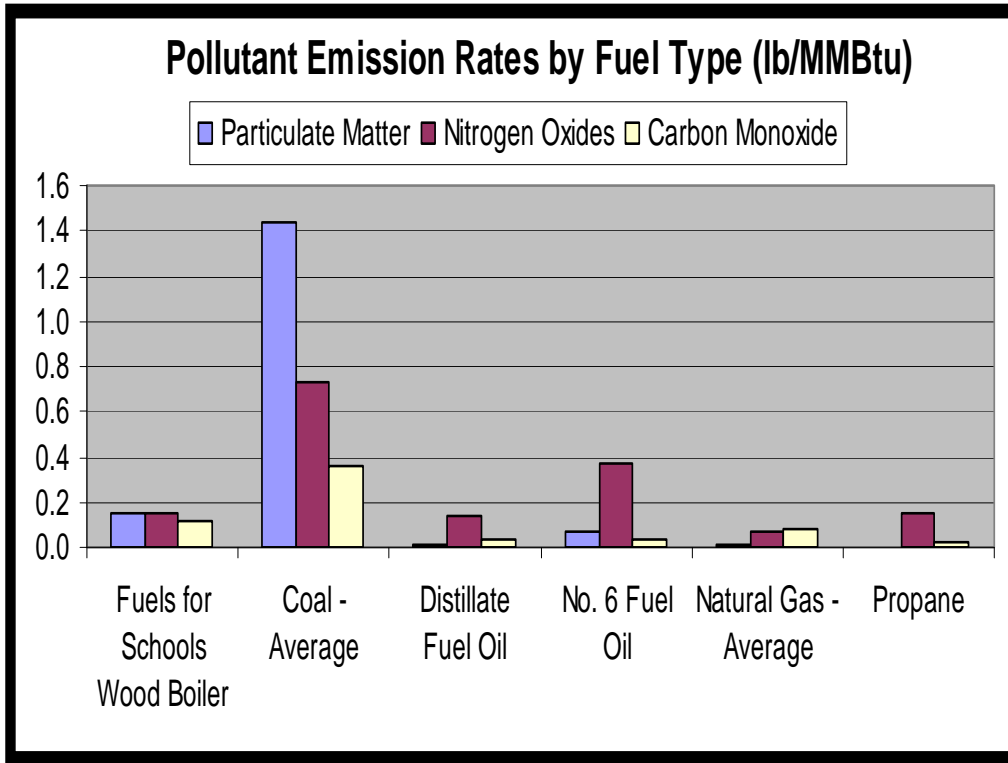
What is AP42? An EPA database of test results from a wide variety of boiler systems



Note the comparison of opening burning whether wildfire or prescribed fire is vastly different that in one of these systems. I continue to gather air quality studies for reference and we will be paying for tests at several more sites this next winter to get the commercial pellets, and different manufacturers data included.

These test results are without any pollution control device at Darby and with a cyclone at T-Falls.

We have 5 more test results that will be available in the coming weeks. Preliminary results indicate similar results from earlier tests. They will get posted on our web site.



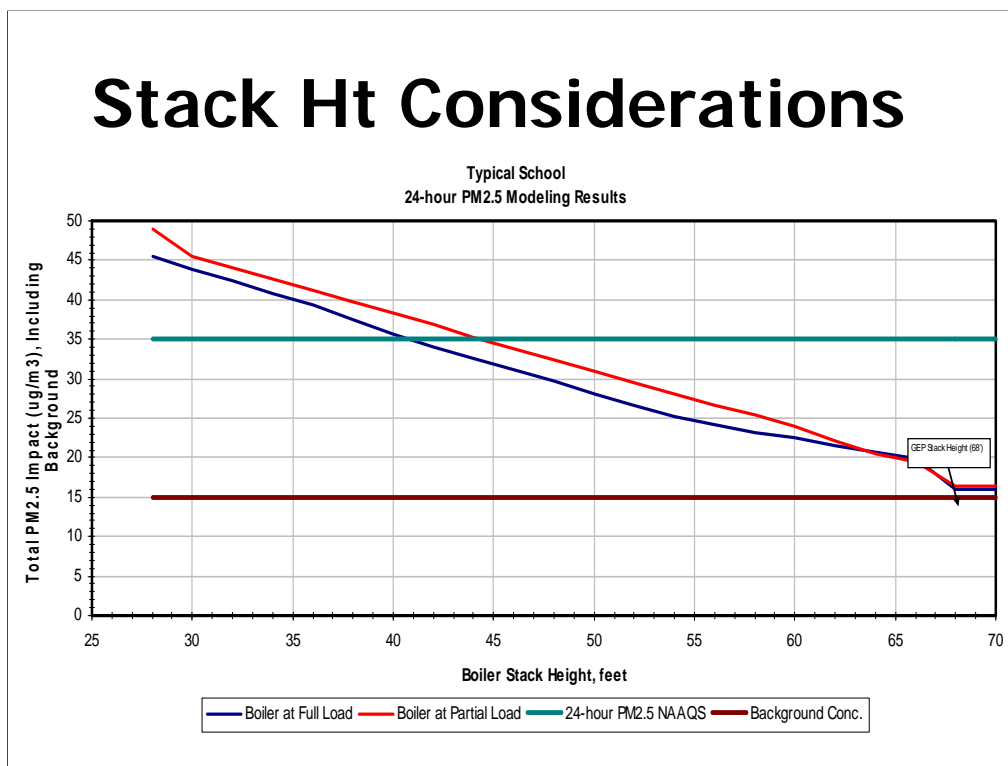
This is PM10 data not 2.5. We have preliminary results on 5 systems with PM 2.5 data and they are consistently less than the AP42. The data will be posted to our web site within a month or so.

What is AP42?

- EPA database of emissions
- Used to do modeling of potential impacts of projects
- Our test results for PM have all been below the average
 - <20% to ? Of the average
 - Why is that important?

The database info is old and doesn't seem to reflect more current manufacturing results from our 6 test results.

Stack Ht Considerations



If these systems are so clean burning why does the stack need to be so tall?

- It is not as clean as nat gas, propane and the local vicinity could be affected if you have the stack too low – remember I said it behaves as a gas and will diffuse throughout the airshed, but
- Downwash - the eddy effect of buildings, topography can cause the air under some atmospheric conditions to carry the emissions down to the ground if the stack is not high enough. I know because we had several of our projects with stack too low and we have had to extend them to avoid the problem. This is something you want to do from the beginning NOT after the fact;
- A good reason to work with your regulators because they can help you avoid these kinds of issues. The MT DEQ enlightened us. Build a positive relationship. Often they may have very little experience with these systems.
- Share information on test results

Some generic modelling by MT DEQ to illustrate the affects of the stack height on the downwash affect of a building in causing the emissions to be higher near the ground.

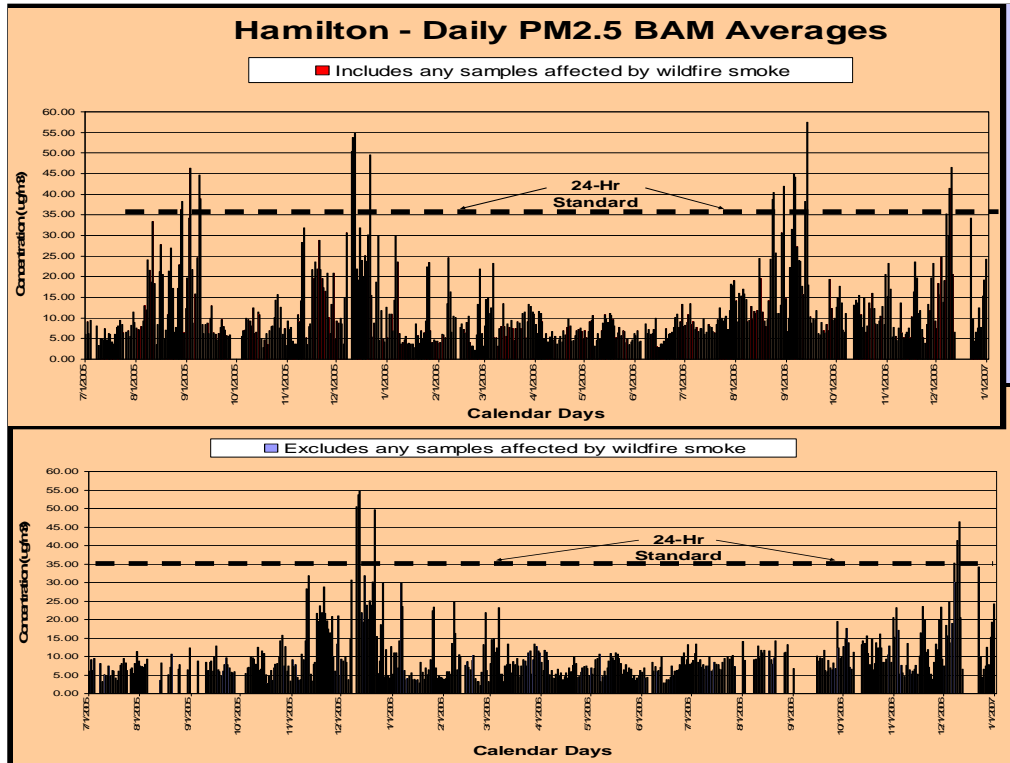
There are several factors that can influence this modelling and therefore you shouldn't take this and figure it will work for your situation.

- Local topography,
- local weather conditions,
- height of surrounding buildings or trees.
- Emissions of the system being installed – this was run with AP42 averages, If emissions are 50% of the average then your starting point of the curve is lower and therefore you will get below the 35 threshold and reach the

Pollution Control Devices

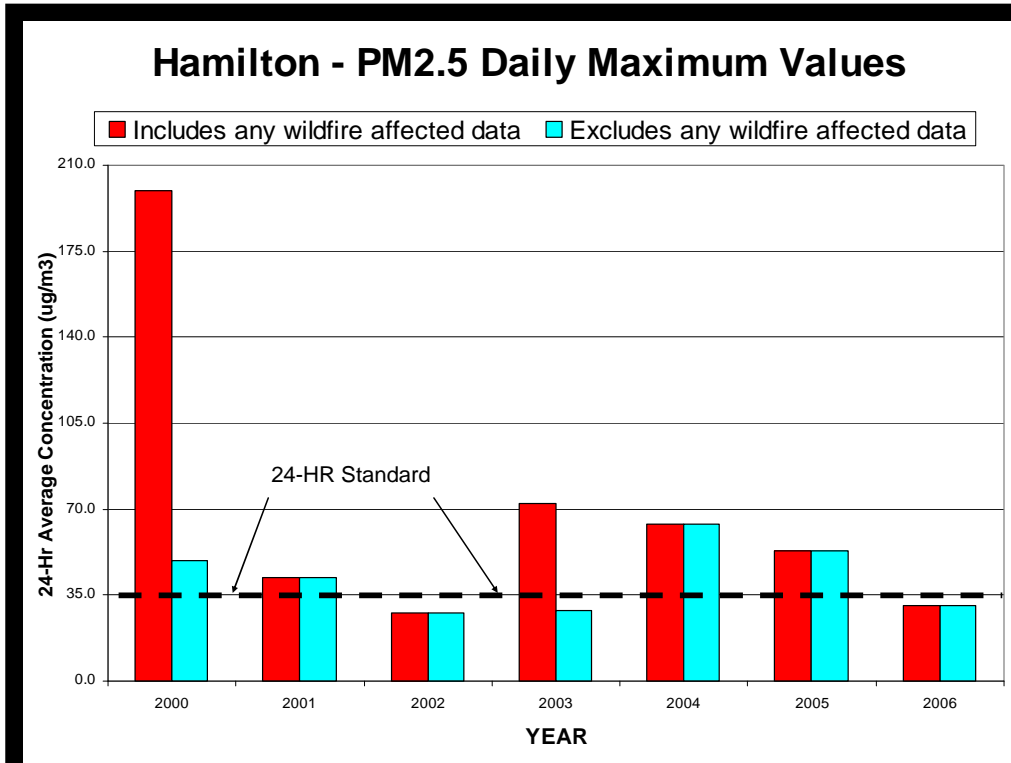
- Cyclones – single, multiclone
 - Minimal effect on PM 2.5
- No real options for small systems
- Large systems
 - Baghouses
 - Electrostatic Precipitators





Note the bimodal affects of fire season and winter heating season. Also note the bump in Nov. 05 fall burning. My suspicion is that some of what you are seeing in Dec with the high PM is a continuation of legal open pile burning with illegal open pile burning. The reason I say that is if you look at Jan and Feb typically as cold as Dec the pile burning was likely substantially completed and therefore reflects that woodstove heating and the interactions of inversions resulting in the pikes from below 10 to the 15-25 range.

Our goal should be to reduce the overall levels regardless of source wildfire vs. prescribed fire and wood stoves.



This is to illustrate the affect wildfires can have on air quality in bad years. For this location 2007 would be similar to 2000.

Libby Swapout Story

- Non-attainment in rural areas
- Wood smoke often the primary culprit
- Old stoves and fireplaces 20-40 times the emissions as new or pellet
- Libby reduced 28% with 1100+ change outs



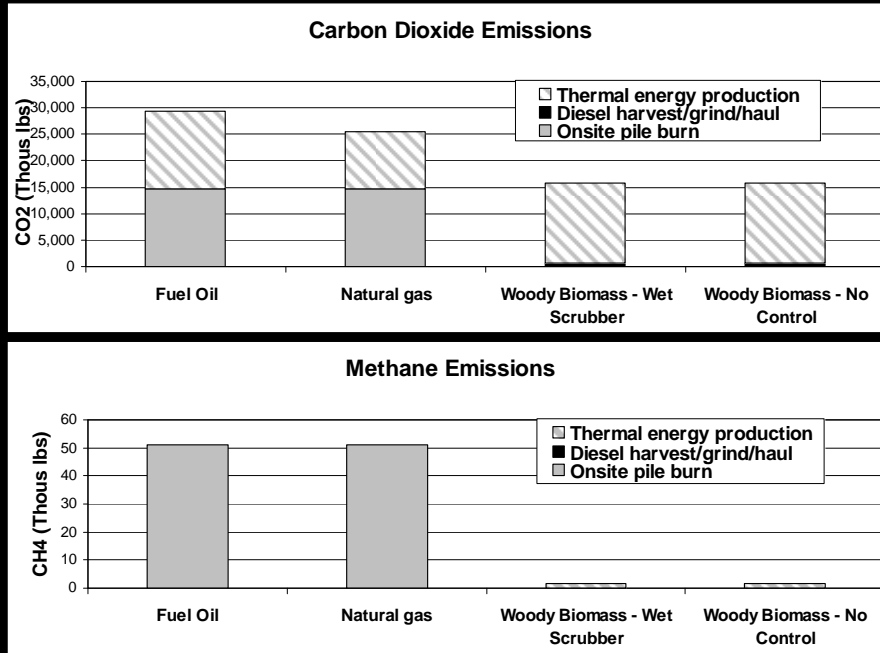
Consider on smaller systems where

OR Tax Credits

- **Help finance conversions**
- **Handout available in back**

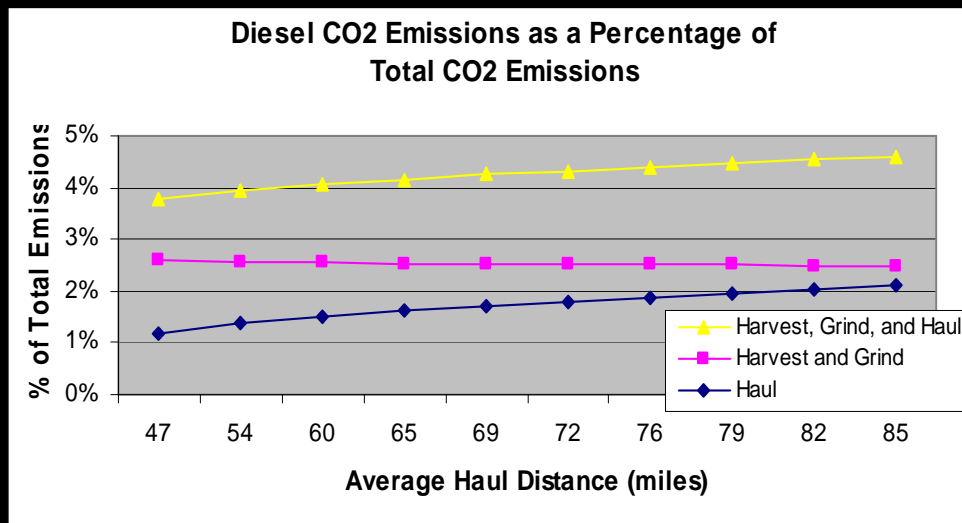


GHG Emissions per 1,000 Ac Treated

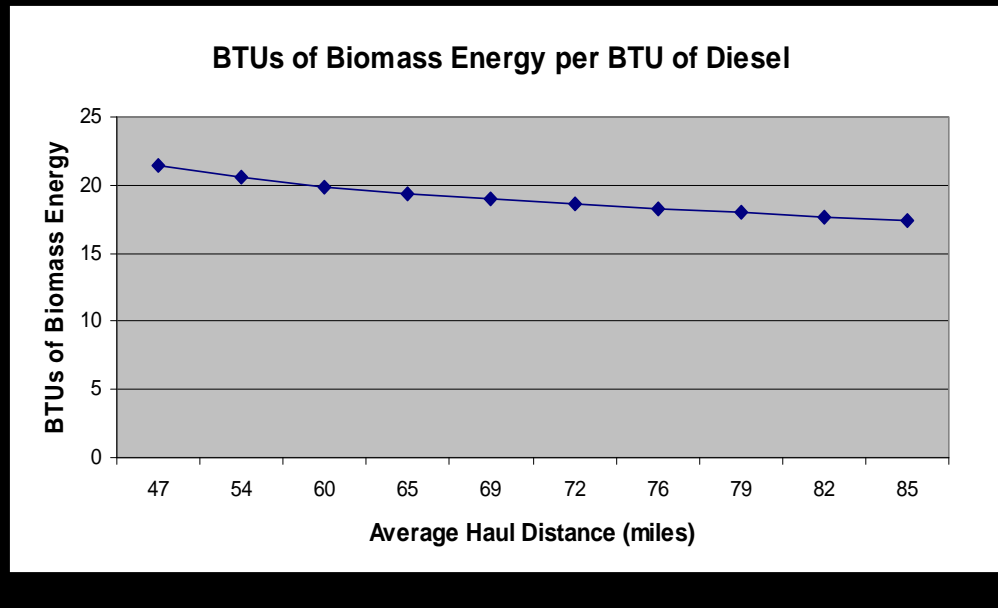


Notice the benefit of using the wood as an offset of fuel oil or natural gas. The cross-hatched bar on the CO₂ can be discounted if the material is used from sustainably managed forests as the C released is recaptured by the new forest with the exception of the dark bar of diesel used.

Affect of Haul Distance on Carbon Dioxide (CO2) Emissions



Biomass Energy Return



Study done for the Bitterroot Valley in SW MT. It assumes 50% MC. This includes the fuel for all the equipment from cutting the trees to skidding, to grinding, to hauling to use site.

Fuel Quality

- **Moisture management**
- **Ash – Dirt – clinkers**
 - **Affects air mix through grate**
- **Operation and maintenance**

Fuel quality affects the performance of the system and the performance of the system can affect the air emissions.

Fixed grate vs. moving grate can greatly affect how the system handles high ash material and the dirt but you are facing much higher capital cost for the moving grate system.

Moisture is often referred to as an issue but with our limited data, we aren't seeing the relationship and I think that is dependent upon the combustion system and the ability to handle the variable moisture content.

Routine O&M is important to keep the air flow appropriate and thus combustion good for efficiency and for air emissions.

Conclusions

- **Multifaceted issue**
 - Open burning higher PM
 - GHG emissions
 - Stack emissions wood vs. natural gas or propane
 - Wildfire emissions
- **State Air management agency**
- **Need more monitoring data**
- **Need development of scale & price appropriate PCD's**
- **www.fuelsforschools.info**

The manufacturing capacity and support exists, the supplier systems exist; A&E and Contractors are familiar and knowledgeable.