

TARM BIOMASS
Innovative Leaders in Alternative Heating Solutions





Heating with Wood Pellets in Vermont Affordable Housing

Keeping Affordable Housing Affordable




Heating the Midwest With Renewable Biomass, April 2012





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
Stanislaus Housing, Rutland, VT
A former Catholic School and living quarters for teachers. Built in 1890s.

Now 20 units of affordable housing. 4.3 MM\$ public/private invested including \$125,000 from DOE.


Pleasant Street Apartments, Enosburg Falls, VT


30% energy reduction through building upgrades. 24 apartments available, all units reserved for low income tenants.


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Pellet Fines Cyclone

Wood pellet storage





Pellet Fines in Cyclone Base

Pneumatic Conveyance




Video Here, click on black square to start.





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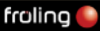
Cost Break Down

Location	# Of Units	Energy Use	Energy Cost Wood Pellets*	Savings Compared to Oil [^]	Approx. Per Unit / Month Heating Cost	Energy Use per Unit per Year
Stanislaus	21	Est. 26 tons	Est. \$6,240	\$3,510	\$25.00	25-40 Million British Thermal Units
Pleasant Street	24	Est. 45 tons	Est. \$10,800	\$6,075	\$37.50	

Compare to typical residence in this area using 112 Million British Thermal Units!

I think the main story of pellets in affordable housing is one of cost and predictability. We have seen fuel prices rise from around 10% of total operation budgets to above 20% in some projects. Pellets offer a clear financial advantage over fuel oil and propane. -Trevor Parsons, Housing Vermont

*Pellets at \$240 per ton bulk delivered
[^]Oil at \$3.75 per gallon



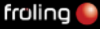


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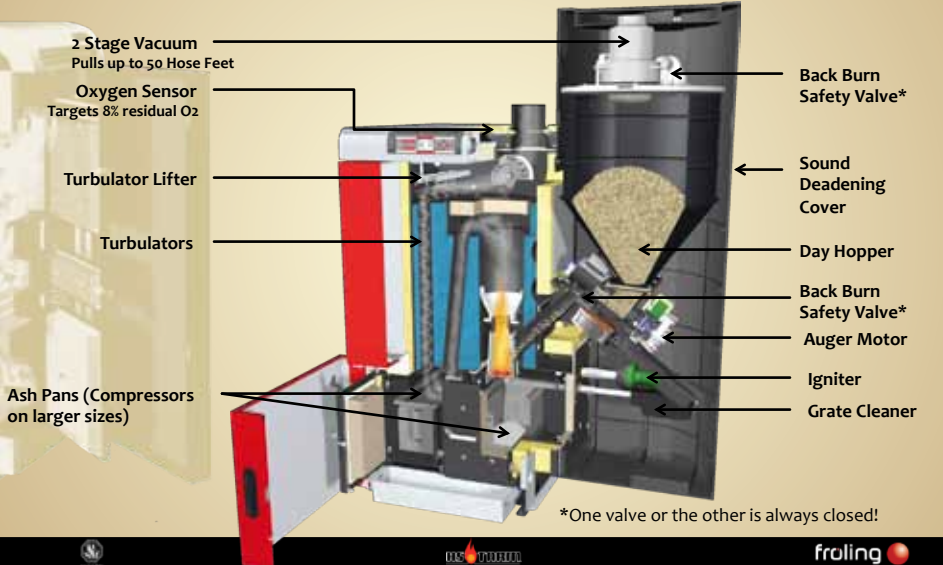
More from Trevor Parsons:

- Data acquisition is helpful if an on-site person is not available
 - a) Confirms system status daily
 - b) Helps diagnose problems that arise
- Bi-Weekly maintenance should be planned, ½ hour per visit.
- Annual cleaning is necessary
- Total annual maintenance budget per location, figure \$1,200. This will get better with time.
- Fuel quality is absolutely essential.
- Pay attention to fuel handling and storage.
- Don't forget to consider what to do with ash.

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2 Stage Vacuum
Pulls up to 50 Hose Feet

Oxygen Sensor
Targets 8% residual O₂

Turbulator Lifter

Turbulators

Ash Pans (Compressors on larger sizes)

Back Burn Safety Valve*

Sound Deadening Cover

Day Hopper



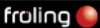
Back Burn Safety Valve*

Auger Motor

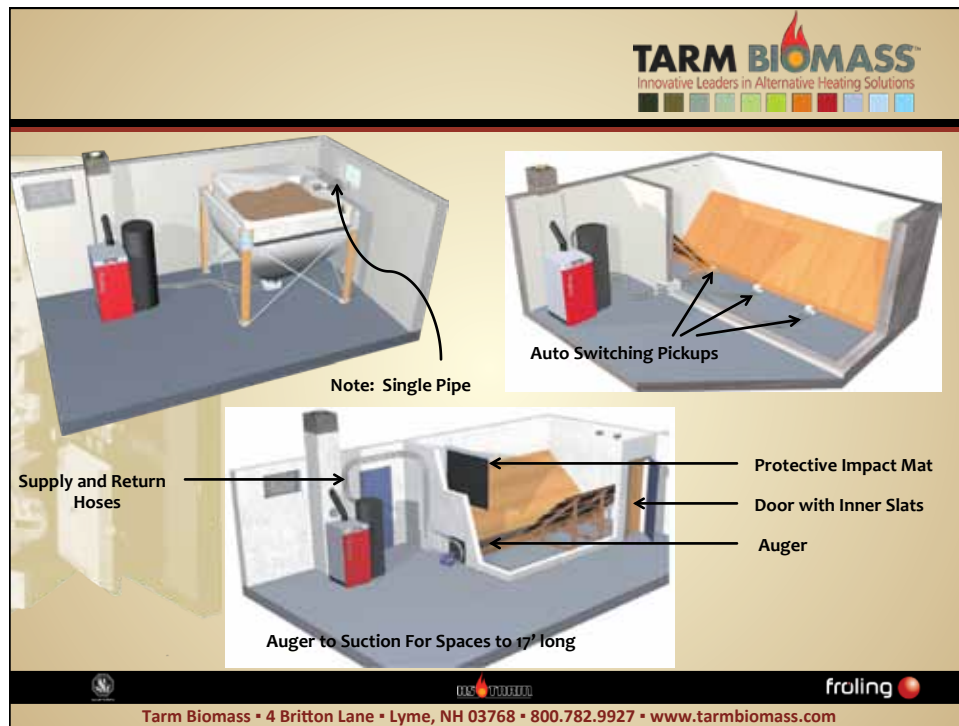
Igniter

Grate Cleaner

*One valve or the other is always closed!

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Making Success More Likely:

- Make Energy Conservation Upgrades First.
- Get an accurate third party heat loss analysis.
- Upgrade the heating distribution if possible.
- Keep all aspects of fuel handling simple, don't push this envelope.
- Leave funding in the project for fine tuning the operation after installation.
- Automate as much as possible. Take humans out of the equation.
- Load match or de-couple from the load.

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Heating Bin Hours vs. Outdoor Temperature

Typical northern US location

Heating Bin Hours vs Outdoor Temperature

Outdoor Temperature (deg F)	Hours per year
-5	50
0	100
5	150
10	250
15	350
20	500
25	700
30	1000
35	750
40	650
45	600
50	600

4800 hours per year at 55 deg F or lower

3900 hours occur at 25°F or higher

80% of heating output is needed at 50% or less of peak heating load

■ Hours per year

Outdoor Temperature (deg F)

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“Small can be beautiful”

- No positive energy benefit from boiler over-sizing
- 25 % under-sizing → only 1 % loss of total annual wood heating output and heating oil savings
- 50 % under-sizing → only 7 % loss of total annual wood heating output and heating oil savings
- Reducing boiler size by 50 % can save 20 to 30 % in capital cost and length of payback period.

Shorter payback periods → More customers

Lower emissions → Happier neighbors

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The Carbon Monoxide Example, Cordwood Boiler

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Each time the boiler turns off, CO drops. When the fan comes back on CO rises dramatically before it then begins to settle downward rapidly.

FAN ON
OPERATION
FAN OFF

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60% reduction in on/off cycling with thermal storage.

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Without Thermal Storage, **1700** on/off cycles per year

Recommend 30 gallons per 10,000 Btu of boiler output for automatic stoking boilers and 70-80 gallons per 10,000 Btu for Cord wood boilers.

With Thermal Storage, **700** on/off cycles per year

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Some Advantages of Cascading

- Reduce installation cost
- Increase utilization
- Add redundancy
- Match seasonal and diurnal variation

A 10% turndown ratio.

A single 600,000 Btu boiler may reduce its output by 70%.

A cascaded installation of three 200,000 Btu boilers may reduce total output by 90%




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Thank You!

Scott Nichols



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