



Advances in Pellet Boilers

Central Heating with Wood Pellets

Prepared for Building for Social Responsibility

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1. Boiler Technology Differences- Then and Now
2. New Methods for Storing and Conveying Wood Pellets
3. Today's Control Techniques
4. Integrating into Modern Homes- Load Matching
5. Two Vermont Examples- Multi Family



Preamble

1. I'm speaking mostly about my equipment.
2. The past wasn't all bad.
3. Equipment upgrades are never ceasing.
4. Standards are in development for bulk pellet delivery and storage.
5. Not all equipment is the same.
6. Europeans have the jump on us, but that doesn't mean they know everything.
7. Success will depend on education and high oil prices and/or regulation.
8. I am not a fuel guy, but will attempt to answer any fuel questions.
9. Feel free to interrupt me any time.

Fuel Handling THEN...





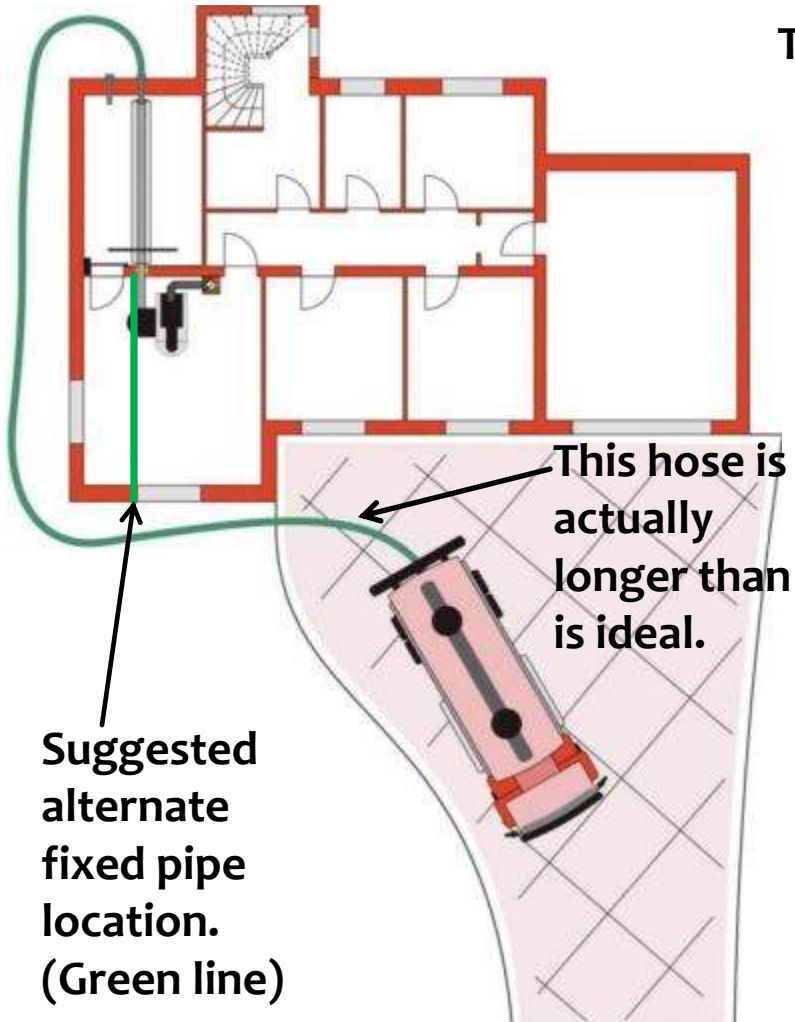
FOUR EXAMPLES OF CREATIVE BULK FUEL CONVEYANCE...



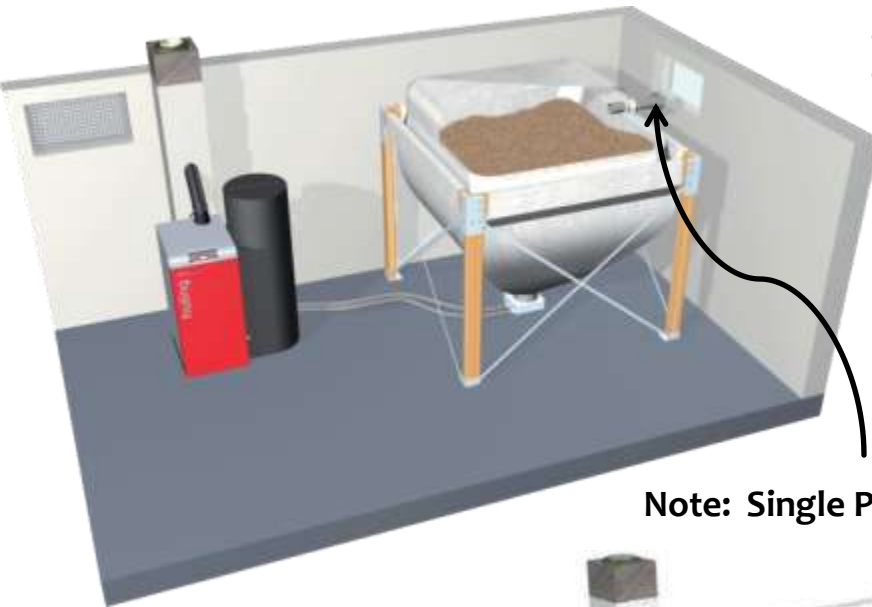
NOW...



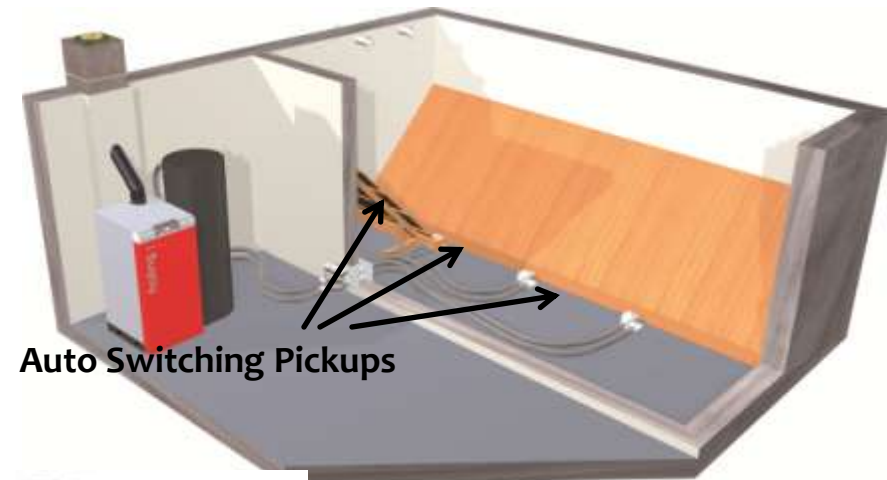
Truck access is an important consideration...



NOW...

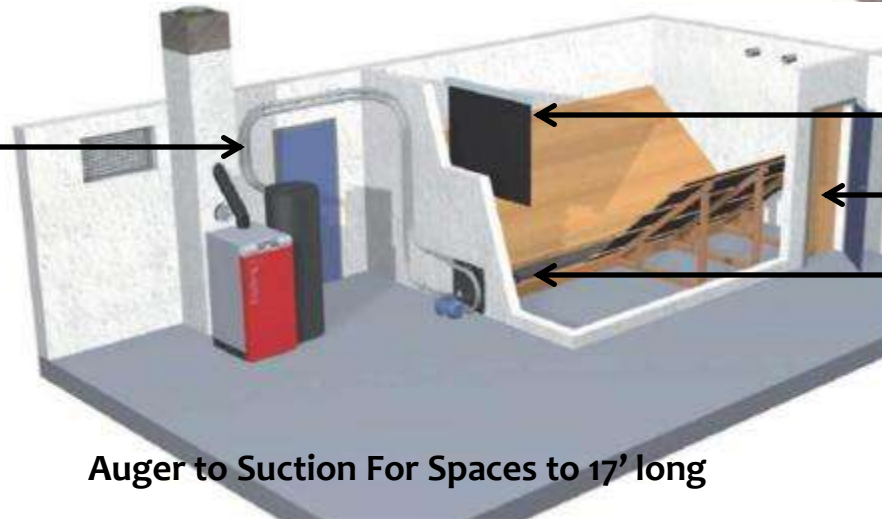


Note: Single Pipe



Auto Switching Pickups

Supply and Return Hoses



Protective Impact Mat

Door with Inner Slats

Auger

Auger to Suction For Spaces to 17' long





Fuel
supply and
return air lines

Active dust removal
recommended for all
uses >10 tons/year.
Decreases long term
maintenance.

Return air passes through dust removal
cyclone

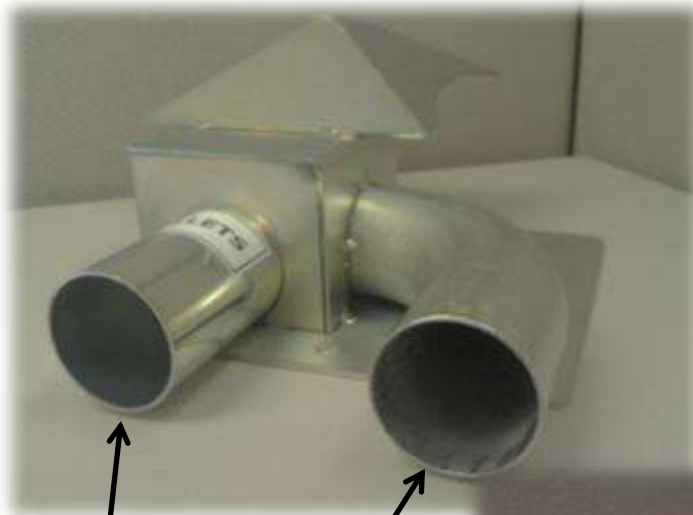




Inside the de-duster cyclone base

Consistency of removed “dust” a.k.a. fines.

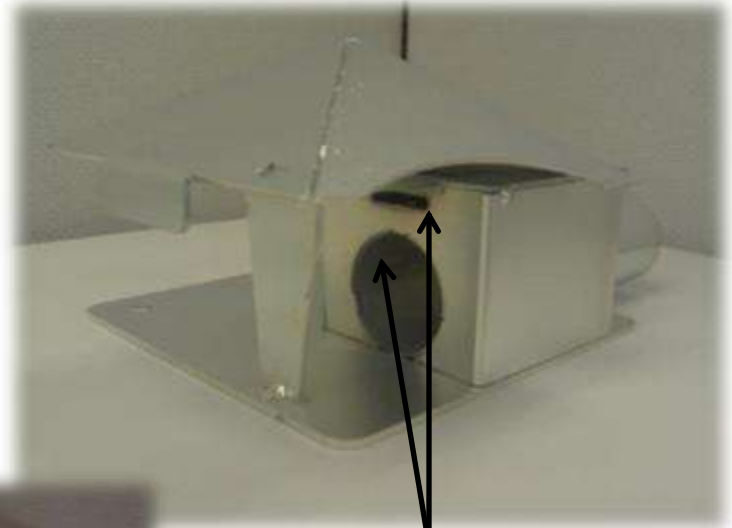




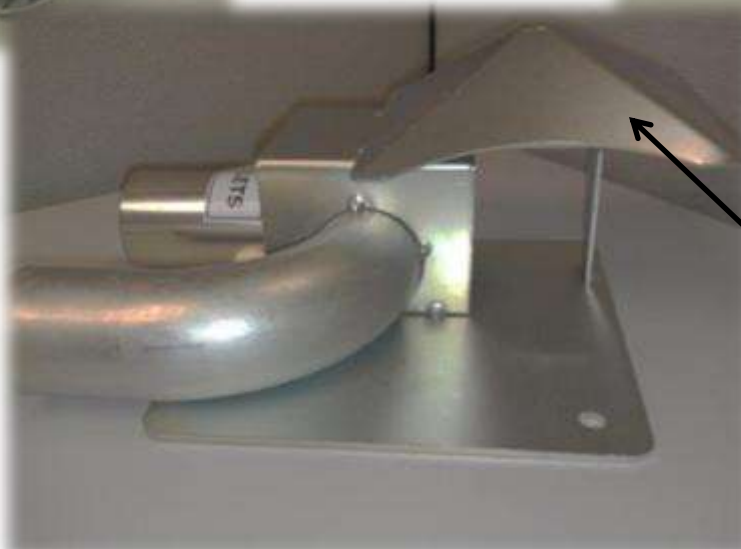
Suction Line

Return Air Line

Suction pick up pellet fuel “probe”, this example unpowered.



Return air turbulating/stirring port, also not seen other ports inside



Roof creates void under pellet pile

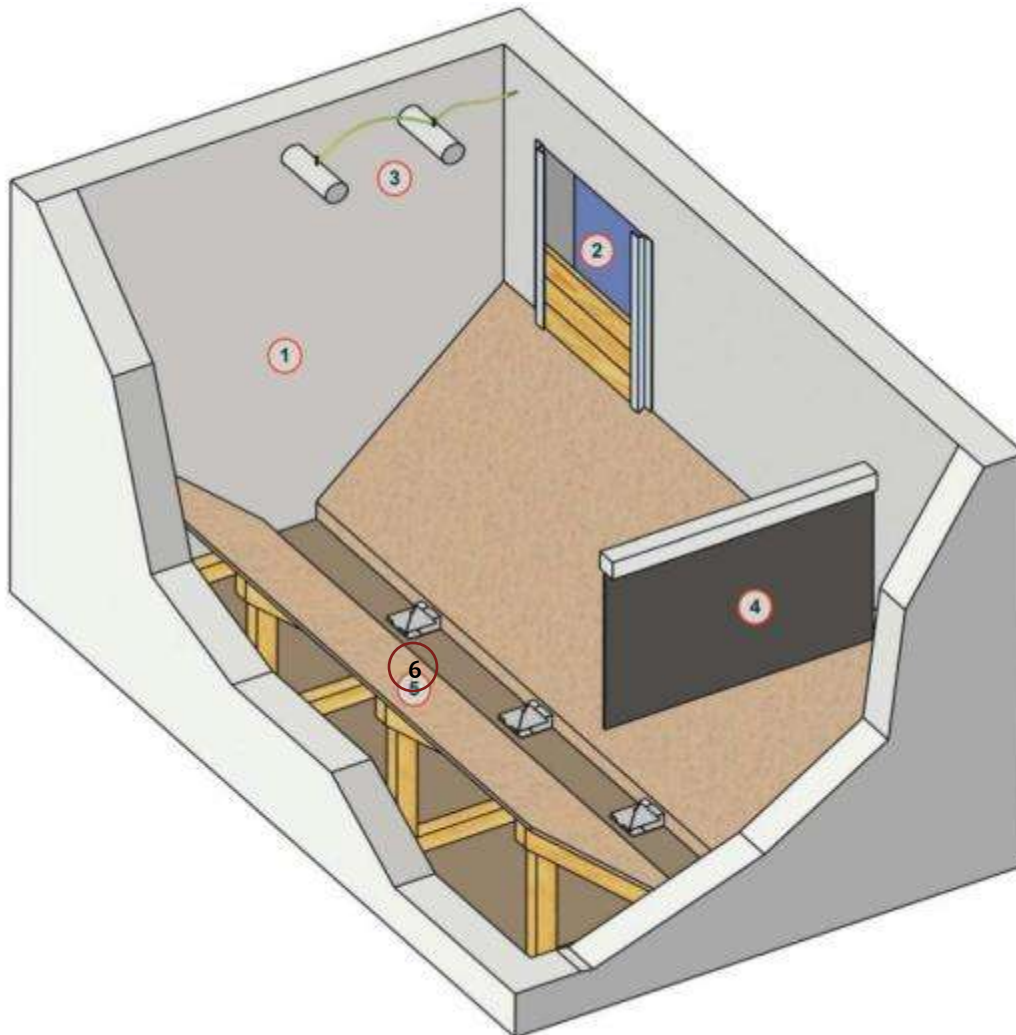


Redundant fuel supply for 3 boilers from one silo. Note slide gate for service.









1. Dry room with no electrical installations or other sources of ignition.
2. Dust tight access with inner slats to relieve pressure.
3. Grounded filler and exhaust pipes well cemented and anchored in wall.
4. Impact mat to protect pellets and wall.
5. Sloping sides 45° +/- 5
6. Minimum distance between pickup points for effective pellet removal.

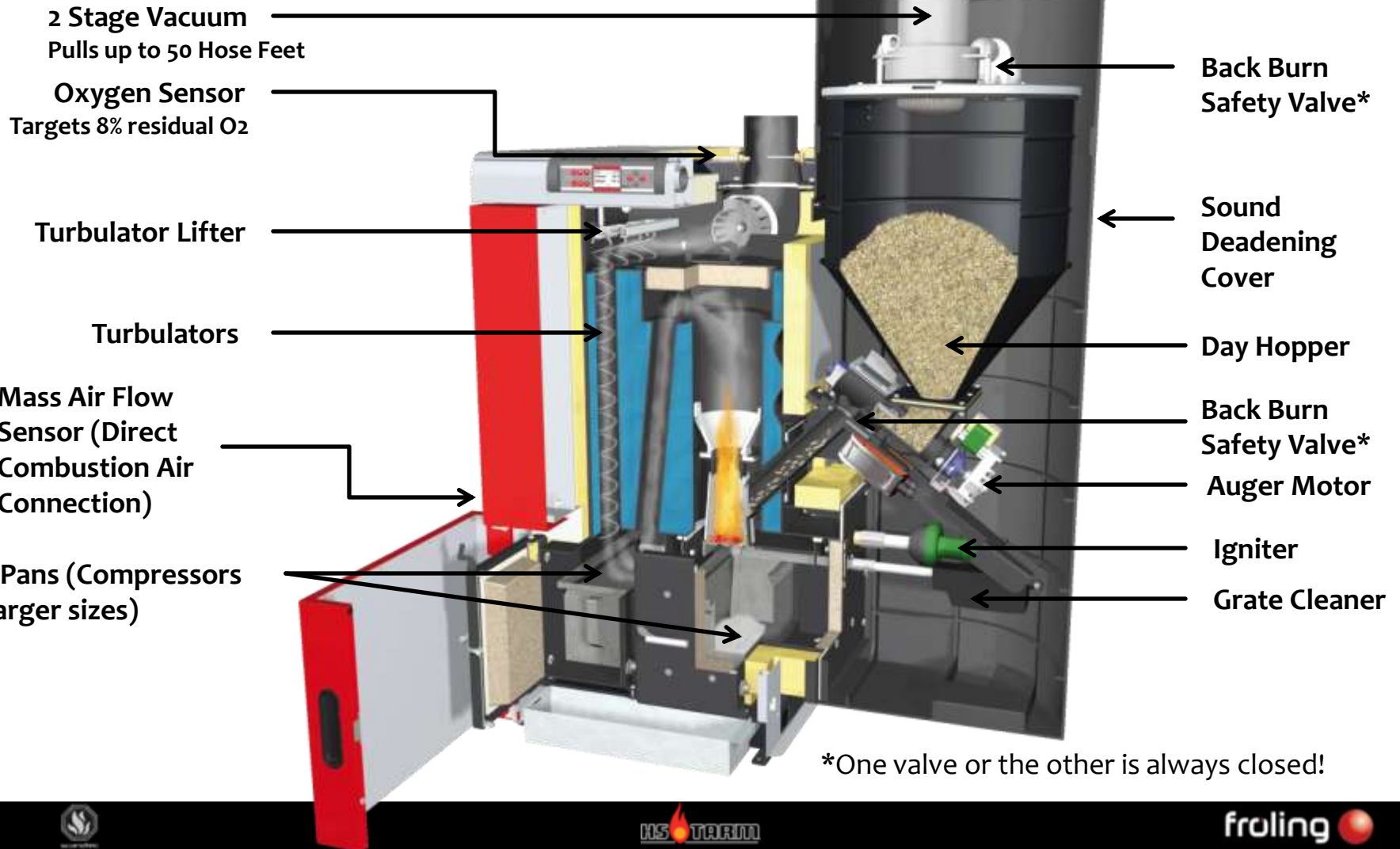
Additional Notes About Pellet Storage Rooms

1. A gap should be allow for above the pellets in the room for air movement
2. In most cases 2/3 of a room's initial volume will be available for pellets after empty space is removed from the equation. This is space above the pile of pellets and space in the corners below the sloping portion.





Drop Feed Burner



THEN...

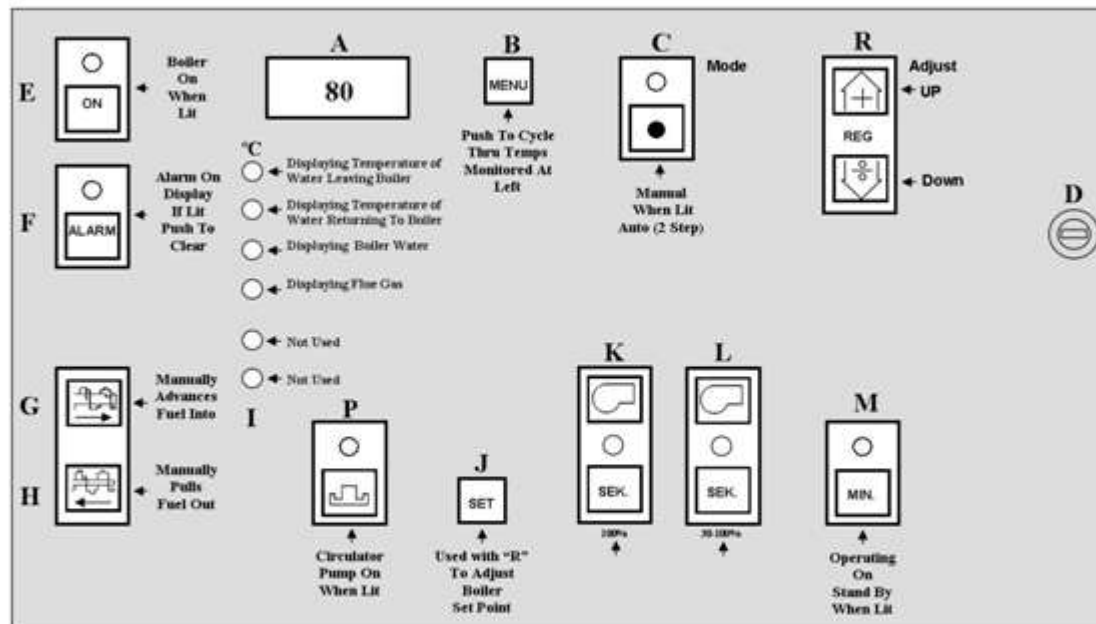


Needed a “learning aid” and manual to figure it out!

NOW...



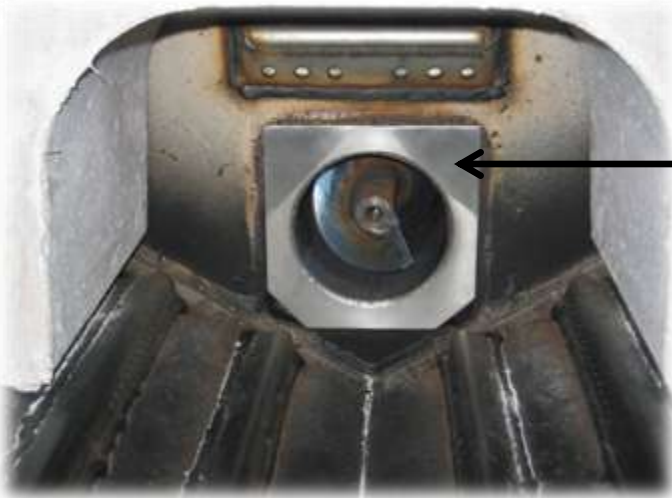
Learning “Aid”





← Wedges

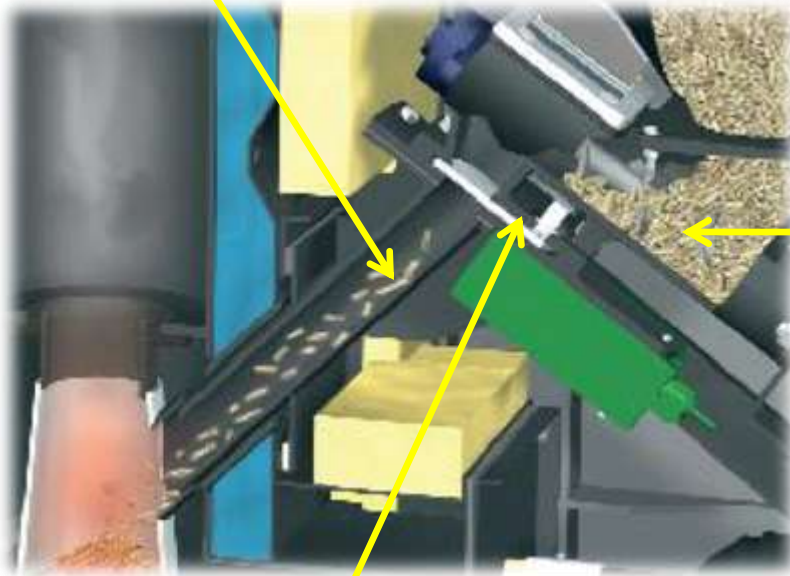
Fire Safety
then...



← Round Tube
Retrofit



Hollow Pellet Drop Tube



**Fire Safety
Now...**

**Upward
Sloping Fuel
Auger**

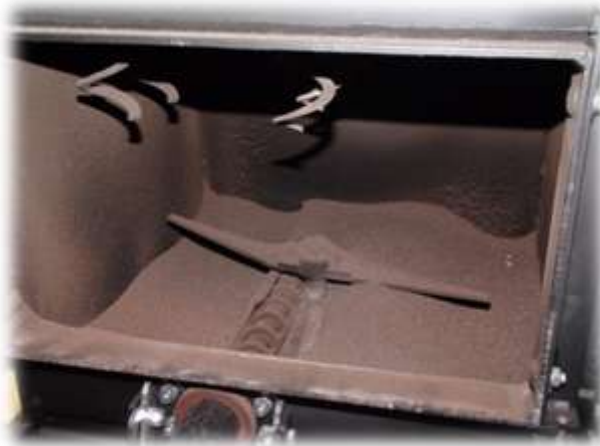
Safety Slide Gate



ASH HANDLING THEN...



ASH HANDLING NOW... Slide 1





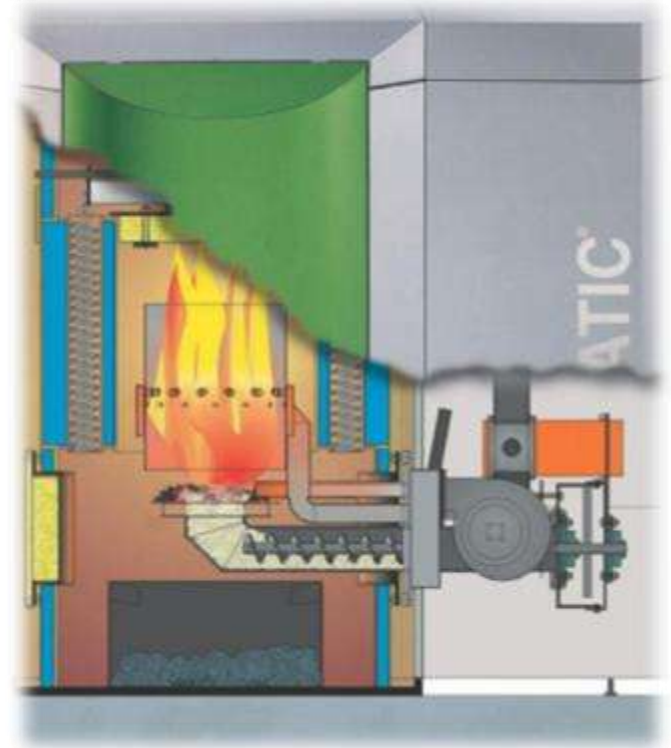
Slide 3

Ash drawers in smaller boilers... Gravity works!

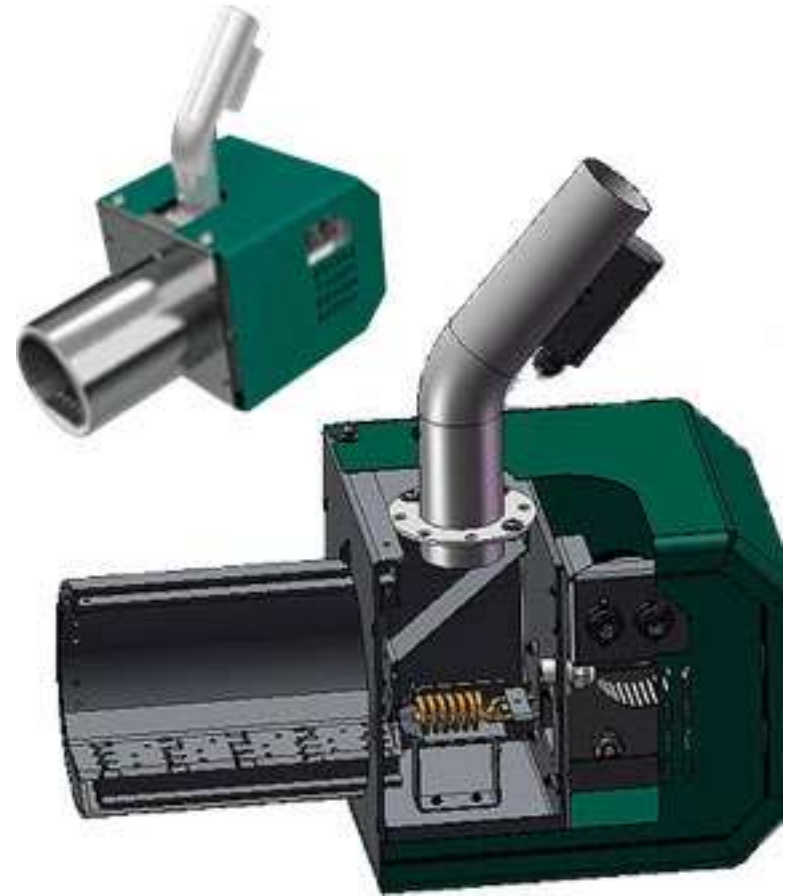


Slide 2

Other Modern Technologies: Under-Fire Burner



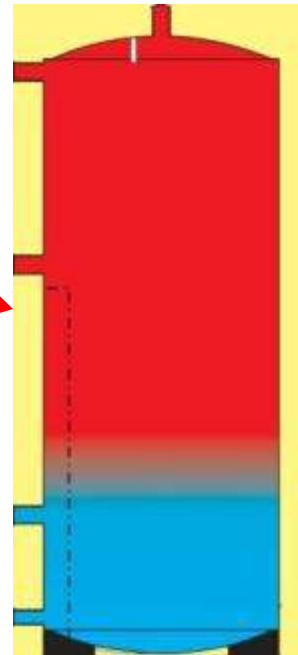
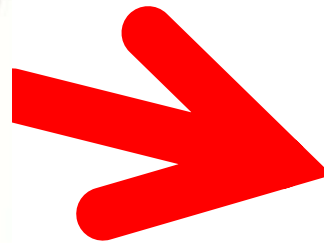
Other modern technologies:
Pellet Burner “Gun”



Load matching



Load De-coupling



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



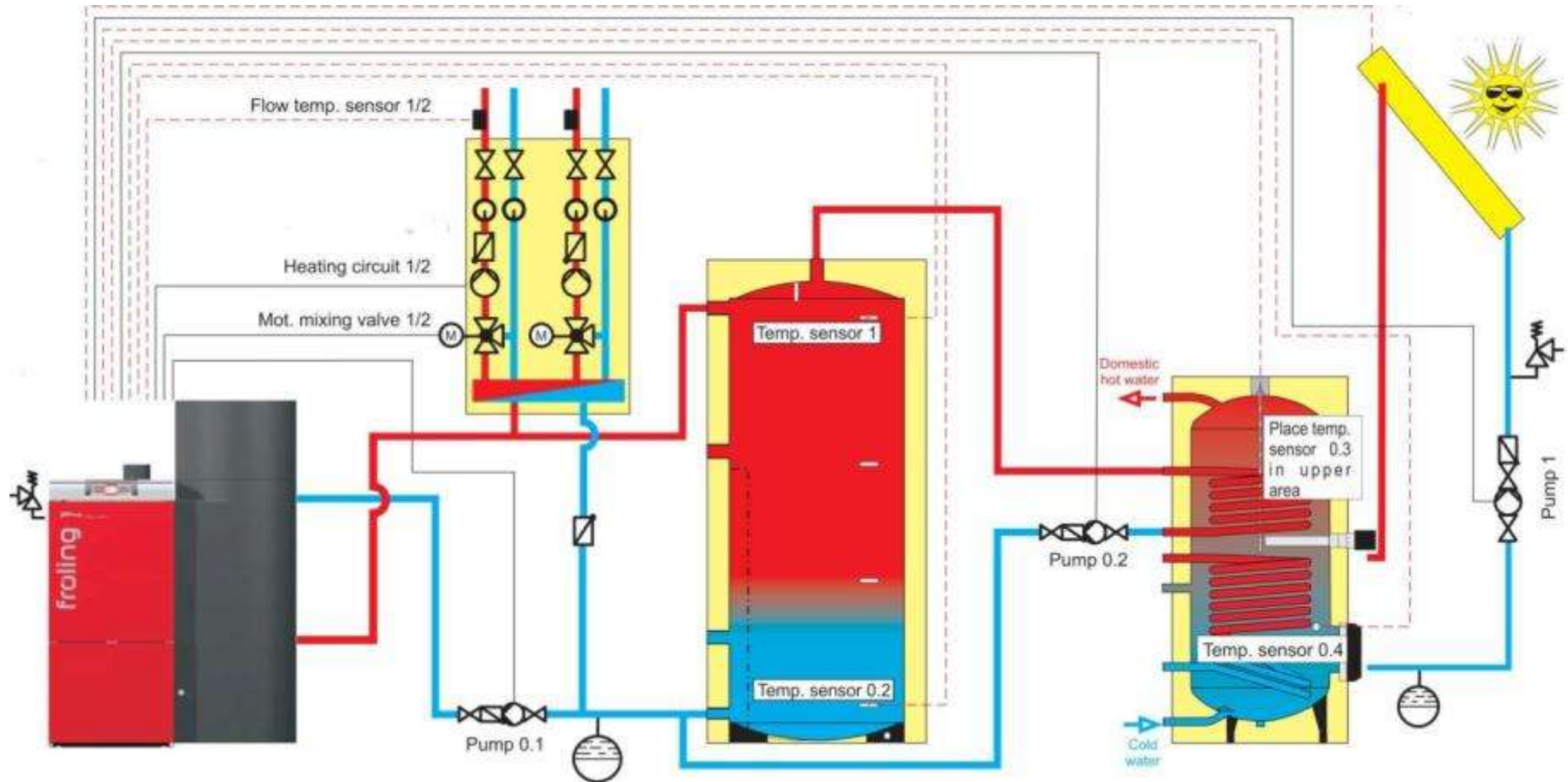
Without Thermal Storage, **1700** on/off cycles per year

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



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

Use with Buffer Tank and Solar Hot Water



Cascaded Systems Then...



Cascaded Systems Now...



Some Advantages of Cascading

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

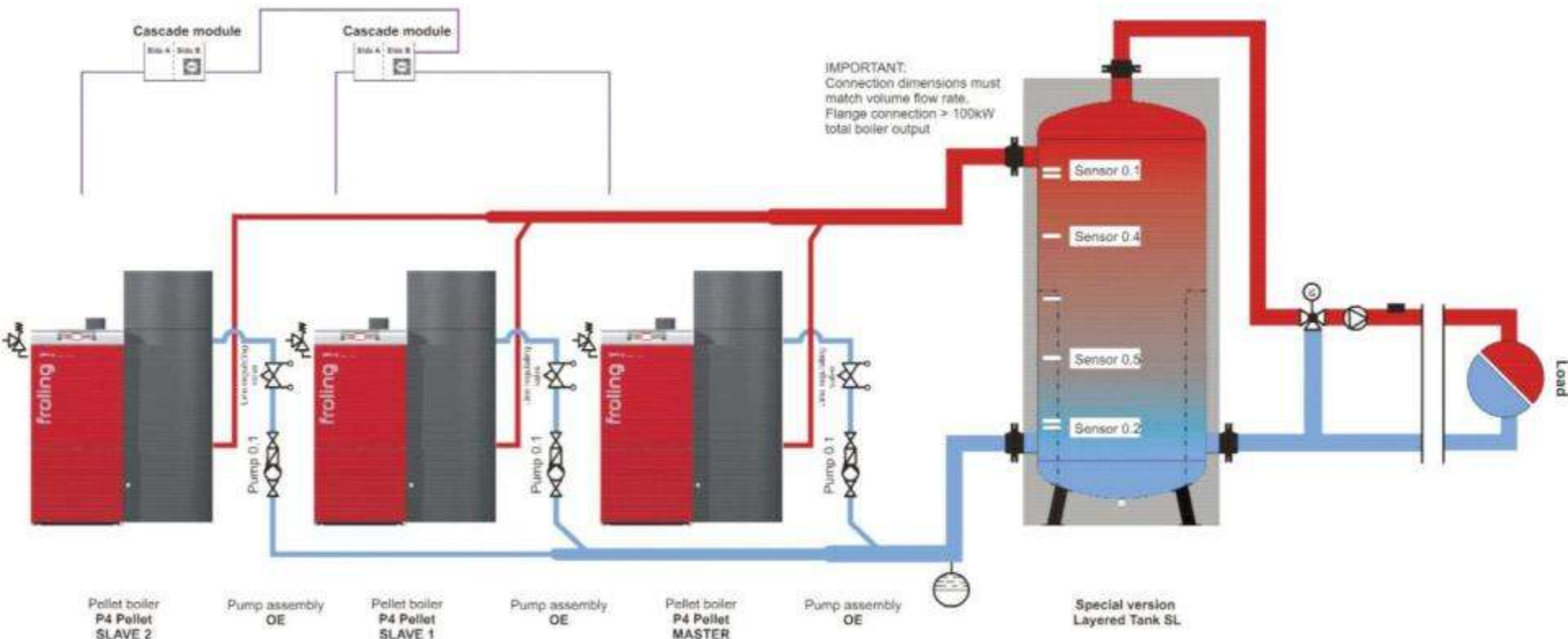
A 10:1 turndown ratio.

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

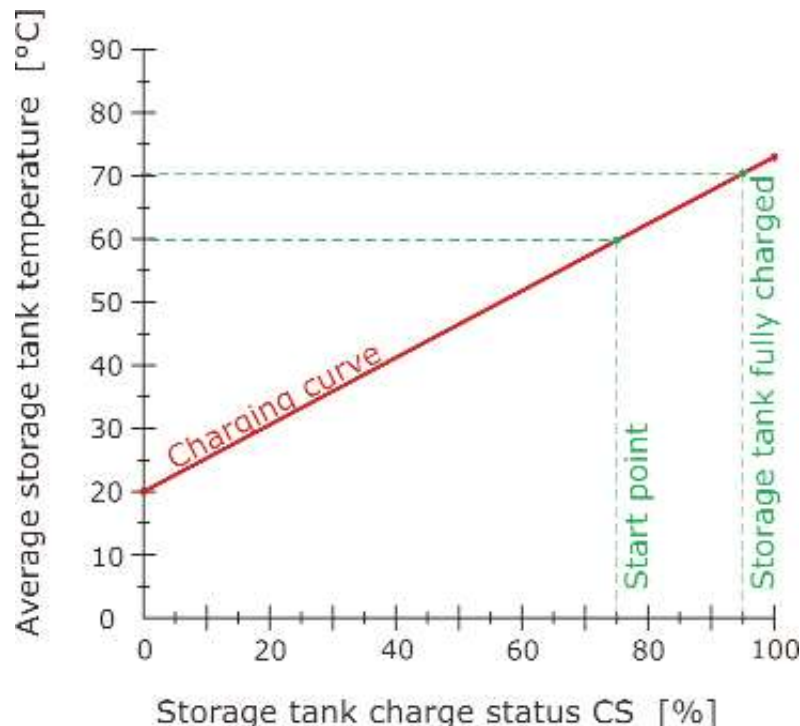
A cascaded installation of three 200,000 Btu boilers may reduce total output by 90%



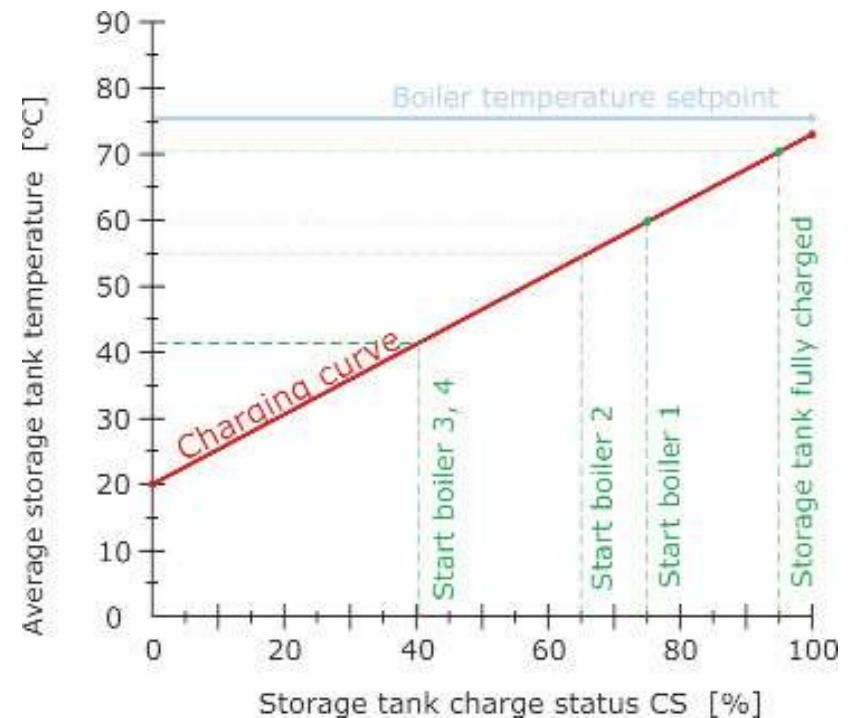
Cascade Plumbing and Thermal Storage



Tank Charging with Single Boiler



Tank Charging with 4 Boilers



Strongly consider redundant conventional heating sources for the next couple of years. Pellet central heating technology is very good, but a deep network of technicians and spare parts is not available.

A cold shower, house, or freeze up will do more to harm the pellet heating industry than the honest assessment of the current state of the industry.

However, even conventional fuel boilers are becoming less standardized...

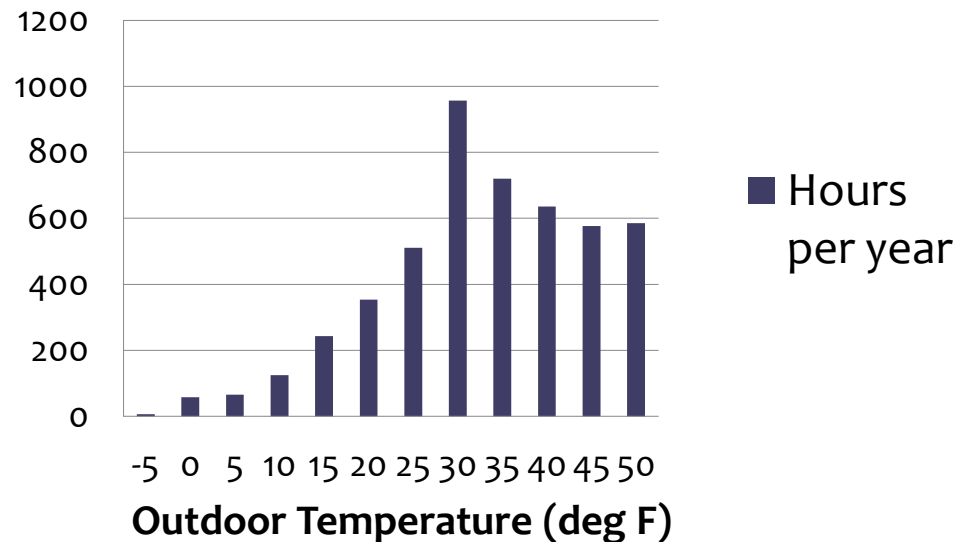


**Peak and redundant load
boiler**

Heating Bin Hours vs. Outdoor Temperature

Typical northern US location

Heating Bin Hours vs. Outdoor Temperature



**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**

“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

Vermont Examples

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.



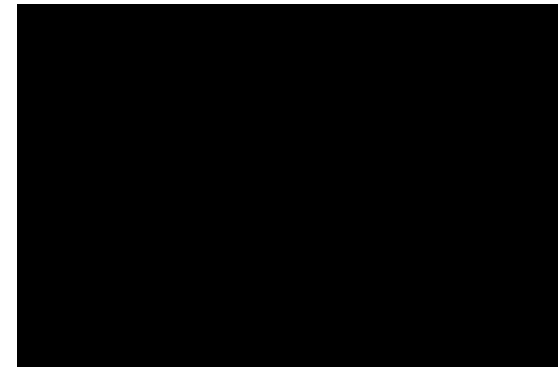
Pleasant Street Apartments, Enosburg Falls, VT

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





Pneumatic Conveyance



Video
Here,
click on
black
square
to
start.

Pellet Fines Cyclone



Wood pellet storage

Pellet Fines in Cyclone Base



Cost Breakdown

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



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.

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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