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Biomass thermal (heat) applications

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In partnership with:
USDA Forest Service Region 5

http://ucanr.org/WoodyBiomass

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Making a Difference for California

Overview

- Wood fuel types
- Domestic stoves

- Institutional systems
  - Scale
  - Typical system
  - Examples
  - Conclusions

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Wood fuel types

Logs/cordwood

Chips

Pellets/densified fuels

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Biomass fuel types

- **Chips**
  - Cheaper
  - Simple
  - More variable
  - Can be problematic to feed/handle
  - Best for buildings above 50,000 ft^2
- **Pellets** (densified wood fuel)
  - Higher energy density
  - Consistent product
  - Clean/convenient
  - Global commodity
  - Equipment intensive
  - Energy input (70-80kWh/t)
  - Expensive end-product
  - Best for buildings 10,000-50,000 ft^2

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Firewood – a valuable product

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Domestic stoves

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Scale for institutional heat

10,000 ft^2-1 million+ ft^2

0.35 million BTU/hr-10 million+ BTU/hr

Heat only

Campfire

Powerplant

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Potential biomass heat users

- Schools
- Hospitals
- Recreation and Aquatic Centers
- Correctional Facilities
- College Campuses
- Shopping Complexes
- Large Warehouses or Garages
- Large Greenhouse Operations
- Industrial Process Heat

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Scale

Facility:	Tilamook Forest Center, OR	Enterprise Public Schools, OR	Chadron State College, NE
Area:	12,500 ft^2	105,000 ft^2	1.1 million ft^2
Fuel:	Wood pellets	Wood chips	Wood chips
Boiler:	0.42 million BTU/hr	2.5 million BTU/hr	9 million BTU/hr

small large

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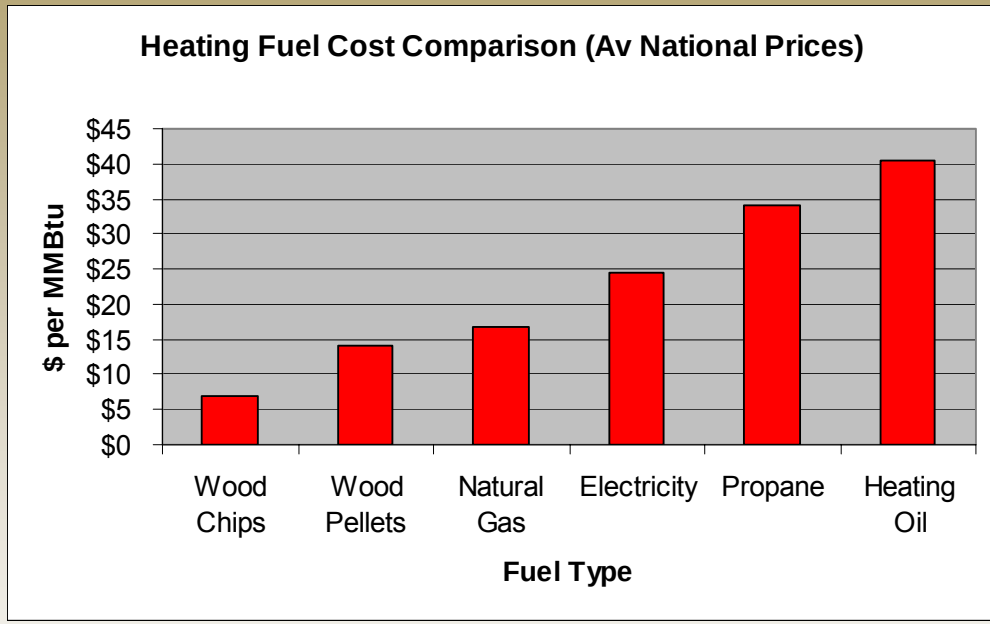
Small scale heat (institutional)

- Can be cheaper than alternatives – it is easy to calculate simple payback
- Carbon neutral
- Local market
- Opportunities for buildings (10,000 sq ft to 1m+ sq ft)



Source: US DOE Energy Information Administration, Sept 08

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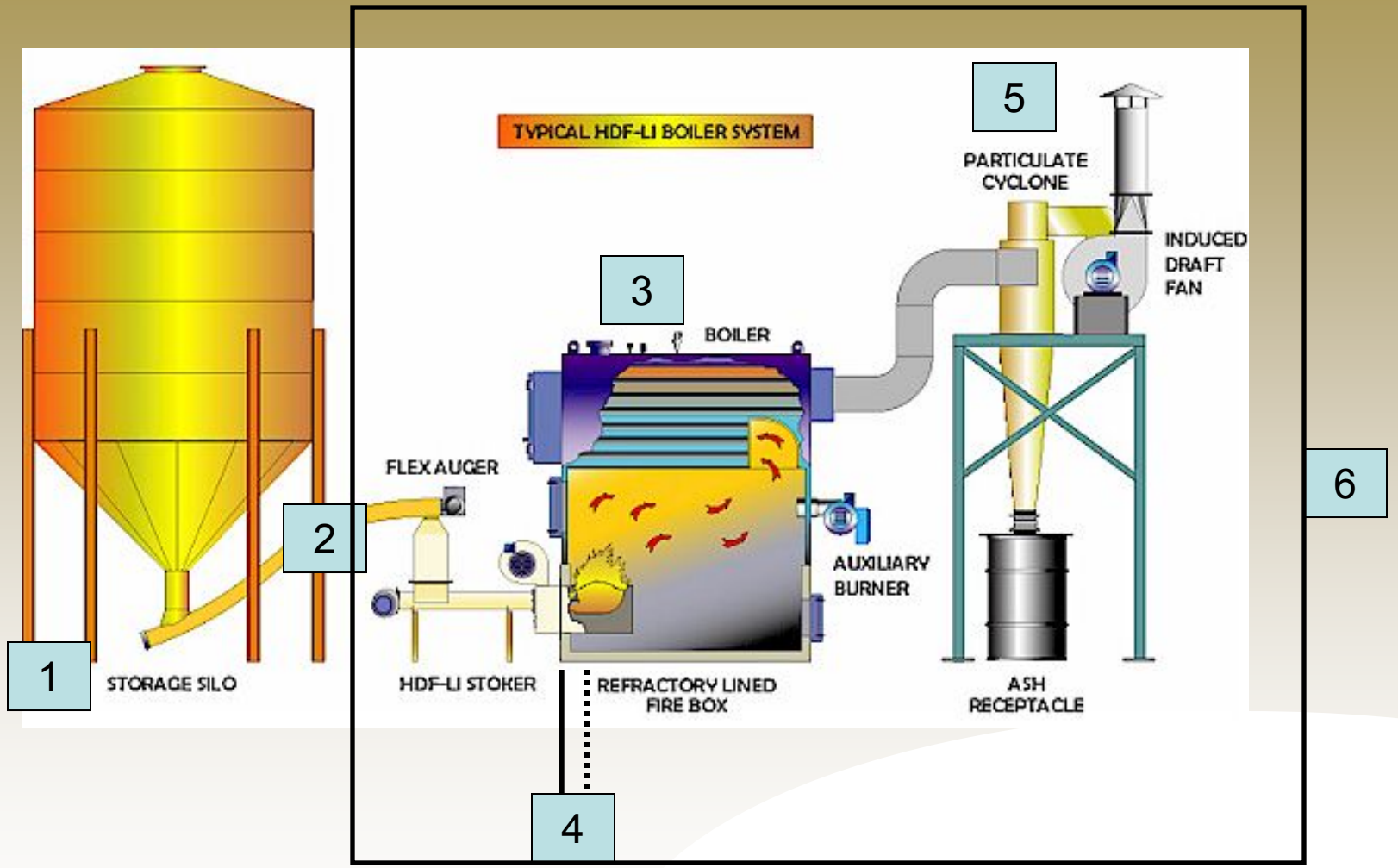
Technology and Performance Benefits

- Off the Shelf Technologies
- Long History of Performance
  - -Vermont State: 25 Schools heat with Biomass
  - -eg Chadron Community College, Nebraska – 25 years of operation

Typical Parts of a Biomass Heat System:

1. Storage Bin – container to keep fuel supply dry and clean.
2. Equipment to handle fuel – to transport the fuel from the bin to the boiler.
3. Firebox and boiler – to burn fuel and generate hot water or steam.
4. Controls – to ensure efficient and clean combustion.
5. Chimney and clean-up equipment – to disperse combustion gases and manage emissions.
6. Building – to house equipment.

Typical pellet boiler system



Source: SolarGen http://www.solageninc.com/

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What do they look like?

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Typical school unit

17,000 BTU/hr hot water (80% efficiency)

Supplemented by:

- Solar hot water
- Gas boiler (peak load and back-up)

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Basic feasibility questions

- Fuel Supply Availability and Predictability
- Commitment: Maintenance, First Cost
- Site Layout: Space, Existing Structures
- Air Quality: Non-attainment Area?
- Project Cost Supported By The Savings

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Payback and finance

- Simple Payback
  - Project Cost, Fuel Cost Savings
- More complex payback tool:
  - http://www.fwe.wisc.edu/extension/BoilerProgram.xls
- Consider an energy savings performance contract (ESPC)
  - Guarantees your energy cost savings to allow access to finance
  - List of federal ESPC vendors on our website

Air Quality Considerations

Air Emissions	Open Field Burning	Biomass Fueled Boiler	Natural Gas Boiler
	lb/Million Btu		
CO	6.89	2.267	0.058
CO_2 fossil		0	114.6
CO_2 non fossil		350.0	0
NO_x	0.36	0.250	0.301
SO_x	0.03	0.013	0.073
VOC	0.74	0	0.009
Methane		0	0.003
Particulates	0.66	0.028	0.009

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Example: school project using chips

- Alturas Elementary/Modoc Middle School
- 4 MMBTU boiler
- 280-360 GT/yr
- $34.50/GT delivered cost for fuel
- Savings in fuel oil: $60,000/yr
- Cost: $1.24m
  - Biomass System : **$332,185**
  - Fuel Reclaiming System : **$86,541**
  - Pumps, Heat Ex., Piping : **$70,732**
  - Installation Costs : **$71,000**
  - Buildings, Roads, Engineering : **$588,600**
- 15 year payback period

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Example: hospital project using pellets

- New build hospital, Burns, OR
- Heating plus evaporative cooling
- 54,000 sq ft
- ~$300,000 investment
- Savings: $58,590/year
- 5 year payback

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Siting Considerations – biomass heat

- Heating needs
  - More is better
  - Consistent demand is better
- Air basin - cleaner air sheds are more amenable
- Timing: new construction or a replacement?
- Current type of fuel
- Biomass fuel availability:
  - Harvest
  - Processing
  - Transport infrastructure
- Fuel storage - fixed or mobile storage takes room and costs money
- Facility staff interest and capacity
- Public support
- Initial investment and payback period

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Main Points

- Wood based heating can make a lot of sense
- Local fuel sourcing – jobs, fuels reduction
- Community/small scale
- Running payback calculations and initial feasibility is simple

Types of biomass boiler

- Wood Chip Fired Boilers
  ≥ 1 MM BTU economical (≥50,000 sq.ft.)
  steam or hot water, automated

- Pellet Fueled Boilers
  ≥ 50,000 BTU to 400,000 BTU, hot water
- automated, smaller footprint, more expensive fuel
- Eg 17,000 BTU unit ~$16,000 FOB
- Cordwood Fired Boilers
  50 kBtuh to 300 kBtuh
  manual loading, least expensive
- Eg ~$8,000 for Almquist unit

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