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Biomass thermal (heat) applications

Jim Jungwirth
Watershed Research and Training Center

Gareth J Mayhead
University of California Berkeley
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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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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WRTC contracted w/ Trinity & Modoc RC&D's to pilot a program for prefeasibility studies

Deliverables:

1. Prefeasibility/Data collection of public buildings in both Trinity & Modoc county
2. Handbook for development of prefeasibility studies in rural counties

FEMP

The Department of Energy Federal Energy Management Program assists agencies and their facilities in reducing energy and water usage and in increasing the amount of renewable energy used to heat and power federal facilities.

http://www1.eere.energy.gov/femp/index.html

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District Heating Opportunities

Facility:	Devils Garden Alturas, CA	Downtown Alturas, CA	Midtown Weaverville, CA
Area:	43,688 ft^2 8 buildings	95,780 ft^2 20 buildings	140,377 ft^2 6 buildings
Fuel:	Wood chips Replacing propane	Wood chips Replacing various fuels	Wood chips Replacing various fuels
Demand:	2.9 million BTU/hr		Est. 5.6 million BTU/hr
Replacement Boiler	2.5 million BTU/hr	5.1 million BTU/hr	
Cost:	$527,000	$835,000	
1st year savings	$87,163		
Simple Pay Back	6 years		

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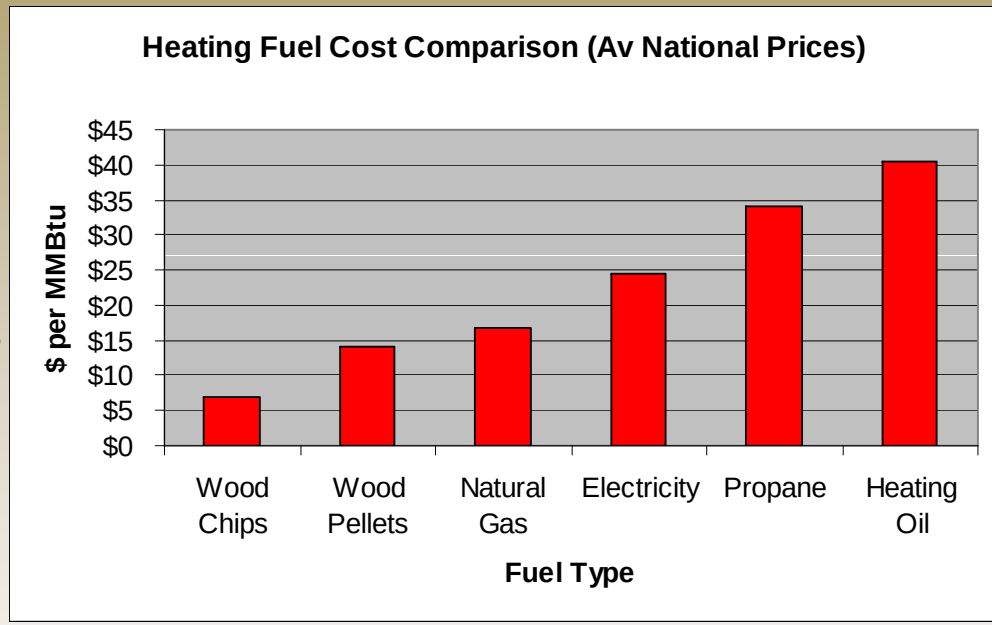
Small scale heat (institutional)

- 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
  - Chadron Community College, Nebraska – 25+ years of operation

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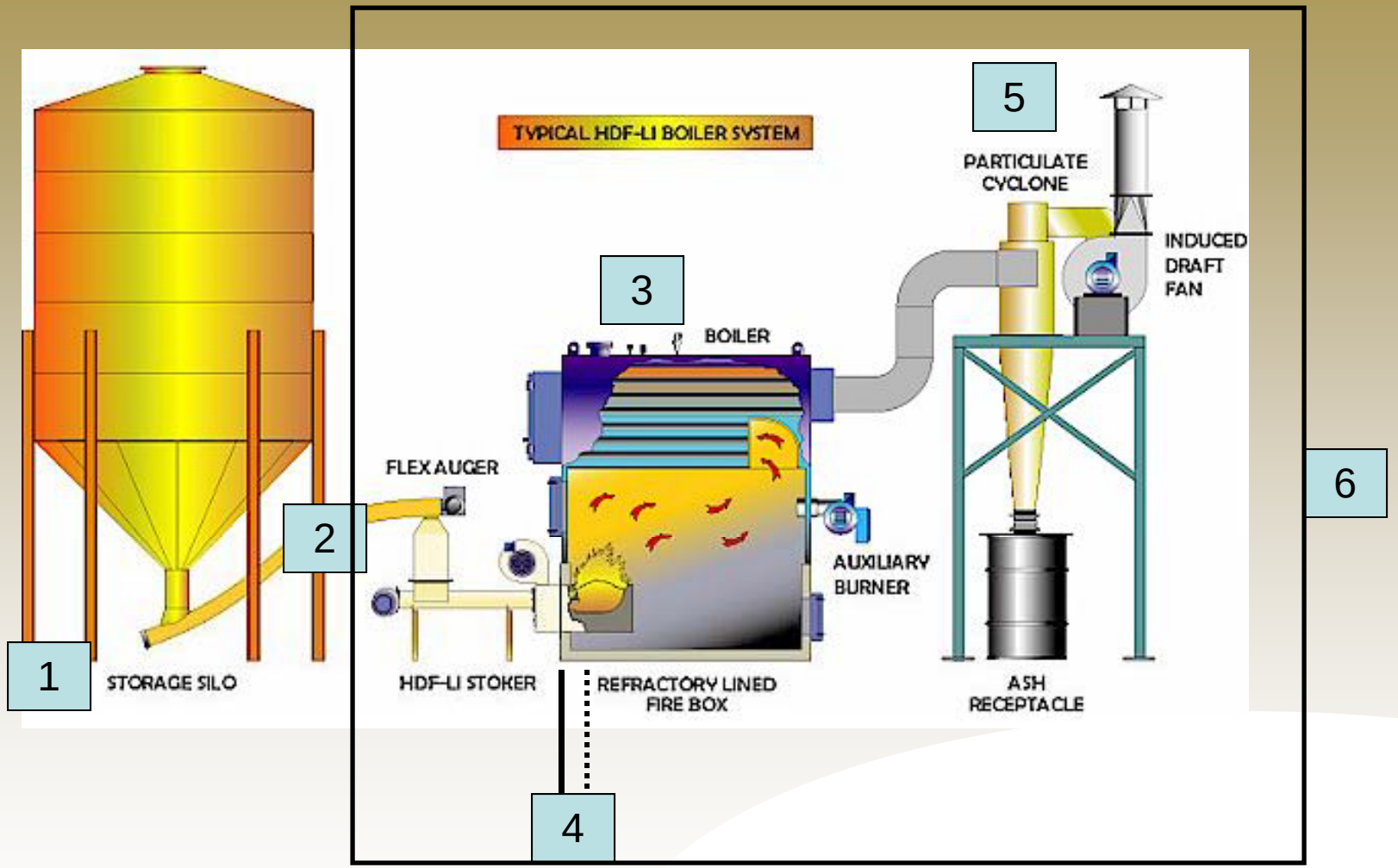
Typical Parts of a Biomass Heat System:

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

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

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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

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