


USDA FOREST SERVICE State and Private Forestry

Advanced Wood Combustion And New Market Opportunities

MD and DE Fall SAF Meeting
November 4, 2009




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Today's Presentation



- Wood Education and Resource Center
- Wood as a Fuel
- Technology Options
- District Heating Concepts




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Wood Education and Resource Center

Main Office Building (23,000 SF)


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WERC States - Eastern Hardwoods

162 Million Acres are in the Eastern Hardwood Forest Type



93% total Eastern forest = private + other public
88% total Eastern forest = private only



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Why WERC?

Sustainability


- Industry
- Communities
- Forests




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Wood as a Fuel

- Low energy density
- Contains water
- Renewable ...managed properly
- Carbon neutral..almost
- Emissions must be addressed



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Wood Energy Strengths

- Regional value added opportunity
- A CO₂ neutral energy generation
- A renewable source of energy
- Secure supply using sustainable management systems
- Maintain local jobs – fuel, installation, maintenance
- Price competitive with other fuels

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Renewables and US Energy Supply

Source	Percentage
Petroleum	40%
Natural Gas	23%
Coal	23%
Nuclear Energy/Power	8%
Renewable Energy	8%

Source	Percentage
Biomass	47%
Hydroelectric	45%
Geothermal	6%
Wind	2%

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Immediate Opportunities

- Direct Combustion
 - Single Buildings
 - Home – firewood, pellets
 - Commercial – firewood, pellets, chips
 - Industrial – process energy - pellets, chips
 - District Energy Systems
 - Multiple buildings-single or multiple owners
 - Year round use
 - Pellets or Chips
 - CHP opportunities

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New Technologies

- Advanced Wood Combustion Systems
- Use of Thermal Storage Systems
- Smaller Scale CHP Units
- Improved Emissions Control Systems
- Value-added Chips

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Advance Wood Combustion

- Improved air control
- Systems automation
- Use of thermal storage
- Integration of renewables
- Improved fuel quality
- Improved emission control systems

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Thermal Storage Systems

- Energy fly wheel
- Improves combustion
- Reduced boiler size
- Allows connection to other energy systems-solar thermal

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Hot Water Thermal Storage




- Unlike electricity, hot water can be stored in a simple tank, allowing it to be produced at the most economical time and used when necessary

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NH Greenhouse Operation

- Two 500HP boilers
- 40,000 gallon thermal storage unit
- Covered storage for 3-4 days of fuel



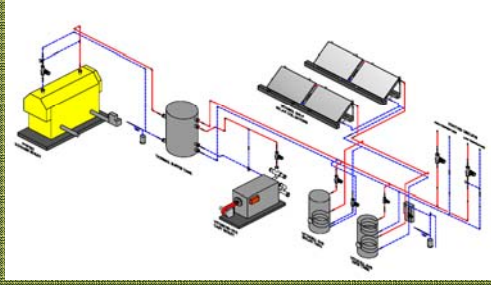
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NH Greenhouse Operation



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Integrated Biomass-Solar System



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Integrated Biomass and Solar

- Wood pellet or chip fired boiler
- Solar thermal panels
- Increased efficiency
- Lower fuel costs



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Value Added Wood Chips

- Reduced Moisture Content < 35%
- Consistent size
- Low bark content
- Improvements = improved combustion, lower emissions, less ash
- Standard, cost effective practice in Europe

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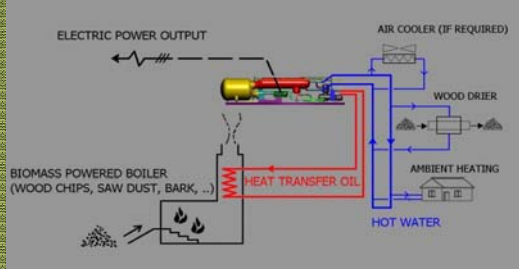
New Emissions Control Systems



- Metal fabric
- Steel cartridge support
- Pneumatic cleaning system
- Mimics fabric bag house

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Organic Rankine Cycle Power Generation



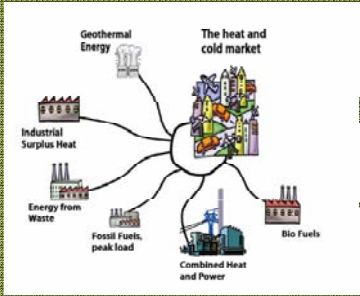
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What is District Heating or Cooling

- Distribution of hot water or steam through networks of insulated pipes
- Meet the space heating, process heating, domestic hot water, or cooling needs of multiple buildings
- Sources of heat: central plant, waste heat from a utility or industry, or geothermal wells

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District Heating and Cooling System Model




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District Energy in Europe

- Europe and Scandinavia were hit hard by the oil shocks of the 1970s.
- Many countries pursued programs to reduce imports and increase energy efficiency.
- In Denmark 60% of homes are on district energy systems.
- National and EU policies encourage DHC.

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Danish Biomass District Heating Plant



- 2 to 5 MWe biomass CHP plants can achieve thermal efficiencies above 90%
- NO cooling tower
- In US stand alone power plants <30% efficient

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District Heating System






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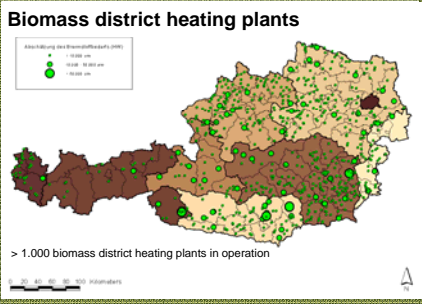
Community district heating with biomass

- Central heating plant for a village
500 kW - 30 MW
- energy distribution via hot water pipes
- since 1980 > 1.000 plants / approx. 1.000 MW heat load
- based on local initiatives
- supported by investment subsidies (40-50% for rural projects with agricultural background / max. 30% for enterprises)



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Biomass District Heating in Austria



Biomass district heating plants

> 1.000 biomass district heating plants in operation

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Hot Water District Heating with Combined Heat and Power

- 150 small systems installed in the U.S. between 1898 and 1905 using waste heat from electric power plants
- Most closed by the 1960's.
- Reintroduced in the U.S. in the 1980's.

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Hot Water District Heating in US

- Many high temperature (>175°F) systems on college campuses and military bases
- District Energy St. Paul - 278 MWth
 - Largest hot water system in North America
 - 80% of the downtown business district
 - 180 buildings and 300 homes

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Farmington, PA

- 2.4 mmbtu system
- 114.000 ft²
- 9 buildings
- Laundry - 1 mmbtu
- Less than 10 yd³ or less than 1 cord/day in winter
- Replaced propane




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Efficiency and Emissions Benefits

- Waste heat from power plants and industries = 30% of nation's energy use
- District heating/cooling systems improve energy efficiency and reduce emissions
- Europeans refer to these systems as "highways for low-carbon heat"

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District Energy Outcomes

- Use local renewable resources not imported oil
- Keep energy dollars in the community/region
- Reduce energy costs and alleviate fuel poverty
- Increase efficiency of energy production, distribution & use; reduce pollution
- Increase local electric generation capacity
- Use low cost thermal energy to promote economic development
- Give communities control over their energy future

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Obstacles to Overcome

- **State and Federal Policies**
 - Renewable Fuel and Electricity Standards
 - Renewable Portfolio Standards
 - Where is the HEAT???
- **Emissions Concerns**
 - PM 2.5 microns and smaller
 - Mercury, NOX, HCL
- **Sustainability Questions**
 - Stress Efficiency – CHP > 60%, Thermal > 80%
 - Require sustainable forest management
 - 300 MW Stand Alone - < 30%

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Forest Service Support


- Market Development and Industry Competitiveness Grants – WERC
- Woody Biomass Utilization Grants - FPL
- Community Wildfire Protection Program
- WERC Woody Biomass and Wood Energy Technical Assistance
- Community Wood Energy Program?

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For more information

<http://www.na.fs.fed.us/ea/werc/werc.shtml/>




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Heat with Wood

Cool the Planet



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