RURAL VOICES FOR CONSERVATION COALITION

WORKING TOGETHER TO FIND SOLUTIONS TO THE ECOLOGICAL AND ECONOMIC CHALLENGES OF THE RURAL WEST.

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Thermal Energy uses of Woody Biomass

Across the nation, rural communities are developing energy projects that use woody biomass to create thermal energy (heat). The use of woody biomass as a source of thermal energy can reduce our dependence on fossil fuels, enhance energy efficiency, cut consumer and industrial energy costs, strengthen rural economies, and aid in forest restoration. It is critical that policy addressing the development of woody biomass thermal applications support the integrated goals of promoting responsible stewardship of our national forests and contribute to the economic health of rural economies.

An Alternative to Fossil Fuels

Approximately one third of the energy consumed in the United States is used to produce thermal energy[1], and one third of thermal energy is generated from petroleum products.[2] Woody biomass is the most efficient source of thermal energy – up to 90% efficient[3] – and could replace approximately 30% of the nation's petroleum imports with a domestic, renewable fuel source. Nevertheless, national renewable energy policies have thus far ignored the thermal energy benefits of biomass utilization and focus their incentives on less efficient energy technologies such as electrical generation and transportation fuels. The development of a national Renewable Electricity Standard (RES) should value the role of thermal energy created from woody biomass and the energy efficiency gains that are captured by using "by-product" heat when generating electricity.

Efforts to reduce our dependence on foreign oil must be broader than improving combustion efficiencies of motor vehicles and substituting bio-based transportation fuels. While these will be part of the solution, so must reducing the amount of petroleum we use to generate thermal energy. Of the petroleum used to generate thermal energy in the United States, a large portion is dedicated to manufacturing processes. In addition, 12.6 million homes nationwide use heating oil (#2 fuel oil) and/or propane – both petroleum distillates – as their primary source of energy for home heating and hot water.[4]

1 Source: http://www.eia.doe.gov/emeu/aer/pecss_diagram.html; accessed 3/3/2009.

2 Source: http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbblpd_a.htm; accessed 3/3/2009.

3 Efficiency of each application varies according to a host of factors, however it typically ranges between 65-90%.

4 Source: http://www.cojoweb.com/ref-heating-oil-propane.html; accessed 3/3/2009; 8.1 million households – heating oil; 4.5 million households - propane.

Key Recomendations:

1. Develop a thermal energy component of national renewable energy policy that includes incentives for stand-alone biomass thermal energy generation and provides tax credits for capitalization costs of space heat projects.
2. Fund the Community Wood Energy Program and other relevant programs in the Food, Conservation, and Energy Act of 2008 and the Energy Independence and Security Act of 2007.
3. Promote wood bio-energy technologies with higher system efficiencies in a national Renewable Portfolio Standard (RPS) or Renewable Electricity Standard (RES) through policy mechanisms such as Renewable Energy Credit (REC), multipliers, and prioritizing the connection of smaller-scaled projects to the electricity grid (prioritized interconnection).
4. Use feed-in tariffs in an RPS or RES to incentivize development of appropriately scaled distributed biomass combined heat and power (CHP) systems that function as a source of wealth capture for forest-reliant rural communities.
5. A definition of renewable biomass in national renewable energy policy must include sustainably harvested material from private and public land, including National Forest System lands.

The use of woody biomass to generate thermal energy, both in stand-alone heat applications and in conjunction with electrical generation (i.e. combined heat and power (CHP) applications), provides a tremendous opportunity to, reduce our dependency on petroleum, reduce carbon emissions by displacing combustion of fossil fuels, support ecologically based forest restoration. and promote a distributed energy economy which includes rural communities as part of the solution.

Creating Thermal Energy is the Most Efficient use of Wood for Energy Production

Current federal energy policies that provide incentives (both regulatory and market-driven) for woody biomass focus on transportation and electricity generation and do not promote the most efficient use of woody biomass – the creation of thermal energy. The Renewable Fuels Standard (RFS) contained in the Energy Efficiency and Security Act of 2007 provides subsidies for the conversion of wood to cellulosic ethanol. The energy conversion for this technology ranges between 40-50% of the energy content in wood feedstocks.

Who We Are

The Rural Voices for Conservation Coalition is comprised of western rural and local, regional, and national organizations that have joined together to promote balanced conservation-based approaches to the ecological and economic problems facing the West. We are committed to finding and promoting solutions through collaborative, place-based work that recognizes the inextricable link between the long-term health of the land and well being of rural communities. We come from California, Oregon, Washington, Idaho, New Mexico, Montana, Arizona and Colorado.

The federal Production Tax Credit (PTC) extended for the generation of electricity from renewable resources provides a per kilowatt hour subsidy for biomass; efficiencies for generating electricity with wood range between 25-40% depending on the scale of the project. Comparatively, no current federal policy providing incentives exists for generating thermal energy from woody biomass although wood-fired boilers of varying scales operate in the range of 65-75% efficiency.

Combined heat and power systems (CHP) in which the production of electricity is coupled with the use of "by-product" heat load can extend overall system efficiencies upward of 80%. Woody biomass is well suited for CHP systems; these systems are typical at many forest products facilities that use thermal energy in on-site manufacturing processes such as drying lumber.

Heat-led CHP is a term used for systems designed around the heat produced in order to capture the maximum amount of heat generated from the production of electrical energy. The design of these systems lend themselves to smaller, distributed energy generation since a large-scale electrical generation (ie. 50 MW) facility would generate a vast amount of excess heat- too large to effectively use in any industrial manufacturing process. Smaller-scale energy systems are well suited to many rural communities located in proximity to public and private forests. Typically, heat-led CHP facilities operate at system efficiencies of at least 65%. For most manufacturing processes, CHP facilities from 0.5–5 MW capacity are most appropriate. For some intensive industrial processes, such as paper manufacturing, heat-led CHP systems up to 15 MW may be appropriate where thermal energy demand is extremely large.

Types of Thermal Energy

1. **Space heat** is the thermal energy needed to heat the physical space of a building; hospitals and schools are two primary examples of space heat users.
2. **Process heat** is the use of thermal energy in an industrial process. Process heat uses vary widely, including manufacturing processes like food packaging and drying lumber, but also include heating water for commercial buildings.

Using Woody Biomass to Create Thermal Energy Saves Money

Rising petroleum costs can have dramatic effects on businesses and residents dependent upon heating oil or propane for thermal energy. A typical rural school in the West might use 50,000 gallons or more of heating oil per year. From 2000-2006 heating oil prices in the US averaged $1.83/gallon.[5] During the fall and winter of the 2007-2008 school year, heating oil averaged $3.24/gallon[6], resulting in a $70,500 increase in annual heating costs for the typical rural school in the West. For industrial consumers, a similar price per gallon increase results in a significantly large increase in energy costs due to the increased scale of thermal energy needed in manufacturing processes. These increased manufacturing costs are typically passed on to consumers.

5 Source: http://tonto.eia.doe.gov/dnav/pet/hist/whoreus4w.htm; accessed 3/3/2009.

6 Source: http://www.eia.doe.gov/emeu/steo/pub/fsheets/real_prices.html; accessed 3/3/2009.

Using Woody Biomass to Create Thermal Energy Makes Sense

Reducing America's dependency on petroleum: Over 12 million homes nationwide use heating oil or propane as their primary source of energy for home heating and hot water. Replacing half of the thermal energy in homes and industrial processes that currently use petroleum-based fuels with heat generated from woody biomass could reduce our domestic oil consumption by over 1 billion barrels annually, roughly 1/7th of current consumption.[1]

Promoting energy efficiency: Using woody biomass to create thermal energy is currently the most efficient use of wood for energy production. Using woody biomass to generate heat alone can be up to 90% efficient[2], whereas using woody biomass to generate electricity alone ranges between 15-40% efficiency. In combined heat and power (CHP) systems, as the heat component increases and the electrical component decreases the overall system efficiencies can approach 80%.

Saving Americans money on heating costs: Using woody biomass to create heat instead of petroleum-based fuel sources can save rural homeowners over $1,000 on their annual energy costs; one rural school in eastern Oregon will save over $125,000 annually in heating costs after switching from heating oil to a wood-fired boiler. For industrial consumers, woody biomass fuels cost approximately 80% less than heating oil or propane to generate the same amount of thermal energy. These costs savings could have dramatic impacts for heat-intensive manufacturing processes.[3]

Keeping energy dollars local to build strong rural economies: For some communities who purchase energy outside of the local economy, as much as 75% of every dollar paid to the utility "leaks" out of the community. The jobs and services associated with procuring wood fuel or manufacturing densified energy products creates wealth that is re-circulated and reinvested in the community.[4]

Reducing carbon dioxide emissions: To produce the same amount of total energy, wood-fired combined heat and power (CHP) systems use one third of the feedstock volume of stand-alone electricity generation facilities due to gains in system efficiency. Therefore, a wood-fired CHP facility operating at 75% system efficiency (including the value of thermal energy) will produce one third of the emissions of a stand-alone facility operating at 25% efficiency while consuming the same volume of wood to produce the same amount of electricity.

1 Source: http://www.cojoweb.com/ref-heating-oil-propane.html; accessed 3/3/2009; 8.1 million households – heating oil; 4.5 million households - propane

2 Efficiency of each application varies according to a host of factors, however it typically ranges between 65-90%.

3 Source- see Table 1.

4 Shuman, Michael, November, 2005: Economics of Proposed Biomass-fired District Heating System for Santa Fe, New Mexico. Available online at: http://www.localenergy.org/documentLibrary.htm

Table 1. Cost efficiency and potential savings of various sources to generate thermal energy.

Energy Sources			Energy Costs		
Feedstock	Price/Unit[1]	MMBtu/unit[2]	$/MMBtu	Commercial[3]	Residential[4]
Wood Chips	$ 40 /green ton	10.1	$6.09	$27,525	n/a
Wood Pellets	$ 160 /ton	16.4	$12.20	$67,805	$1,153
Cordwood	$ 175/cord	19.5	$12.82	$62,372	$1,060
Natural Gas	$ 1.05 /therm	0.1	$13.13	$72,975	$1,241
Heating Oil	$ 2.95/gallon	0.139	$28.30	$147,500	$2,508
Propane	$ 2.10/gallon	0.0905	$29.01	$161,271	$2,742

1 Prices are subject to change and those used here represent average values.
2 CTA Group. Biomass Boiler Market Assessment Final Report, October 5, 2006.
3 Calculated based on the energy output of 50,000 gallons of heating oil consumption of a typical rural school. Consumption and cost for an industrial user would be significantly greater.
4 Calculated based on the energy output of 850 gallons of heating oil consumption of an average residence. Actual residential consumption is highly variable based on home insulation efficiency, geographic location, and year to year temperature variability.

While residential consumption varies by household, an average residential consumer uses 850 gallons of heating oil annually. The cost per gallon increase described above would result in an additional $1,200 in annual heating costs per year, or an increase of 77%. In contrast, consumption of transportation fuel per passenger car is around 600 gallons per year.[7] To result in a similar increase of costs ($1,200 per year), the national average for fuel prices would have to increase an additional $2.00 per gallon over current costs.

Using wood, either in chip or pellet form, to generate thermal energy is more efficient in terms of energy output per unit cost than other fossil fuel based sources. Table 1 above shows the cost per million British Thermal Units (MMBtu) for various sources of thermal energy and the potential energy cost savings from switching from petroleum-based sources to woody biomass for a commercial (ie. rural school) and residential consumer. After accounting for boiler efficiencies, wood chips are roughly 80% less costly to generate a MMBtu than petroleum-based fuels. Even when compared to natural gas, wood fuels are more cost efficient per unit of thermal energy. This cost relationship has potentially dramatic impacts for commercial and residential consumers. For example, a rural household could save over $1,500 per year in energy costs by switching from propane to wood pellets to heat their home.

Economic and Ecological Benefits to Rural Communities

Using woody biomass to generate thermal energy can have tremendous economic benefits for rural communities. Procuring wood chips or densified energy products locally can function as a source of wealth capture for forest-reliant communities. Instead of energy spending flowing out of the community, it can be recirculated within the community, directly in the form of wages, and indirectly resulting in additional community services.

Many rural communities throughout the West benefit from business investments in manufacturing wood-based densified energy products like pellets or bricks. As many rural, forest-reliant communities are surrounded by overstocked forests that are now prone to uncharacteristic wildfire, appropriately-scaled manufacturing facilities provide local employment and add value to the by-product of hazardous fuel reduction and forest restoration treatments on Federal lands. The manufacturing process for wood pellets needs thermal energy, resulting in an opportunity to co-locate and purchase the “by-product” heat from a CHP facility that generates electricity. These types of integrated facilities have the opportunity to place rural, forest-reliant communities across the West at the beginning of the energy pipeline instead of at the end.

Case in Point

By using woody biomass instead of heating oil to create thermal energy, the school in Enterprise, Oregon in the eastern part of the state is projected to save $125,000 annually on heating costs. This additional money can eventually be reallocated to improving the quality of education via staff increases and/or curriculum additions. Similar results have occurred in Montana where the US Forest Service’s Fuels for Schools initiative has been implemented.

7 Calculated using 12,000 miles per year per passenger vehicle and fuel efficiency of 20 miles per gallon.

Reducing Carbon Dioxide Emissions through Efficient Thermal Wood-Energy Systems

Promoting efficiency across energy sectors should be one aspect of reducing carbon dioxide emissions. Regardless of feedstock source, electrical generation by CHP facilities capture up to 50% more of overall energy (including thermal) when compared to stand-alone electricity generating facilities. To produce the same amount of total energy, CHP facilities use one-third of the feedstock volume of stand-alone facilities. Combusting less volume of any feedstock (coal, heating oil, propane, or wood) will result in reduced carbon dioxide emissions. A CHP facility operating at 75% system efficiency will reduce emissions by two-thirds compared to a stand-alone facility operating at 25% efficiency. By incentivizing heat-led CHP, national renewable energy policy will favor appropriately scaled and distributed electrical generation facilities that have a need to co-locate with a thermal energy consumer, thus promoting the most efficient capture of energy.

The development of national renewable energy legislation has the potential to significantly reduce our dependence on foreign oil, improve the health of our forested lands, and increase durable employment opportunities in rural communities. Yet, to achieve these goals, energy policy must consider a suite of renewable energy options, including thermal energy generated by woody biomass.

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