

The Use of Wood Biomass for Distributed Energy
Generation in Iowa;
A Modeling Approach Based on the Energy
Demands of Ethanol Energy Systems

Prepared by:
Midwest CHP Application Center
Located at the University of Illinois at Chicago
Steffen Mueller, PhD
(312) 355-3982
muellers@uic.edu

Prepared for:
The Iowa Department of Natural Resources
Jim Bodensteiner
(515) 281-8416

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Executive Summary

The study examines the use of wood biomass as a distributed energy source in Iowa. Wood biomass can come from a variety of sources including forest residues, primary mill residues, and urban wood waste. Utilizing biomass from these sources, the study assesses its conversion to energy in three types of wood biomass energy systems that are sized to meet the energy requirements of 100 million gallon per year ethanol plants. Then, the costs are compared to two natural gas fired energy systems commonly utilized in these size ethanol plants.

The three biomass energy systems include a fluidized bed boiler, a fluidized bed boiler with combined heat and power (CHP) and a biomass gasification system without CHP. The two natural gas fired energy systems consist of a boiler plant and a CHP system. While the study looks at 100 mgpy ethanol plants, the chosen size and application is only a reference point, and the results are transferable to other industrial distributed generation projects.

The study looks at the available wood biomass quantities in Iowa and the delivered costs to the plant gate. Biomass supply raw data was provided for this study by M&E Biomass (Oak Ridge, Tennessee), a consulting firm headed by Marie Walsh, who is a recognized expert in the field of biomass supply assessments. The raw data was analyzed using GIS software and an ethanol plant financial model developed by the Midwest CHP Application Center.

Since biomass is generally delivered to plant gates within a radius not to exceed 70 road miles, the study finds that there are about four different regions in Iowa where biomass concentrations merit use in industrial energy systems such as in ethanol plants. Three of these regions straddle the eastern border of Iowa along the Mississippi river, the fourth region is in the center of the state around Polk County.

The study finds that the biomass availability in these regions does not support the energy requirements of a 100 mgpy ethanol plant in any one region. However, depending on the region, ethanol plant energy systems ranging from 40 mgpy to 15 mgpy could be supported. To assure biomass availability an ethanol plant operator will be required to pay approximately \$80 per dry ton delivered or \$4.90 per MMBtu.

While natural gas is significantly more expensive in Iowa at \$8.05 per MMBtu, it has a capital cost advantage since natural gas fired energy generation equipment is less expensive than biomass fired equipment. Therefore, the present study takes fuel, O&M, and capital costs into consideration. Considering all cost components the study finds that wood biomass is very competitive with natural gas fired systems. In fact, the wood biomass CHP system is financially most attractive. While the natural gas fired system contributes about \$0.33 per gallon to the cost of ethanol produced, a biomass fired CHP system reduces these costs to \$0.30 per gallon.

The study assesses energy generation from wood waste only. Additional biomass resources (for example, corn stover) are likely available in higher quantities and could be used in combination with wood for energy generation.

1. Introduction

The purpose of this study is to assess the potential use of wood biomass as a distributed energy source in Iowa. The study is modeled on the energy demand of a 100-million-gallon-per-year ethanol production facility or an industrial facility with similar energy needs. The study looks both at the use of wood combustion (in a fluidized bed boiler) and wood gasification technologies for energy generation. The biomass fired systems are compared to natural gas fired energy systems, the currently most deployed technologies at ethanol plants.

The study determines first the available wood biomass resources in Iowa. In general biomass availability varies with the price a customer such as an ethanol plant is willing to pay. Secondly, the study compares the cost of biomass to ethanol plants with the cost of natural gas. Ethanol plants also utilize electricity: Since the electricity consumptions differ between biomass and natural gas fired facilities, a comparison also requires an assessment of the currently prevailing electricity rates in Iowa. Besides fuel and electricity costs, the capital costs of the energy equipment (boilers, turbines, dryers) and financing assumptions available for these systems in the market need to be determined. Taking the fuel and electricity costs as well as the capital cost and financing costs into consideration allows a direct comparison of the total energy costs incurred by ethanol plants using biomass versus natural gas fired systems.

2. Fuel Feedstocks

2.1 Biomass

2.1.1 Biomass Supply and Costs

Biomass fuel feedstocks differ from natural gas since cost, quantity, and quality vary significantly by region. The present study uses biomass cost assumptions based on supply curve raw data obtained from M&E Biomass. M&E Biomass, headed by Marie Walsh, is located in Oak Ridge Tennessee. The firm is well respected in the field of biomass supply modeling and assessments. Supply curves determine the quantity of specific qualities of waste wood types (forest residues, urban waste, etc) available for energy generation at different prices. With increasing prices an increasing quantity of waste wood is diverted from its current destination (i.e. landfills for construction waste) or current use (i.e. sawdust for animal bedding) to become an energy feedstock. The principal types of wood waste assessed in this study are:

1) Forest Residues:

The types of waste wood included in this category are logging residues and land clearing for future developments. Selected sources of information used in assessing the supply curves in this category are the Timber Products Output (TPO) Database from the USDA Forest Service and the Forest Inventory Analysis Program. This database is combined with projections from the Resource Policy Act (RPA) Assessment by the USDA Forest Service. The methodology is detailed in “Estimated U.S. Forest Residue Supply and Distribution – Documentation of Methodology and Data Sources” by Marie Walsh, November 18, 2007.

2) Primary Mill Residues:

Primary mills convert logs into other wood products and include sawmills that produce lumber, pulp mills, veneer mills, and others. In the process of converting trees into wood products, waste residues are generated consisting of bark and other fine wood residues. Wood biomass assessments from this source are largely based on the TPO database. The methodology is detailed in “Estimated U.S. Forest Industry Mill Residue Supply – Documentation and Methodology” by Marie Walsh, November 17, 2007.

3) Clean Urban Wood Wastes:

This category includes the wood components of municipal solid waste such as pallets, yard trimmings, construction wastes, and others. Selected sources of information include waste surveys conducted by the BioCycle Magazine, US Census data, and other publications. The methodology is described in “Estimated U.S. Urban Wood Waste Supply – Documentation of Methodology and Data Sources” by Marie Walsh, November 17, 2007.

We obtained biomass supply curves that identify the available waste wood quantity between the price range of \$20 to \$100. Appendix A shows the quantity by price for all three feedstocks. The available quantities from forest residues and clean urban wood waste do not increase significantly for prices paid in excess of \$70, whereas some additional supply becomes available from primary mill residues above this price level. For the present study we looked at two price levels: wood biomass available “at the source location” at \$40/dt and \$70/dt. At the source location refers to biomass prices that do not include transportation to the energy generation facility. Transportation cost estimates are added later. Depending on the feedstock and the region, some additional infrastructure developments may be required (for example collecting yard trimmings separately from urban wastes). The available amount of feedstock in dry tons from these three types of wood wastes at \$40 and \$70 by county is listed in Appendix B. The analysis of the supply curve raw data is detailed in the following.

The heating values for waste wood differ by wood type. The heating values assumed for the three different wood types are listed in Table 1 (Southern Forest Research Partnership Inc. 2007). As can be seen for primary mill residues the heating value for dry sawdust was assumed, for clean urban wood wastes an average of the heating values for wood pellets and dry wood (resinous and non-resinous), and for forest residues an average of the various different tree parts was assumed.

Table 1: Heating Values of Selected Wood Biomass

Fuel Type	Moisture Content (%)	Heating Value (MMBtu/ton)
Green Wood	50.0%	8.2
Seasoned Wood	20.0%	13.3
Dry Sawdust	13.0%	13.9
Wood Pellets	10.0%	14.4
Dry Wood (Non-resinous)	0.0%	16.3
Dry Wood (Resinous)	0.0%	19.3
Dry Stemwood	0.0%	16.4
Dry Bark	0.0%	16.9
Dry Branches	0.0%	17.3
Dry Needles	0.0%	17.5
Primary Mill Residues:		13.9
Clean Urban Wood Wastes		16.7
Forest Residues		17.0

Multiplying the assessed quantity by its heating values results in the available total heating quantity in MMBtu per county. Figure 1 and Figure 2 show the heating quantities by county. The maps were created with a GIS software product (Mapland by Software Illustrated). Maps of available biomass by county in dry tons are shown in Appendix C. Based on the maps, four different regions of increased biomass supply can be identified. Within each region biomass supplies can be concentrated with transportation distances that do not exceed 50-70 road miles. Table 2 below shows the counties that make up each region, the assigned region name, and the available heating quantities at \$40 and \$70 per

dt per county. Table 3 shows the total heating quantities by region (which differ since the heating values per dry ton differ) as well as the total available tons.

Multiplying the total available dry tons by \$40 or \$70 and dividing it by the available MMBtu in the region yields the average cost per MMBtu at the source. As can be seen the average costs per region range from \$4.25 to \$4.32 per MMBtu).

Multiplying the total available dt by \$50 or \$80 and dividing it by the available MMBtu yields the average costs per MMBtu delivered and therefore reflective of a \$10/dt transportation charge. The added \$10/dt transportation charge (personal conversation with Marie Walsh, M&E Biomass) results in delivered costs ranging from \$4.86 to \$4.94 per MMBtu. It should be noted that the transportation estimates are essentially break-even costs and don't provide an explicit return to the supplier. Implicit returns are provided at each price level such that if the breakeven price for a supplier is \$30/dt and \$40/dt is being paid, that supplier gets a \$10/dt return but suppliers whose breakeven cost is \$40/dt get no return. This approach may provide the appropriate returns in many but not all cases to provide the materials.

Looking at the available biomass quantities by selected region shows a good concentration of wood biomass in the “Central” region with a total of 800,000 MMBtu available annually. The biomass supply in this region is dominated by forest residues from Adair county and urban wood waste in Polk county. The “East” region has the highest concentration of biomass supply with 1,750,000 MMBtu. This region is dominated by forest residue supply from Scott county.

Table 2: Wood Biomass Supply by Selected Counties and Regions

Iowa	Total MMBtu at \$40/dt	Total dt at \$40/dt	Total MMBtu at \$70/dt	Total dt at \$70/dt	Biomass Region
Adair	222,430	14,174	304,290	18,984	Central
Adams	6,783	400	10,100	596	Central
Boone	34,098	2,017	49,971	2,954	Central
Dallas	28,740	1,720	37,198	2,226	Central
Madison	8,375	501	10,924	654	Central
Polk	213,778	12,794	280,964	16,815	Central
Story	42,177	2,524	55,926	3,347	Central
Warren	22,944	1,373	30,170	1,806	Central
Benton	123,659	8,645	332,019	23,512	East
Cedar	74,439	5,192	79,272	5,479	East
Clinton	36,968	2,198	52,323	3,109	East
Iowa	50,989	3,003	76,703	4,517	East
Jackson	123,441	7,262	192,003	11,293	East
Johnson	66,781	3,995	87,657	5,243	East
Jones	30,644	1,811	45,202	2,670	East

Iowa	Total MMBtu at \$40/dt	Total dt at \$40/dt	Total MMBtu at \$70/dt	Total dt at \$70/dt	Biomass Region
Linn	116,639	6,970	155,389	9,283	East
Muscatine	27,373	1,631	38,065	2,267	East
Scott	443,982	26,167	689,142	40,598	East
Allamakee	265,527	16,340	375,127	22,781	Northeast
Black Hawk	59,791	3,578	80,969	4,846	Northeast
Bremer	13,102	783	17,501	1,046	Northeast
Buchanan	9,932	594	13,465	806	Northeast
Chickasaw	37,172	2,600	39,382	2,732	Northeast
Clayton	178,385	11,076	276,800	17,242	Northeast
Delaware	42,368	2,498	63,551	3,745	Northeast
Dubuque	119,820	7,088	174,674	10,328	Northeast
Fayette	22,678	1,343	33,181	1,963	Northeast
Howard	8,022	476	11,502	683	Northeast
Winneshiek	40,175	2,371	59,799	3,527	Northeast
Appanoose	30,467	1,797	45,599	2,688	Southeast
Davis	84,142	5,678	135,588	9,188	Southeast
Des Moines	46,226	2,736	67,858	4,014	Southeast
Henry	148,464	10,349	159,690	11,013	Southeast
Jefferson	78,652	4,628	119,268	7,017	Southeast
Keokuk	62,513	3,678	94,874	5,580	Southeast
Lee	103,730	6,596	136,570	8,532	Southeast
Louisa	12,937	766	18,861	1,116	Southeast
Mahaska	20,855	1,236	30,198	1,789	Southeast
Monroe	25,207	1,484	38,041	2,240	Southeast
Van Buren	122,371	7,192	192,250	11,298	Southeast
Wapello	36,842	2,182	53,572	3,172	Southeast
Washington	52,892	3,118	79,006	4,656	Southeast

Table 3: Summary of Wood Biomass Supply and Cost in Selected Regions

Biomass Region	Total MMBtu by Region \$40/dt	Total dry tons per region at \$40/dt	Costs per MMBtu per region at \$40/dt	Costs per MMBtu per region at \$50/dt delivered	Total MMBtu by Region \$70/dt	Total dry tons per region at \$70/dt	Costs per MMBtu per region at \$70	Costs per MMBtu per region at \$80/dt delivered
Central	579,324	35,504	2.45	3.06	779,543	47,382	4.25	4.86
East	1,094,914	66,872	2.44	3.05	1,747,774	107,970	4.32	4.94
Northeast	796,972	48,748	2.45	3.06	1,145,951	69,699	4.26	4.87
Southeast	825,297	51,441	2.49	3.12	1,171,374	72,302	4.32	4.94

Wood Waste Energy Potential in Iowa

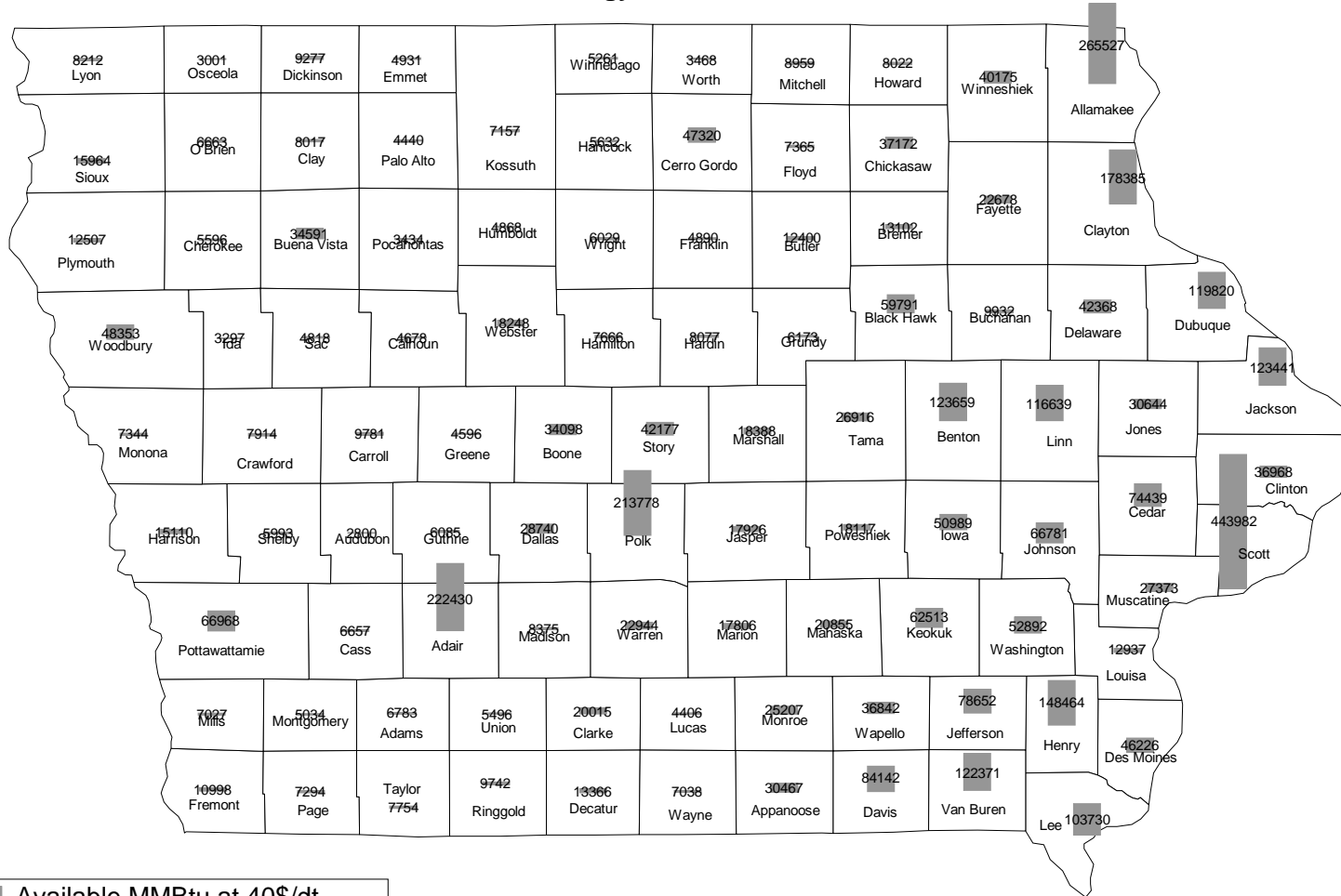


Figure 1: Wood Waste Heating Quantities at \$40/dt

2.1.2 Biomass Logistics:

Biomass energy projects require both a stable supply and consistent quality of biomass. The Montana Department of Natural Resources and Conservation (DNRC) administers the “Fuels for Schools” program in the state. Under this program several wood waste fired projects have been supported. To assure a consistent supply of fuel, the DNRC has compiled a very comprehensive bid process. The invitation to bid document to supply waste wood to a newly constructed waste wood boiler in the Eureka Public School District is reproduced in Appendix D. The invitation to bid document specifies the required moisture content, wood particle size, sampling and quality control procedures, and other logistics required for a wood biomass project. The particular fuel requirements are customized to the particular energy system (boiler) installed at the Eureka School District; fuel requirements and specifications obviously vary by energy system. However, the attached sample document provides a good overview of the level of detail of fuel specifications and logistics that need to be addressed in a wood biomass energy project.

2.2 Natural Gas

The study compares the overall costs to fuel biomass energy systems to the costs of similar systems fueled by natural gas. Therefore, meaningful natural gas cost assumptions to similarly sized energy systems have to be made. Natural gas fired ethanol plants generally fall into the large industrial customer class. Therefore, the natural gas cost assumptions for the present study are based on costs incurred by industrial customers in Iowa. According to the US DOE Energy Information Administration, these costs averaged 8.05 \$/MMBtu (EIA Natural Gas Price Calculator, www.eia.doe.gov)

2.3 Electricity

Determining the exact electricity costs available to ethanol plants is associated with relatively high uncertainties. While ethanol plants are large electricity users, oftentimes, their location at the end of a rural electric feeder results in electricity costs higher than those for comparative industrial customers. Therefore, electricity costs for ethanol plants are assumed to track average bundled costs to commercial customers of 0.073 \$/kWh in Iowa. This cost assumption is based on US DOE Energy Information Administration, Electric Power Annual with data for 2006, Report Released: October 22, 2007, Prices for "Total Electric Industry" to Commercial Customers.

3. Energy Systems

This section assesses the energy requirements and the costs of five different energy systems that can be used to fuel a 100 mgpy ethanol plant. The assessed systems are:

- Plant A: Natural Gas Non CHP
- Plant B: Natural Gas CHP
- Plant C: Biomass Non CHP Plant
- Plant D: Biomass CHP
- Plant E: Biomass Gasification Non CHP Plant

3.1 Ethanol Plant Energy Requirements

The energy requirements for each energy system are detailed below. More detailed information can be found in Mueller and Cuttica (2006).

Plant A: Natural Gas Fired Non-CHP System

A natural gas fired boiler consumes fuel with an annual heating value of 2,150,000 MMBtu. At a boiler efficiency of 80% the natural gas fired boiler generates 1,720,00 MMBtu of steam annually. The steam is used for cooking and distillation. Boiler steam is not used for drying since a direct fired dryer provides a more efficient way to dry the DDGS by-product. A total of 1,050,000 MMBtu of fuel is used in the natural gas direct fired dryer system (information by Henneman Engineering and EEA Inc.). Finally, a regenerative thermal oxidizer (RTO) is used for the destruction of volatile organic compounds (VOC) emitted from the energy system and the drying process. It is assumed that the RTO consumes 33,000 MMBtu annually.

Electricity is used in all stages of the ethanol production process since all stages utilize either motors, fans, or other electric components. The ethanol production process consumes about 0.75 kWh/gallon or 75,000 MWh (100 mgpy plant) annually (Roddy, 2006).

Plant B: Natural Gas Fired CHP System

A natural gas CHP plant will generally add a gas turbine CHP with a supplementary-fired heat recovery steam generator (HRSG). The gas turbine system considered was sized to ensure that all generated power would be used on-site. The gas turbine size chosen consists of a 7.2 MW gas turbine with supplemental firing to meet additional steam requirements not met by the exhaust recovery. Natural gas CHP systems consume slightly more thermal fuel (3,460,000 MMBtu) but purchase significantly less electricity (16,600 MWh) than the equivalent non CHP plant.

Plant C: Biomass Fired Plant

On a yearly basis, biomass with a heating value of 4,025,000 MMBtu is combusted in the fluidized bed boiler system of a 100 mgpy ethanol plant. At a boiler efficiency of 78%

the fluidized bed boiler system generates a total of 3,140,000 MMBtu of steam annually, 1,720,000 MMBtu is used for the combined cooking and distillation process, 1,420,000 MMBtu is used in a steam fired dryer. A biomass fired boiler of this type has a nominal capacity of approximately 350,000 lbs/hr of steam (Energy Products of Idaho, 2006).

Electricity use at a biomass fired plant is higher than in a natural gas fired one since an additional 15,000 MWh is required to operate the solid fuel handling equipment as well as the pumps and motors of the fluidized bed boiler.

A biomass fueled fluidized bed boiler may be configured so that the exhaust gases from the dryer can be rerouted back through the boiler for VOC destruction. Therefore, many biomass plants do not require a separate RTO.

Plant D: Biomass Fired CHP Plant

A biomass fired chp system adds a steam turbine for electricity generation. The steam turbine CHP system produces about 93% of the plant's total annual electricity needs. While the steam flows are the same in terms of lbs/hr of boiler output, the CHP system uses 10.1% additional biomass over the non-CHP base case in order to provide higher pressure and temperature steam for the turbine generator. Overall biomass use at the plant increases from 4,025,641 MMBtu/yr in the non-CHP base case to 4,431,356 MMBtu/yr with CHP, for a total increase in biomass consumption of 405,715 MMBtu/yr.

Plant E: Biomass Gasification Plant

The biomass gasification plant modeled for the present study is similar in concept to the system installed at the Corn Plus ethanol plant in Minnesota. An 80% efficient gasifier is generates producer gas that is fed to a boiler, dryer, and RTO system. The boiler, dryer, and RTO are identical to the natural gas fired plant equipment. In fact, the Corn Plus plant is a retrofit to an existing natural gas fired ethanol plant. Due to the efficiency loss in the gasifier, the biomass requirements are derived by dividing the natural gas fired boiler plant requirements by the gasifier efficiency resulting in 4,025,000 MMBtu (personal conversation with Frontline BioEnergy LLC, www.frontlinebioenergy.com).

Electricity requirements total about 90,000 MWh annually with 75,000 MWh used in the ethanol production process and 15,000 MWh required primarily for biomass fuel handling equipment. Similar to the natural gas fired plant a separate RTO is installed for VOC destruction. The RTO consumed 33,000 MMBtu annually.

Table 4 summarizes the fuel and electricity requirements for each ethanol plant energy system. Comparing the required biomass quantities for a 100 mgpy plant to the available biomass in the four Iowa regions with the highest biomass supply concentration shows insufficient biomass availability at the assessed price level of \$70/dt (\$80 delivered): For example, a biomass boiler system supplying a 100 mgpy ethanol plant requires 4 million MMBtu of biomass whereas the "East" region determined to yield the highest biomass concentration only produces 1.7 million MMBtu.

However, rather than fueling one 100 mgpy plant the available biomass supply can be used a) to fuel smaller systems or b) for co-firing in existing solid fuel (i.e. coal) boilers. For example, the 1.7 million MMBtu of biomass is likely sufficient to fuel the requirements of a 40 mgpy plant. The 1.1 million MMBtu available in the southeastern and northeastern regions can likely fuel the requirements of a 25 mgpy plant in each region, and the 700,000 MMBtu in the central region could likely support a 15 mgpy plant. Alternatively, the available biomass can be used in larger ethanol plants with solid fuel boilers in co-firing applications and contribute towards an equivalent size of ethanol output. In total, more than 105 million gallon of ethanol could be produced in these 4 regions from biomass. Furthermore, as mentioned above, at price levels in excess of \$70/dt (\$80 delivered) some additional biomass from primary mill residues becomes available. Conversely, at price levels less than \$70/dt (\$80 delivered) less biomass will be available. In fact at \$40/dt (\$50 delivered) the available wood biomass across the assessed four regions would suffice to fuel about 70 mgpy of ethanol production.

Table 4: Fuel and Electricity Requirements of 100 mgpy Ethanol Plant Energy Systems

	Plant A: Natural Gas Plant	Plant B: Natural Gas CHP	Plant C: Biomass Plant	Plant D: Biomass CHP	Plant E: Biomass Gasification
Fuel Quantity					
Required Fuel (MMBtu)	3,233,000	3,459,823	4,025,641	4,431,356	4,041,250
Purchased Power (kWh)	75,000,000	16,639,000	90,000,000	6,294,000	90,000,000

3.2 Ethanol Plant Energy System Costs

The equipment costs of natural gas fired and solid fuel plants are taken from Mueller and Cuttica (2006). The equipment costs for the biomass gasification plant are based on a personal conversation with Frontline Bioenergy LLC. The cost assumptions are summarized in Table 5.

Table 5: Fuel, Capital and O&M Cost of Ethanol Plant Energy Systems

	Plant A: Natural Gas Plant	Plant B: Natural Gas CHP	Plant C: Biomass Plant	Plant D: Biomass CHP	Plant E: Biomass Gasification
Capital Cost					
Firetube Boiler Cost (\$)	1,200,000	N/A	20,000,000	23,000,000	1,200,000
Dryer (\$)	7,420,000	7,420,000	17,250,000	17,250,000	7,420,000
RTO (\$)	2,750,000	2,750,000	N/A	N/A	2,750,000
Pipeline Cost (\$)	1,440,000	1,440,000	N/A	N/A	1,440,000
Gas Turbine or Steam Turbine	N/A	9,000,000	N/A	3,605,000	25,000,000
Total Energy System Capital Cost (\$)	12,810,000	20,610,000	37,250,000	43,855,000	37,810,000
O&M Cost					
Personnel Cost (\$)	100,000	100,000	200,000	200,000	200,000
Emissions Operating Permitting Fees (\$)	2,500	2,500	20,000	20,000	2,500
Turbine O&M (\$)	N/A	437,708	N/A	209,265	incl. in personnel
Disposables (\$)			166,000	166,000	
Boiler System Maintenance (\$)	incl. in personnel	N/A	360,000	360,000	incl. in personnel
Total O&M Cost (\$)	102,500	540,208	746,000	955,265	202,500

The useful life of a dry mill ethanol plant is estimated to be between 30 to 60 years (Jeff Laut with Broin, quoted in Ethanol Producers Magazine, May, 2006, p. 69). More conservatively, the useful life of energy producing equipment is rated at 20 years (ASHRAE Handbook, HVAC Applications, 1995). Financing assumptions detailed by BBI international for dry mill ethanol plants are as follows: 10 to 15 year loans with 35 % to 40% equity. The loan interest rates are 2% to 2.5% over prime rate (BBI Ethanol Plant Handbook). For the purpose of this study the loan duration is assumed to be 12 years with an interest rate of 10% (2% over an 8% prime rate).

While not enough biomass is available to fuel a single 100 mgpy plant, the study has shown that enough biomass is available for multiple projects (3 to 4) cumulatively achieving this capacity level. Therefore, the 100 mgpy single plant model was used for comparison purposes although the costs of multiple projects may be different due to economies of scale effects. However, since natural gas and biomass plants alike would be

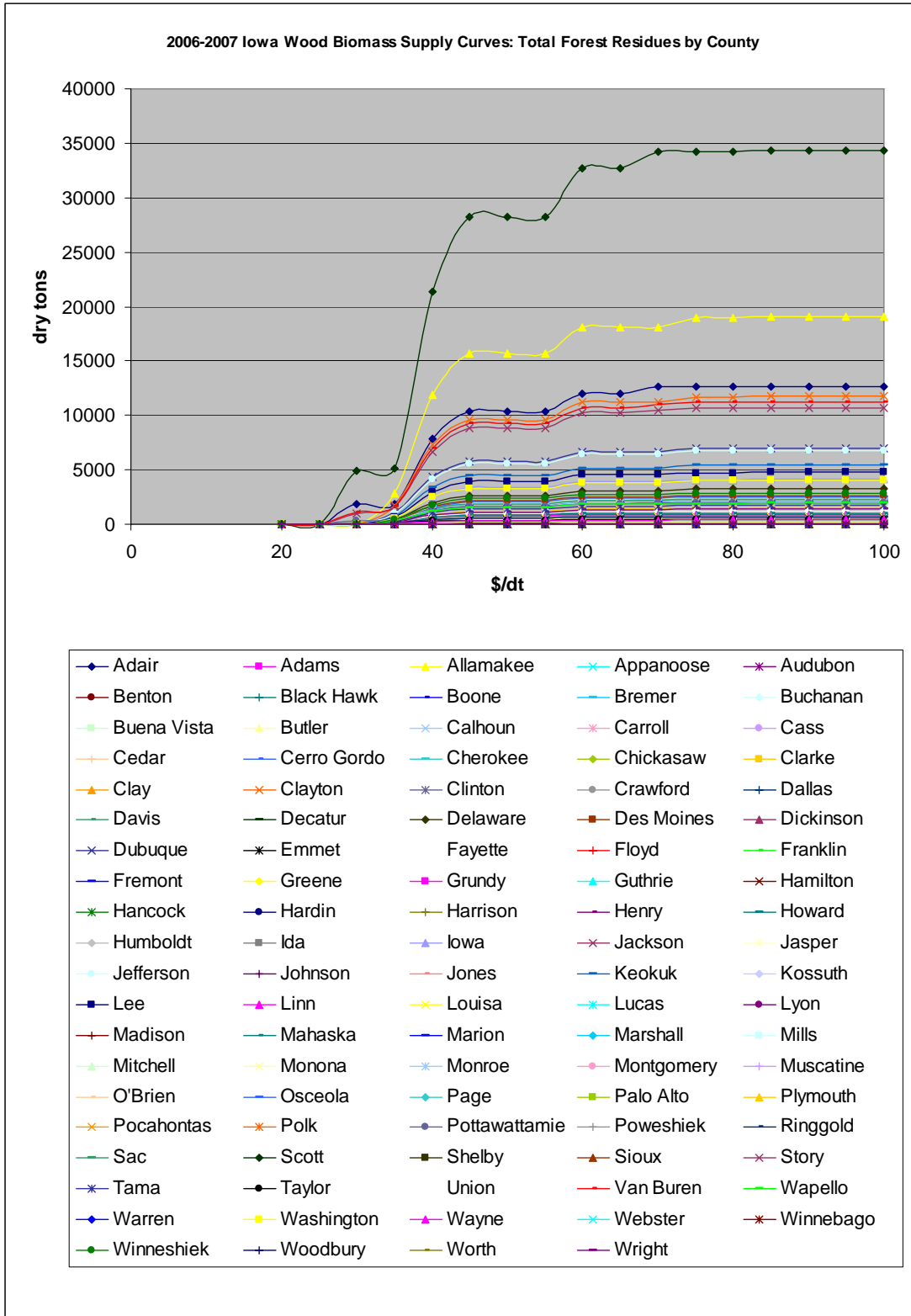
affected by these effects, the overall error is likely very small. Therefore, the 100 mgpy single plant model was used in the cost comparison analysis detailed below.

Combining the financing assumptions with the capital, O&M and fuel costs determined above the total energy system cost can be calculated. The spreadsheet model used in this analysis can be downloaded at www.lifecycleassociates.com. Table 6 shows that the total cost for all three biomass fired energy systems are very similar to the natural gas fired ones. Therefore, under the stated assumptions, biomass is an attractive alternative to natural gas fired systems. In fact, the biomass fired chp system is the least expensive one with \$29.7 million despite the higher initial equipment capital cost. The natural gas standard energy system (non-chp) is the most expensive one with \$33.5 million annual cost. On a per gallon of ethanol produced basis, a natural gas fired energy systems contributes about \$0.33 to the costs of each gallon, whereas a biomass chp system is less expensive at \$0.30 per gallon. However, biomass costs in excess of \$70 may alter the financial attractiveness of this fuel relative to natural gas.

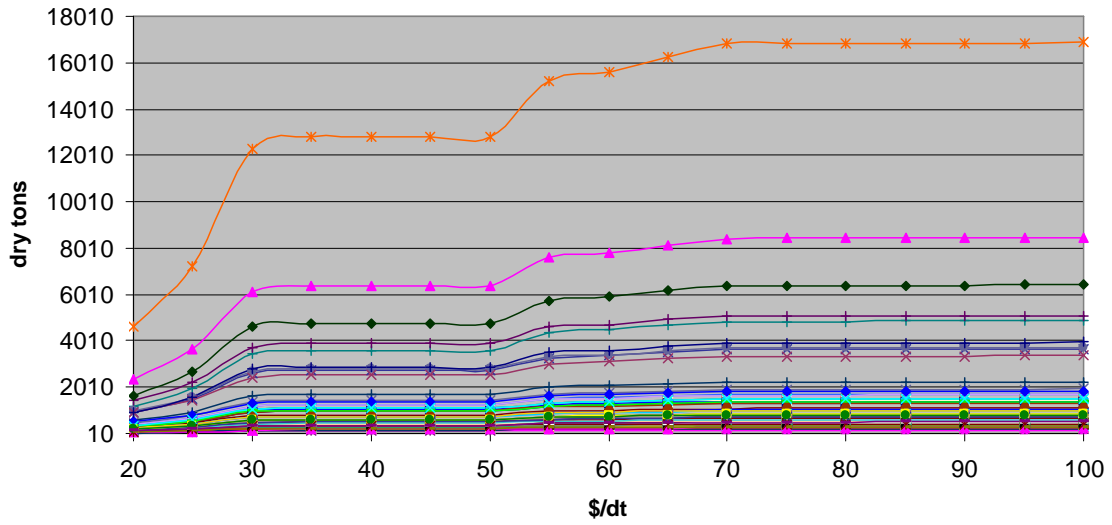
Table 6: Energy System Cost Comparison

	Plant A: Natural Gas Plant	Plant B: Natural Gas CHP	Plant C: Biomass Plant	Plant D: Biomass CHP	Plant E: Biomass Gasification
Required Fuel (MMBtu)	3,233,000	3,459,823	4,025,641	4,431,356	4,041,250
Purchased Power (kWh)	75,000,000	16,639,000	90,000,000	6,294,000	90,000,000
Delivered Fuel Cost (\$)	26,036,636	27,863,332	19,886,667	21,890,899	19,963,775
Electric Cost (\$)	5,467,500	1,212,983	6,561,000	458,833	6,561,000
Other O&M Cost (\$)	<u>102,500</u>	<u>540,208</u>	<u>746,000</u>	<u>955,265</u>	<u>202,500</u>
Total Fuel and O&M (\$)	31,606,636	29,616,522	27,193,667	23,304,996	26,727,275
Total Energy System Capital Cost (\$)	12,810,000	20,610,000	37,250,000	43,855,000	37,810,000
Annualized Loan Payments (\$)	1,880,038	3,024,792	5,466,933	6,436,305	5,549,121
Add: Fuel and O&M Cost (\$)	<u>31,606,636</u>	<u>29,616,522</u>	<u>27,193,667</u>	<u>23,304,996</u>	<u>26,727,275</u>
Total Annual Energy System Cost (\$)	33,486,674	32,641,314	32,660,600	29,741,301	32,276,396
Energy system cost per gallon (\$)	0.33	0.33	0.33	0.30	0.32

Appendix A: Wood Biomass Supply Curves by County

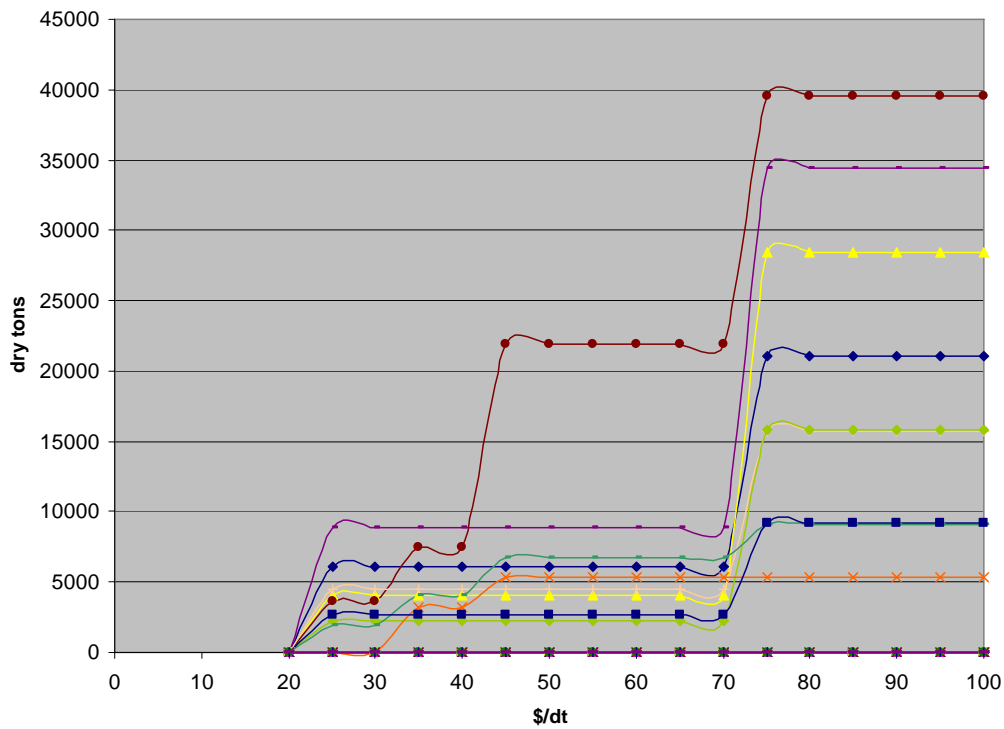


2006-2007 Iowa Wood Biomass Supply Curves: Clean Urban Wood Wastes by County



- | | | | | |
|-------------|-------------|---------------|------------|-----------|
| Adair | Adams | Allamakee | Appanoose | Audubon |
| Benton | Black Hawk | Boone | Bremer | Buchanan |
| Buena Vista | Butler | Calhoun | Carroll | Cass |
| Cedar | Cerro Gordo | Cherokee | Chickasaw | Clarke |
| Clay | Clayton | Clinton | Crawford | Dallas |
| Davis | Decatur | Delaware | Des Moines | Dickinson |
| Dubuque | Emmet | Fayette | Floyd | Franklin |
| Fremont | Greene | Grundy | Guthrie | Hamilton |
| Hancock | Hardin | Harrison | Henry | Howard |
| Humboldt | Ida | Iowa | Jackson | Jasper |
| Jefferson | Johnson | Jones | Keokuk | Kossuth |
| Lee | Linn | Louisa | Lucas | Lyon |
| Madison | Mahaska | Marion | Marshall | Mills |
| Mitchell | Monona | Monroe | Montgomery | Muscatine |
| O'Brien | Osceola | Page | Palo Alto | Plymouth |
| Pocahontas | Polk | Pottawattamie | Poweshiek | Ringgold |
| Sac | Scott | Shelby | Sioux | Story |
| Tama | Taylor | Union | Van Buren | Wapello |
| Warren | Washington | Wayne | Webster | Winnebago |
| Winneshiek | Woodbury | Worth | Wright | |

2006-2007 Iowa Wood Biomass Supply Curves: Primary Mill Residues by County



- | | | | | |
|---------------|---------------|-----------------|--------------|-------------|
| ◆ Adair | ◆ Adams | ▲ Allamakee | ◆ Appanoose | ◆ Audubon |
| ● Benton | ◆ Black Hawk | ◆ Boone | ◆ Bremer | ◆ Buchanan |
| ◆ Buena Vista | ▲ Butler | ◆ Calhoun | ◆ Carroll | ◆ Cass |
| ◆ Cedar | ◆ Cerro Gordo | ◆ Cherokee | ◆ Chickasaw | ◆ Clarke |
| ▲ Clay | ◆ Clayton | ◆ Clinton | ◆ Crawford | ◆ Dallas |
| ◆ Davis | ◆ Decatur | ◆ Delaware | ◆ Des Moines | ◆ Dickinson |
| ◆ Dubuque | ◆ Emmet | ◆ Fayette | ◆ Floyd | ◆ Franklin |
| ◆ Fremont | ◆ Greene | ◆ Grundy | ◆ Guthrie | ◆ Hamilton |
| ◆ Hancock | ◆ Hardin | ◆ Harrison | ◆ Henry | ◆ Howard |
| ◆ Humboldt | ◆ Ida | ◆ Iowa | ◆ Jackson | ◆ Jasper |
| ◆ Jefferson | ◆ Johnson | ◆ Jones | ◆ Keokuk | ◆ Kossuth |
| ◆ Lee | ◆ Linn | ◆ Louisa | ◆ Lucas | ◆ Lyon |
| ◆ Madison | ◆ Mahaska | ◆ Marion | ◆ Marshall | ◆ Mills |
| ◆ Mitchell | ◆ Monona | ◆ Monroe | ◆ Montgomery | ◆ Muscatine |
| ◆ O'Brien | ◆ Osceola | ◆ Page | ◆ Palo Alto | ◆ Plymouth |
| ◆ Pocahontas | ◆ Polk | ◆ Pottawattamie | ◆ Poweshiek | ◆ Ringgold |
| ◆ Sac | ◆ Scott | ◆ Shelby | ◆ Sioux | ◆ Story |
| ◆ Tama | ◆ Taylor | ◆ Union | ◆ Van Buren | ◆ Wapello |
| ◆ Warren | ◆ Washington | ◆ Wayne | ◆ Webster | ◆ Winnebago |
| ◆ Winneshiek | ◆ Woodbury | ◆ Worth | ◆ Wright | |

Appendix B: Table of Available Wood Biomass by County

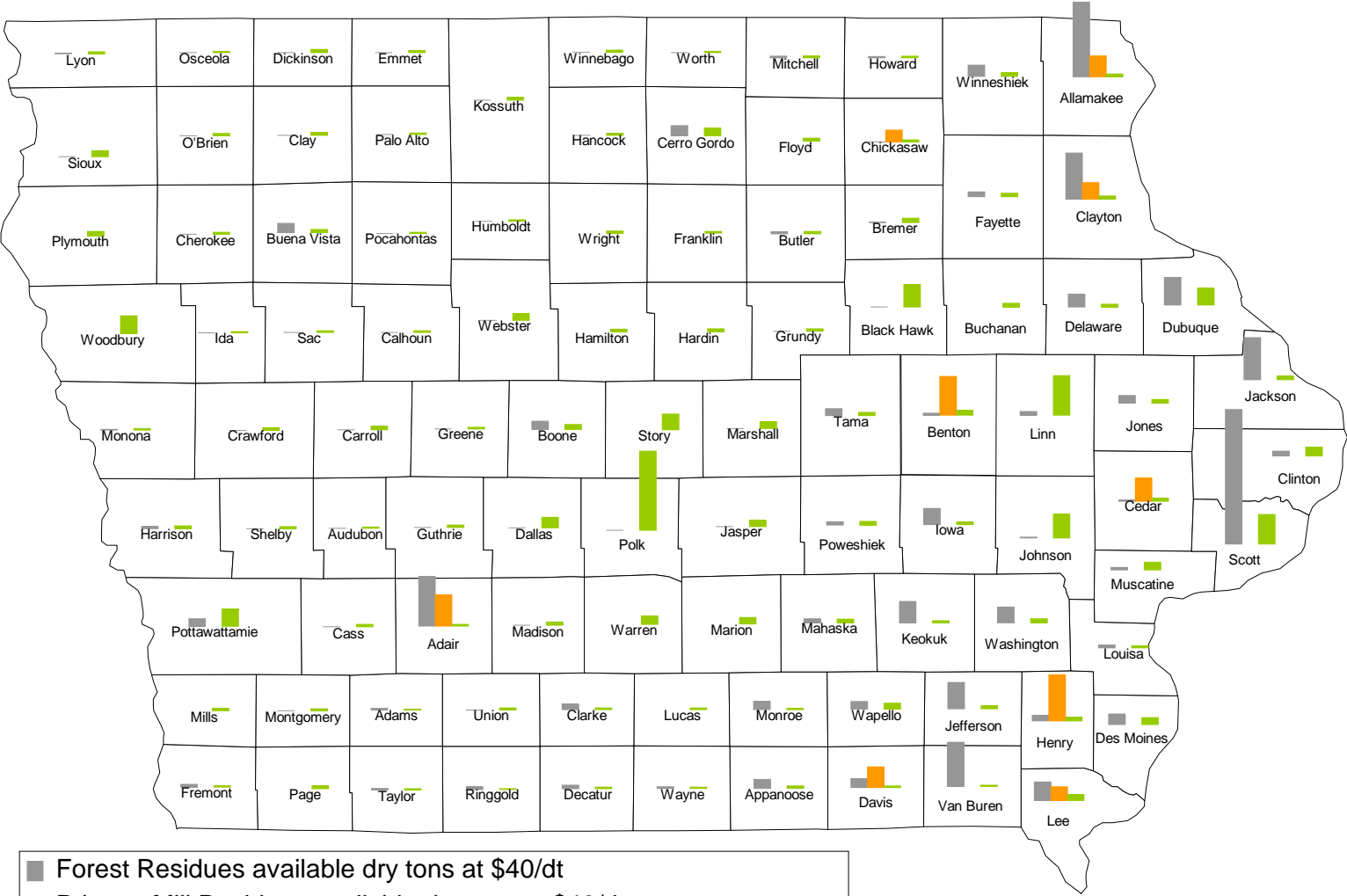
Iowa	Forest Residues dry tons at \$40/dt	Primary Mill Residues dry tons at \$40/dt	Clean Urban Wood Wastes dry tons at \$40/dt	Forest Residues dry tons at \$70/dt	Primary Mill Residues dry tons at \$70/dt	Clean Urban Wood Wastes dry tons at \$70/dt	Total MMBtu at \$40/dt	Total MMBtu at \$40/dt
Adair	7,859	6,076	239	12,589	6,076	319	222,430	304,290
Adams	287	0	113	440	0	156	6,783	10,100
Allamakee	11,843	4,044	453	18,135	4,044	602	265,527	375,127
Appanoose	1,423	0	374	2,178	0	510	30,467	45,599
Audubon	0	0	168	0	0	232	2,800	3,881
Benton	317	7,514	814	485	21,945	1,082	123,659	332,019
Black Hawk	0	0	3,578	1	0	4,845	59,791	80,969
Boone	1,264	0	753	1,936	0	1,018	34,098	49,971
Bremer	47	0	736	73	0	973	13,102	17,501
Buchanan	0	0	594	0	0	806	9,932	13,465
Buena Vista	1,493	0	549	2,391	0	750	34,591	53,236
Butler	323	0	413	494	0	563	12,400	17,831
Calhoun	0	0	280	0	0	385	4,678	6,439
Carroll	0	0	585	0	0	795	9,781	13,280
Cass	0	0	398	0	0	541	6,657	9,045
Cedar	194	4,449	548	298	4,449	732	74,439	79,272
Cerro Gordo	1,572	0	1,230	2,407	0	1,680	47,320	69,059
Cherokee	0	0	335	0	0	459	5,596	7,679
Chickasaw	11	2,256	333	17	2,256	459	37,172	39,382
Clarke	917	0	264	1,404	0	356	20,015	29,854
Clay	0	0	480	0	0	649	8,017	10,848
Clayton	7,302	3,233	540	11,181	5,336	725	178,385	276,800
Clinton	775	0	1,423	1,187	0	1,922	36,968	52,323
Crawford	0	0	474	0	0	642	7,914	10,735
Dallas	0	0	1,720	1	0	2,226	28,740	37,198
Davis	1,414	4,024	241	2,165	6,696	327	84,142	135,588
Decatur	557	0	233	853	0	318	13,366	19,824
Delaware	2,008	0	489	3,075	0	670	42,368	63,551
Des Moines	1,638	0	1,097	2,508	0	1,505	46,226	67,858
Dickinson	0	0	555	0	0	726	9,277	12,129
Dubuque	4,367	0	2,721	6,687	0	3,641	119,820	174,674
Emmet	0	0	295	0	0	401	4,931	6,703
Fayette	770	0	573	1,179	0	784	22,678	33,181
Floyd	0	0	441	0	0	606	7,365	10,120
Franklin	0	0	293	0	0	399	4,890	6,672
Fremont	429	0	221	658	0	298	10,998	16,175
Greene	0	0	275	0	0	375	4,596	6,273
Grundy	0	0	369	0	0	494	6,173	8,260
Guthrie	0	0	364	1	0	481	6,085	8,040
Hamilton	0	0	459	0	0	622	7,666	10,391

Iowa	Forest Residues dry tons at \$40/dt	Primary Mill Residues dry tons at \$40/dt	Clean Urban Wood Wastes dry tons at \$40/dt	Forest Residues dry tons at \$70/dt	Primary Mill Residues dry tons at \$70/dt	Clean Urban Wood Wastes dry tons at \$70/dt	Total MMBtu at \$40/dt	Total MMBtu at \$40/dt
Hancock	0	0	337	0	0	455	5,632	7,609
Hardin	0	0	483	0	0	665	8,077	11,105
Harrison	413	0	484	631	0	643	15,110	21,484
Henry	866	8,900	583	1,326	8,900	786	148,464	159,690
Howard	203	0	273	311	0	371	8,022	11,502
Humboldt	0	0	291	0	0	392	4,868	6,557
Ida	0	0	197	0	0	272	3,297	4,538
Iowa	2,547	0	457	3,900	0	617	50,989	76,703
Jackson	6,675	0	586	10,503	0	790	123,441	192,003
Jasper	0	0	1,073	0	0	1,450	17,926	24,229
Jefferson	4,195	0	433	6,424	0	593	78,652	119,268
Johnson	107	0	3,887	164	0	5,078	66,781	87,657
Jones	1,229	0	582	1,881	0	789	30,644	45,202
Keokuk	3,371	0	307	5,161	0	419	62,513	94,874
Kossuth	0	0	428	0	0	591	7,157	9,885
Lee	2,954	2,667	975	4,524	2,667	1,341	103,730	136,570
Linn	563	0	6,407	862	0	8,421	116,639	155,389
Louisa	432	0	334	661	0	455	12,937	18,861
Lucas	0	0	264	0	0	360	4,406	6,017
Lyon	158	0	330	242	0	448	8,212	11,605
Madison	0	0	501	1	0	653	8,375	10,924
Mahaska	622	0	614	953	0	836	20,855	30,198
Marion	0	0	1,066	0	0	1,398	17,806	23,359
Marshall	0	0	1,100	1	0	1,495	18,388	24,996
Mills	0	0	421	0	0	571	7,027	9,536
Mitchell	234	0	298	358	0	407	8,959	12,900
Monona	154	0	283	235	0	381	7,344	10,364
Monroe	1,275	0	210	1,952	0	288	25,207	38,041
Montgomery	0	0	301	0	0	415	5,034	6,928
Muscatine	393	0	1,237	602	0	1,665	27,373	38,065
O'Brien	0	0	399	0	0	543	6,663	9,082
Osceola	0	0	180	0	0	247	3,001	4,130
Page	0	0	437	0	0	598	7,294	10,001
Palo Alto	0	0	266	0	0	364	4,440	6,076
Plymouth	0	0	748	0	0	1,000	12,507	16,704
Pocahontas	0	0	205	0	0	286	3,434	4,787
Polk	1	0	12,793	2	0	16,813	213,778	280,964
Pottawattamie	1,200	0	2,785	1,923	0	3,688	66,968	94,350
Poweshiek	503	0	572	770	0	763	18,117	25,873
Ringgold	434	0	141	664	0	194	9,742	14,553
Sac	0	0	288	0	0	397	4,818	6,637
Scott	21,383	0	4,784	34,200	0	6,397	443,982	689,142
Shelby	0	0	359	0	0	486	5,993	8,126
Sioux	0	0	955	0	0	1,279	15,964	21,369

Iowa	Forest Residues dry tons at \$40/dt	Primary Mill Residues dry tons at \$40/dt	Clean Urban Wood Wastes dry tons at \$40/dt	Forest Residues dry tons at \$70/dt	Primary Mill Residues dry tons at \$70/dt	Clean Urban Wood Wastes dry tons at \$70/dt	Total MMBtu at \$40/dt	Total MMBtu at \$40/dt
Story	0	0	2,524	0	0	3,347	42,177	55,926
Tama	1,076	0	514	1,648	0	694	26,916	39,654
Taylor	281	0	178	431	0	244	7,754	11,413
Union	1	0	328	1	0	448	5,496	7,509
Van Buren	6,983	0	209	11,012	0	286	122,371	192,250
Wapello	1,189	0	994	1,820	0	1,351	36,842	53,572
Warren	0	0	1,373	0	0	1,806	22,944	30,170
Washington	2,494	0	625	3,818	0	838	52,892	79,006
Wayne	242	0	175	370	0	241	7,038	10,323
Webster	0	0	1,092	1	0	1,485	18,248	24,819
Winnebago	0	0	315	0	0	429	5,261	7,168
Winneshiek	1,777	0	594	2,721	0	806	40,175	59,799
Woodbury	0	0	2,894	0	0	3,923	48,353	65,546
Worth	0	0	208	0	0	284	3,468	4,753
Wright	0	0	361	0	0	497	6,029	8,305

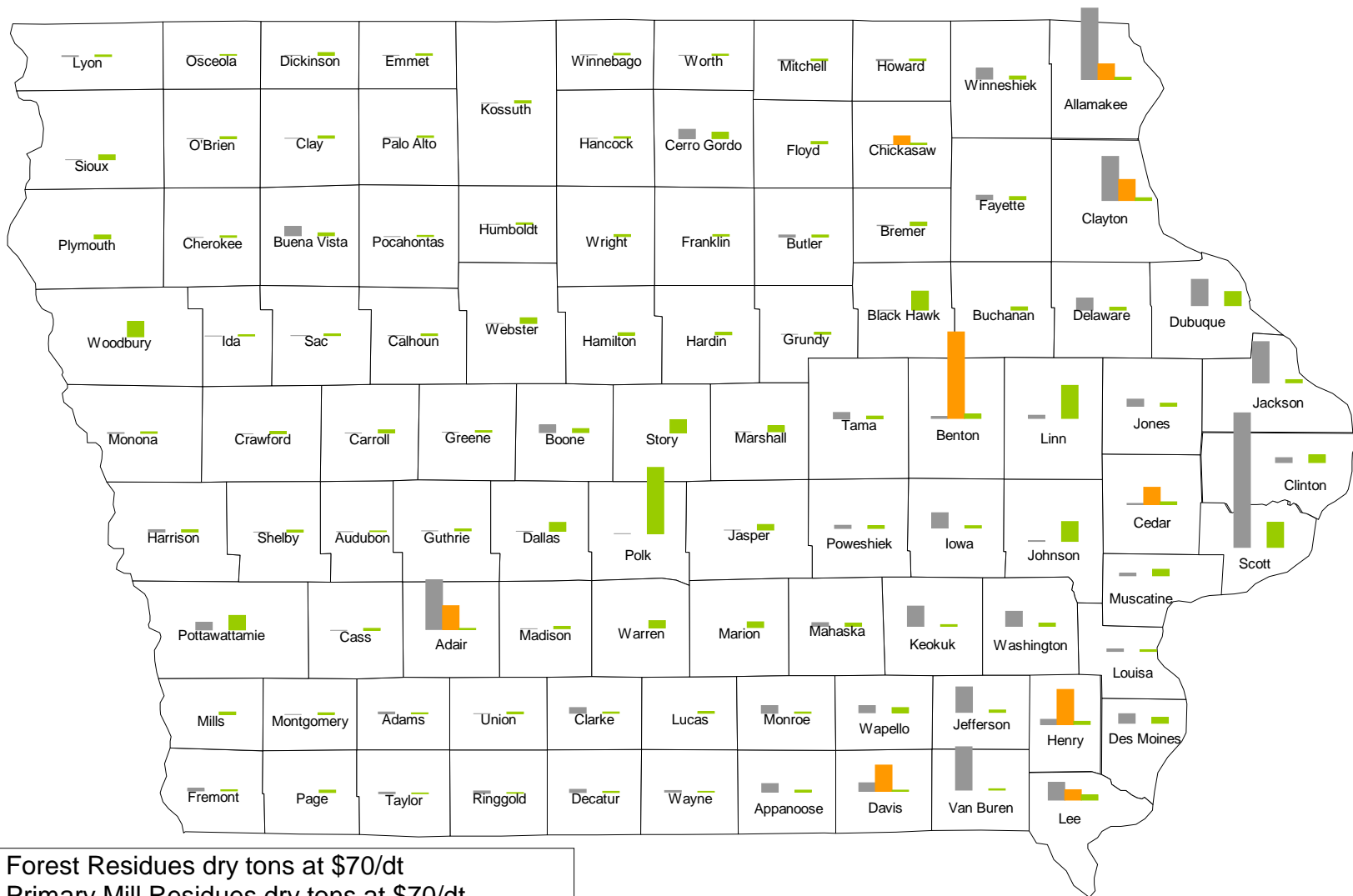
Appendix C: Maps of Available Biomass Supply by County

Wood Waste Supply Potential in Iowa



Forest Residues available dry tons at \$40/dt
 Primary Mill Residues available dry tons at \$40/dt
 Clean Urban Wood Wastes available dry tons at \$40/dt

Wood Waste Supply Potential in Iowa



Appendix D: Waste Wood Sample Bid Document

Eureka Public Schools Invitation to Bid – Biomass Fuel Supply

Invitation to Bid

PUBLIC NOTICE

INVITATION TO BID FOR BIOMASS FUEL SUPPLY Eureka Public Schools

The Board of Trustees for Eureka Public Schools in Eureka, Montana is seeking written bids for the supply of woody biomass fuel to utilize in the new wood-fired boiler to be constructed during the summer of 2007. The boiler is anticipated to be operational in October of 2007, at which time deliveries of fuel to the storage facility would be expected to commence. The anticipated annual fuel usage will be 850 "green" tons (averaging 40% moisture content). Fuel use will vary throughout the year, however, with greater consumption requirements during the heating months and significantly reduced consumption requirements during the summer and shoulder seasons.

Further information pertaining to this Invitation to Bid can be obtained from Gary Blaz, Eureka Schools Superintendent, P.O. Box 2000, Eureka MT 59917, (406) 297-5637. To be considered, all bids must be directly submitted to _____ by 2:00 p.m. (local time), June 22, 2007. ONLY BIDS RECEIVED AT THE SCHOOL DISTRICT OFFICE ON OR BEFORE THAT TIME WILL BE CONSIDERED -- FAX BIDS WILL NOT BE ACCEPTED. All bids will be opened and read aloud at that time and place and taken under advisement. A recommendation as to which bid (if any) should be accepted will be made to the Board of Trustees by the Administration at its regular Board meeting scheduled for _____. All bids must be sealed and plainly marked "Biomass Fuel Supply Bid".

The Board of Trustees reserves the right to reject any and all bids, to waive formalities, and to accept the bid deemed most advantageous to the School District.

**Gary Blaz, Superintendent
Eureka Public Schools
P. O. Box 2000
Eureka, MT 59917**

PUBLICATION DATES:

Eureka Public Schools
Invitation to Bid – Biomass Fuel Supply

<u>Table of Contents</u>	<u>Page Number</u>
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Bid / Award Process	3
Bid Security	4
Contract Structure	4
Specifications	4-11
Anticipated Schedule of Events	11
Bid Form	12

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

INTRODUCTION AND PURPOSE OF INVITATION

Thank you for your interest. Please consider the contents of this document our invitation for your bid to provide a high-quality and reliable supply of woody biomass fuel to utilize in the new wood-fired boiler to be installed to heat Eureka Public Schools. The boiler is anticipated to be operational in the fall of 2007, at which time deliveries of fuel to the storage facility would be expected to commence. The anticipated annual fuel usage will be 850 "green" tons (averaging 40% moisture content) annually. Fuel use will vary throughout the year, however, with greater consumption requirements during the heating months and significantly reduced consumption requirements during the summer and shoulder seasons.

It is the intent of the District to receive sealed bids from interested suppliers up to 2:00 p.m., June 22, 2007. Further information may be obtained from the following:

Gary Blaz, Superintendent
Eureka Public Schools
P. O. Box 2000
Eureka, MT 59917

BID / AWARD PROCESS

To be considered, all bids must be directly submitted to _____ by 2:00 p.m. (local time), June 22, 2007. All bids will be opened and read aloud at that time and place and taken under advisement by the Board of Trustees. A recommendation as to which bid (if any) should be accepted will be made to the Board of Trustees by the Administration at its regular Board meeting scheduled for June 21st, 2007 . All bids must be sealed and plainly marked "Biomass Fuel Supply Bid".

The District anticipates awarding a contract to the lowest responsible and responsive bidder, as measured by the specifications set forth in this Invitation to Bid. The Board of Trustees of Eureka Public Schools, Eureka, Montana reserves the right, however, to reject any and all bids, to waive formalities, and to accept the bid deemed most advantageous to the School District.

For further information, please contact

Gary Blaz, Superintendent
Eureka Public Schools
P. O. Box 2000
Eureka, MT 59917

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

BID SECURITY

In accordance with the requirements of § 18-1-201 *et seq.* MCA, each bid must be accompanied by either (1) lawful money of the United States, (2) cashier's check, certified check, bank money order, or bank draft, in any case drawn and issued by a federally chartered or state-chartered bank insured by the FDIC or (3) a bid bond or bond executed by a surety company authorized to do business in the State of Montana, and made payable to the District in the amount of ten (10) percent of the bid. Such check or bond will be returned to all except the three (3) lowest bidders within three (3) days after the opening of the bids, and the remaining checks or bonds will be returned promptly after the District and the accepted bidder have executed the supply contract, but in no event any later than sixty (60) days after the date of the opening of bids.

CONTRACT TERM AND STRUCTURE

The contract will run from October 1, 2007 through September 30, 2008 unless terminated earlier in accordance with its terms, and may be extended for an additional two year period upon mutual agreement of the parties. The contract documents for this fuel supply contract will consist of the terms of this Invitation to Bid (including but not limited to the following Specifications), the Bid Form and a separate written contract to be entered into between the Board of Trustees and the successful bidder.

SPECIFICATIONS

FUEL TYPE

The following specifications for fuel type are intended to clearly describe the anticipated tolerances of the biomass boiler equipment. In practical terms, compliance issues with size and material specifications will only occur if and when problems are encountered with fuel feeding through the system, or with ash production or other significant maintenance problems associated with fuel composition. When and if necessary, compliance with size specifications will be measured by determining that 100% of a representative sample of fuel delivered passes through an inclined vibratory screen with 6" round holes, and not more than 10% passes through a screen with 1/16" holes.

1. Fuel shall be biomass comprised of wood wastes of conifer or deciduous trees processed as described below. Bidders will specify whether a chipper or grinder will be used to process the fuel.
1. Fuel shall be reduced to a size range, which can be efficiently fired in the Eureka Public Schools boiler installation. The desired size range is from 1/16" in each dimension up to 2 ½" X 2 ½" X ½". Up to 50% of the fuel by volume can be up to 3" in any dimension. Up to 10% of the material by weight can be sawdust, smaller than 1/16" cubed, except that **no wood flour** (see #3, below) is permitted. The required percentages are measured on a per delivery basis.
2. Up to 5% of the fuel by volume could be 3-6" long sticks or peelings, as long as they are not larger than pencil-size in combined width/depth, OR are able to continue feeding through the system without causing shutdowns or other system problems. Percentage is on a per delivery basis.
3. Sander dust or wood flour, which is biomass comprised of very fine wood powder that feels greasy to the touch and becomes easily airborne, **will not** be permitted. Typically wood flour is defined as 60-80 mesh.
4. The moisture content of the fuel shall generally not exceed 45% wet weight basis per delivery. Wet basis is calculated by (dry weight ÷ wet weight)100. Desired range of

moisture content is between 25% and 35%, with an expected tolerance of 15% to 45%. Fuels below 10% average moisture content per delivery will generally not be permitted unless prior arrangements have been made (e.g., commercial pellets of 5% or less moisture may occasionally be used). Fuels above 45% moisture content are unacceptable and will be required to be removed at the Supplier's expense.

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

5. Fuel shall be free from non-combustible and non-biomass material, such as paint, nails, glues, rocks and dirt. The supplier must take care to eliminate sources of dirt and rocks to the greatest extent possible, although minimal amounts of dirt and rocks in slash obtained from whole tree skidding operations is expected. Any damage to boiler or conveyance equipment resulting from dirt, rocks or otherwise contaminated fuel will be the financial responsibility of the fuel supplier.
6. Fuel supply in the storage bin must be kept at not less than 1/4 capacity or 12.5 tons. Bin shall be filled to capacity each Friday.
7. **The Supplier must make every reasonable effort to obtain at least 50% of the fuel supply from logging slash or other un-merchantable logging residues, and/or brush, trees, limbs and tops removed to reduce wildfire risk or to improve forest health. This is material that would otherwise be burned in open piles. This requirement is for 50% of the total material delivered to the Eureka Public Schools storage bin during the first two full years of the boiler's operation.** The remainder can be obtained from wood processing facilities, landfills, or other appropriate sources. The contractor must maintain adequate and accurate records and documentation of fuel sources and provide them to the District upon request. All wood fuel is to be obtained in a safe and legal manner.

MOISTURE CONTENT SURCHARGES AND PENALTIES

Monthly payments for fuel deliveries shall be adjusted as follows for moisture content:

- For each delivery between 36% and 40% moisture, 10% of the price per ton delivered shall be deducted from the next monthly payment.
- For each delivery between 41% and 45% moisture, 20% of the price per ton delivered shall be deducted from the next monthly payment.
- For each delivery over 45% moisture, 40% of the price per ton delivered shall be deducted from the next monthly payment.

OFF-SITE STOCKPILE / RESERVE SUPPLY

It is the Supplier's responsibility to procure, store and protect the fuel in such a manner as to be usable when delivered to Eureka Public Schools. A reserve supply of at least 300 tons of fuel must be established by no later than December 1, 2007, so that the reserve is available to draw from during inclement weather or hazardous transportation conditions. Eureka Public Schools will determine and secure the site for this local supply, which will be identified when the supplier is determined. Bidders are encouraged to investigate local transportation options from the reserve supply to the school and to cooperate with local operator(s). Bidders are required to describe how they anticipate meeting the off-site storage/reserve supply requirements on their Bid Form and the District reserves the right to award the contract based on considerations of BOTH price and the character of the proposed off-site stockpile / reserve supply arrangements.

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

ON-SITE STORAGE / DELIVERY

The fuel storage bin at the Eureka Public Schools facility will hold approximately 50 tons of fuel and there will be adequate room to allow a tractor and 52' trailer to back up into the storage bin. The storage bin door is 16' high by 12' wide and the storage bin floor is on grade. The storage area is 14' wide by 46' long by 18' high, and designed to accommodate walking floor chip vans, pneumatic system or conveyer belt style delivery. It may accommodate dump-style delivery, but prospective bidders must present, as a component of their bid, a proposal for the use of such equipment and a clear description of how the bidder will efficiently make deliveries with such equipment and systems. The Supplier will be responsible for making timely and efficient deliveries and cleaning up any spills of wood fuel on District property.

The fuel supply in the storage bin must be maintained at not less than 1/4 capacity or 12.5 tons and the storage bin must be filled to capacity each Friday. The ANTICIPATED maximum fuel demand will be **45 TONS** per week. Typical weekly demand during the main heating season will be 30-35 tons. The Supplier will remain in regular contact with the Eureka Public Schools facilities representative and is required to visit the facility as often as necessary to determine quantities needed and delivery dates and times. The timing of all deliveries must be coordinated with facilities personnel and food service deliveries and the District reserves the right to structure delivery times as may be necessary to avoid conflicts with District operations and/or traffic. The Supplier is required to work cooperatively with all parties to avoid problems with storage, wait time of the delivery drivers, overloading of the system, and to allow time for maintenance of the system and equipment.

The Supplier will remain aware of pedestrian and vehicular traffic at all times and exercise due care and diligence to prevent any injury or damage to property or to students, staff and members of the public attendant to its activities in fulfilling its obligations to the District under the fuel supply contract.

Unless otherwise agreed, all fuel delivered and accepted by the District will be weighed on a scale agreed upon by the District and certified by the State of Montana Department of Weights and Measures.

The weight thereby determined, in conjunction with moisture content measurements specified below, shall be the basis for calculating the amount of any payments due the Supplier.

QUALITY CONTROL

Eureka Public Schools facilities supervisor and/or other District representatives will periodically inspect delivered fuel for compliance with size requirements and non-combustible or non-biomass material. With respect to size specifications, a representative sample of fuel will be screened to determine compliance.

Average moisture content shall be determined by the District for each delivery using the following methods:

1. Collect a representative sample from a load of fuel as delivered at the Eureka facility.
2. Weigh the sample and record as wet weight.
3. Dry sample in an oven at 220 degrees Fahrenheit for 4 hours, note the weight.
4. Dry sample for 15 minute periods until no weight drops are noted, record the weight as dry weight.
5. Subtract dry weight from weight from wet weight to determine moisture content weight.
6. Divide wet weight into moisture content weight and multiply by 100 to determine % moisture content as delivered.
7. Repeat this process for at least 2 samples from different parts of the load, and average the results.

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

Samples will be representative of the entire load and any samples provided by the Supplier and/or its drivers will not be acceptable. The District will maintain documentation of the timing and location of all samplings and will provide that documentation to Supplier on a bi-monthly basis.

Non-combustible content shall be measured by the District on an as-needed basis as follows:

1. Collect a sample from a load as delivered at the Eureka facility.
2. Weigh the sample and record as wet weight.
3. Burn sample in muffle furnace at 1,200 degree F. for 3 hours.
4. Weigh the material remaining and record as non-combustible weight.
5. Divide the wet weight into the non-combustible weight and multiply by 100 to determine the % non-combustible content as delivered.

PAYMENT

Beginning November 1, 2007, payments will be made by the District to the Suppliers on an 11-month even payment schedule on the 1st of each month, beginning November 1, 2007, and adjusted as set forth below. Using the bid price per ton for fuel within the desired moisture content range of 25% to 35%, the total estimated annual requirement of 850 tons shall be divided by 12 months to determine an even monthly payment amount. On October 1 of each year, the parties will calculate the actual delivery amounts over the course of the preceding contract year and a final "close-out" payment will be promptly made either (1) from the

District to the Supplier to account for any underpayment or (2) from the Supplier to the District to account for any overpayment. The "close-out" payment will be made no later than October 15th.

The moisture content surcharges and penalties will be calculated based on tons delivered in each month, and the next monthly payment and the "close-out" payment shall be adjusted up or down accordingly.

Example of 12 month payment calculations¹:

Bid price is \$24 per ton X 1,000 tons = \$24,000 ÷ 12 = \$2,000 each month.

Actual first year consumption = 800 tons X \$24 = \$19,200. Supplier will remit a "close-out" payment to the District in the amount of \$2,800 no later than October 15th (\$4,800 total excess for year less \$2,000 credit for September delivery)

Actual first year consumption = 1100 tons X \$24 = \$26,400. District will remit a "close-out" payment to the Supplier in the amount of \$4,400 no later than October 15th (\$2000 for September delivery plus \$2,400 excess)

¹ Example does not take into account the effect of any other pricing adjustments under the contract such as moisture content surcharges and/or penalties, delivery default penalties, fuel adjustments, etc.

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FUEL ESCALATION

The Supplier will be entitled to a fuel escalation surcharge, calculated monthly and based on the following table:

AT LEAST	BUT LESS THAN:	SURCHARGE
	\$3.33	0%
\$3.33	\$3.51	.5%
\$3.51	\$3.69	.75
\$3.69	\$3.87	1.0%
\$3.87	\$4.05	1.25%
\$4.05	\$4.23	1.50%
\$4.23	\$4.41	1.75%
\$4.41	\$4.59	2.0%

If the fuel surcharge rises above 2% the table will be updated. For purposes of making any monthly surcharge calculation, the price of diesel will be the average of the most recent four weeks posted on the U.S. Department of Energy's Weekly Retail On-Highway Diesel Prices at: (Rocky Mountain Region)

<http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp>

DEFAULT IN DELIVERY / TERMINATION

The District's intent in entering into this contract is to utilize wood biomass fuel in lieu of propane and fuel oil, and any failures by the Supplier to effect the timely and reliable delivery of fuel to the District will defeat the primary purpose of the contract. Accordingly, on any day in which the fuel supply bin at Eureka Public Schools becomes or remains empty for any length of time, or contains only non-compliant fuel, a monetary penalty of \$250/day will be assessed and withheld from the Supplier's next scheduled payment.

If the Supplier at any time fails to perform its obligations under the contract and does not cure such failure within five (5) days of its receipt of written notice from the District, the District may immediately terminate the contract and seek damages from the Supplier for the breach of its obligations, including but not limited to any costs and expenses attendant to securing alternative sources of biomass fuel and/or utilizing other fuel sources in lieu of biomass fuel.

COMPLIANCE WITH LAWS / NONDISCRIMINATION

In providing services under the contract, the Supplier is required to fully comply with all federal, state or local laws, rules and regulations applicable to its operations and to warrants that any subcontractors it may hire will comply as well. Any hiring undertaken by the Supplier or its

subcontractors in the performance of this contract will be made on the basis of merit and qualifications and it is strictly prohibited from discriminating on the basis of race, color, religion, creed, political ideas, sex, age, marital status, physical or mental disability or national origin.

Eureka Public Schools **Invitation to Bid – Biomass Fuel Supply**

DISPUTE RESOLUTION

The contract will be governed by the laws of Montana and any litigation concerning the contract must be brought in the Montana Eleventh Judicial District Court in Kalispell. In the event that either party files suit to enforce their rights under the contract, the prevailing party will be entitled to recover their costs and attorneys fees from the other party, in addition to any other damages awarded by the Court.

INDEMNITY / INSURANCE

The Supplier will perform its services under the contract entirely at its own risk, and the Supplier will assume all responsibility for its performance of the contract. The Supplier will agree to indemnify and hold harmless the District, its officers, employees and students from any and all claims, demands, and causes of action of any kind or character, including reasonable attorneys fees and costs, arising in favor of the Supplier's employees or anyone else on account of bodily or personal injuries, death or damage to property arising out of the services performed by the Supplier or in any way resulting from the acts or omissions of the Supplier and/or its agents, employees, subcontractors or anyone else for whom the Supplier is responsible.

The Supplier will be required to carry and maintain appropriate workers compensation coverage for all of its employees and will be required to provide proof of such coverage to the District prior to commencing the provision of services under the contract.

In addition, the Supplier will be required to carry and maintain the insurance coverage outlined below from an insurance company (or companies) authorized to write insurance in the State of Montana, with a minimum "A.M. Best Rating" of A. The Supplier will be required to carry and maintain both (1) appropriate comprehensive general liability insurance extending coverage to its activities under the contract, including personal injury liability, bodily injury liability and property damage coverage, with a combined single limit of \$ 1 million per occurrence and \$ 2 million aggregate per year and (2) appropriate commercial automobile coverage as follows:

Bodily Injury and Property Damage:

Coverage to include --All owned autos, All hired autos, All non-owned autos

Combined Single Limits: \$1,000,000.00 each accident

Uninsured / Underinsured Motorist Limits: \$1,000,000.00

Any deductible or self-insured retention amount must be declared to and approved by the District. The District shall be named as an additional insured on such coverages and each must contain at least a forty-five (45) day notice of cancellation provision.

Anticipated Schedule of Events

ITB Published:

Bids Due

June 21, 2007

Board Action on Recommendation
re: Award

June 21, 2007

Finalize Contract Structure	July 5, 2007
Contract Documents Signed	July 19, 2007
Fuel Deliveries Commence	Oct. 1, 2007

BID FORM

BIOMASS FUEL SUPPLY

TO: Gary Blaz, Superintendent
Eureka Public Schools
P. O. Box 2000
Eureka, MT 59917

BIDDER: _____

ADDENDAS RECEIPT: The Bidder acknowledges receipt of the following Addenda:

Addendum No. ____ dated _____.
Addendum No. ____ dated _____.
Addendum No. ____ dated _____.

BID OFFER: The undersigned Bidder, having carefully reviewed the Invitation to Bid and accompanying materials (including but not limited to the specifications) and having carefully ascertained the conditions under which the contemplated services are to be performed, hereby BID and offer to enter into a contract to perform those services for the following price:

Numerical: \$_____ per delivered ton of biomass fuel

Written: \$_____ Dollars per delivered ton of biomass fuel

**DESCRIPTION OF OFF-SITE STORAGE / RESERVE SUPPLY
ARRANGEMENTS (See Specifications, P. 6):**

**ALTERNATIVE PROPOSAL FOR DUMP-STYLE DELIVERY (See
Specifications, P. 6):**

The Bidder agrees that this Bid shall remain open for acceptance and the price shall remain firm and unchanged, notwithstanding any error in the Bid, at the amount set forth above for a period of thirty (30) days from the opening of this Bid.

The Bidder understands and acknowledges that this Bid is subject to acceptance by the District and to the preparation and execution of a contract document. The Bidder agrees to execute the contract within fourteen (14) days of any notification of the acceptance of its bid and to provide proof of all insurance required under the contract at that time.

The Bidder acknowledges that if s/he has not answered all of the above questions and completed all applicable blanks, his/her bid may be rejected as incomplete and non-responsive.

THIS BID IS SUBMITTED BY:

Company: _____

Signature of Bidder: _____

Printed Name: _____

Title: _____

Telephone No.: _____

Fax No.: _____

References

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Kotrba, Ron, May 2006. "Larger Scale, Relative Economics," Ethanol Producer Magazine

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