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FIRST DRAFT

Status of Fiber Fuel Use in Minnesota

With Emphasis on Automated Systems

September 1986

Minnesota
RTMENT OF
RAL RESOURCES

Dept. of Natural Resources
Division of Forestry

Fiber Fuels Institute

MINNESOTA
Department of Energy
and Economic Development

STATUS OF FIBER FUEL USE IN MINNESOTA

with emphasis on automated systems

Prepared by:

Minnesota Department of Natural Resources, Division of Forestry
St. Paul, Minnesota

Minnesota Department of Energy and Economic Development
St. Paul, Minnesota

Fiber Fuels Institute, Minneapolis, Minnesota

SEPTEMBER 1986

The fiber fuels industry in Minnesota is growing. Producers, consumers and associated service industries are all feeling the effects of this growth and occasionally the frustration of not having a ready source of industry information. This summary of the status of the fiber fuels industry in Minnesota is intended to alleviate some of the latter frustrations.

CONTENTS

CHRONOLOGY OF FIBER FUEL USE IN MINNESOTA

Prior to 1970

° A small number of wood industries burn residue for energy and waste disposal.

° Ottertail Power Company uses wood energy to produce electricity at a small plant in Bemidji.

° Annual consumption of wood for residential heating approaches 200,000 cords.

1970 to 1975

° The Arab oil embargo causes a dramatic increase in fossil fuel prices.

° Grand Marais School District Converts the first Minnesota school to wood energy.

° Residential fuelwood consumption increases.

1976 to 1980

° Wood pelletizing plants are established at Marcell and Stillwater. The Stillwater plant fails.

° Schools at Laporte, St. Joseph and McGregor convert to pelletized wood fuel.

° Residential fuelwood consumption increases to 1.3 million cords annually.

° Thirteen wood industries and three nonwood related companies convert to wood energy.

° Two "Minnesota Coal" conferences in Brainerd bring industry, government and community leaders together to examine the use of wood for energy.

° DNR initiates the Minnesota Peat Program and the Peat Inventory Project.

° The Grand Rapids Regional DNR Headquarters becomes the first state facility to convert to wood energy.

° A study by Minnesota Energy Agency and DNR shows adequate non-industrial wood resources to support substantial wood energy development.

1981 to the Present

° Wood fuel briquetting plants are established at Pine River, Grand Rapids, Blackduck, Rice, and Virginia. Wood fuel pellets are produced in Gilbert, Crosby and Marcell. Densified wood fuel production capacity exceeds market demand.

° Northwest Economic Development Corporation installs residential pellet furnaces as part of a fuel assistance program.

° Blandin Paper Company builds a large scale wood residue fired co-generation plant at Grand Rapids.

° Aitkin Ironworks installs a wood fired central heating system to provide heat for their plant and five public buildings in Aitkin.

° DNR installs wood burning systems at five sites.

° The Western Lake Superior Sanitary District began using wood chips to incinerate sludge at Duluth.

° The Fiber Fuels Institute is formed to promote the Minnesota bio-fuels industry.

° Legislation is passed to permit third party financing of state facility heating system fiber fuel conversions.

° Peat is harvested by private firms for DNR combustion testing. Peat fuel combustion testing is done at Virginia Public Utilities, U.S. Bureau of Mines, and U of M Duluth.

° Over 200 commercial and industrial scale facilities are using fiber fuel energy.

FIBER FUEL SUPPLIERS

DENSIFIED FUEL PELLET SUPPLIES IN MINNESOTA
(Wood, Peat, Paper, Agriculture, Residues)

Alternative Fuels Inc.
15831 Highway 55
Plymouth, MN 55447
(612)553-9568

Aspen Fibre Corp.
1112 First St. East
Duluth, MN 55805
(218)728-2582

Northern Xtrax Inc.
P.O. Box 185
Gonvick, MN 56644
(218)487-5279

Rapid River Companies
P.O. Box 458
Baudette, MN 56623
(218)634-2041

Rivard's Quality Seeds Inc.
Argyle, MN 56713
(218)437-6638

Dynamic Resources
Norman Nelson
Rt. 3, Box 277
Bagley, MN 56621
(218)657-2272

Tri-State Trak Enterprises
P.O. Box 43
LaCrescent, MN 55947
(507)895-8644

Watson Turf Nursery
23601 Ambassador Blvd.
Saint Francis, MN 55070
(612)753-1132

DENSIFIED FUEL PELLET SUPPLIERS OUTSIDE MINNESOTA

Alfalfa Pelleting Ltd.
Box 718
West Fargo, ND 58078
(701)282-4421

Forest Fuel Corp.
Route 2, Box 205-B1
Mason, WI 54856
(715)372-4024

Jack Biomass
P.O. Box 1401
Watertown, SD 57201
(605)202-1965

LaCrosse Milling Co.
Box 86
Cochrane, WI 54622
(608)248-2222

Whetstone Pelleting
Rural Route 1, Box 52
Milbank, SD 57252
(605)432-5160

DENSIFIED FUEL LOG/BRIQUETTE SUPPLIERS IN MINNESOTA

Baker Industries - Durkee Plant
P.O. Box 69
Pine River, MN 56474
(612)587-4432

Maust & Sons
Preston, MN 55965
(507)765-2188

Bemidji Fiber Fuels Inc.
919 Carr Lake Road S.E.-Box 126
Bemidji, MN 56601
(218)759-1450

Ferche Millwork Inc.
P.O. Box 39
Rice, MN 56367
(612)393-2288

FIBER FUEL DISTRIBUTORS

Forest Fuels Inc.
1020 Washington St.
Brainerd, MN 56401
(218)828-0904

St. Cloud Conservation Corp.
670 N. Highway 10
St. Cloud, MN 56302
(612)253-3668

Nordhiem Sheet Metal Co.
First St. & Minnesota Ave.
Bemidji, MN 56601
(218)751-3923

Topco, Inc.
4300 Willow Drive
Hamel, MN 55340
(612)478-2161

H & H Wood Products
Rt. 1, Box 146
Floodwood, MN 55736
(218)476-2860

FIBER FUEL SUPPLIERS

GREEN WOOD FUEL SUPPLIERS

Green wood fuel is generally available from three sources:

Wood Processing Industry
Tree Service Companies
Full Tree Chippers

WOOD PROCESSING INDUSTRY

There are over 700 sawmills and 1,000 secondary manufacturers statewide that can supply wood residues in the form of bark, sawdust, slabs and edgings, cut-offs, shavings, and sanderdust. Of the sawmills, about 30 have debarking and chipping machinery that produce chips which are available for fuel.

TREE SERVICE COMPANIES

Most municipalities throughout the state are serviced by tree service companies. Most of these companies have facilities that produce chips which are available for fuel.

FULL TREE CHIPPER OPERATIONS

The following is a partial list of full tree harvesting operations which could supply green chips for fuel:

Bergstom Logging Company
516 Second Avenue
International Falls, MN 56649
(218)283-4477

McCabe Forest Products
119 West Lewis Street
Duluth, MN 55803
(218)724-8070

Arthur Newgren
RR 1
Cromwell, MN 55726
(218)644-3630

Roger Anwiler
RR 2, Box 55A
Bovey, MN 55709
(218)245-1057

Alvin Lindquist
Hill City, MN 55748
(218)697-8296

Ratzlaff Logging & Lumber
508 1st Street
Princeton, MN 55371
(612)389-3801

Larry Pelland
Loman, MN 56654
(218)279-3344

Korhonen Timber Products
221 East Park Drive
Hibbing, MN 55746
(218)263-7420

Dave Baumgarten
Superior Forest Products
2555 London Road
Duluth, MN 55812
(218)728-5159

Hasbargen Logging Inc.
Route 3, Box 814
Birchdale, MN 56629
(218)634-2174

Larry Mannausau
Northwoods Chipping, Inc.
International Falls, MN 56649
(218)276-2316

Stan's Wood Chips
Box 345
Big Falls, MN 56627
(218)276-2490

Ziemba & Sons
Route 2, Box 16
Littlefork, MN 56653
(218)278-6735

Richard Demars & Sons
Ray, MN 56669
(218)875-3435

Dick Walsh Forest Products
Itasca Star Route
Park Rapids, MN 56470
(218)732-5665

OTHER FUEL SUPPLIERS

Lindquist Logging
Route 1, Box 48C
Swatara, MN 55785
(218)697-8296
(milled peat)

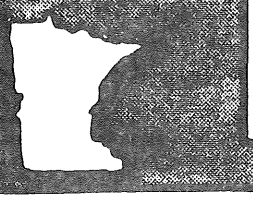
Great Lakes Peat Products Co.
Route 1, Box 118
Cotton, MN 55724
(218)482-3488
(sod peat)

Minnesota Forest Products
Rt. 2, Box 190
Onamia, MN 56359
(green wood chips)

PRICES

Densified Fuel Prices: $50 - $55/ton Delivered
(Prices vary with location, volume and shipping distance)
Chips: $18 - $24/ton Delivered
Sawdust & Bark: $12 - $16/ton Delivered

(Prices vary with location, volume and shipping distance)



Minnesota / Forest Resources Fact Sheet

WOOD RESOURCES AVAILABLE FOR ENERGY - 1985/1986

SOURCE	SUPPLY AVAILABLE ANNUALLY
1. UNUSED TIMBER OF LIMITED MARKET POTENTIAL * mostly high density hardwood pulp from hardwood forest types * only a small fraction used for industrial products * contributes about 100,000 cords annually as source of residential fuelwood	500,000 CORDS
2. UNUSED HARVESTING RESIDUE * approximately 40% of the wood remaining after commercial harvest (2 1/2" + diameter) * about 500,000 cords of this is comprised of the hardwood component of the aspen type * this source will expand in the future as commercial harvest increases * contributes about 200,000 cords to residential fuelwood * can be harvested as roundwood or chips	700,000 CORDS
3. OTHER FOREST RESIDUES * includes wood available from low productivity forests, land clearing, mortality, and non-commercial forest land * contributes about 200,000 cords for residential fuelwood * can be harvested as roundwood or chips	1,200,000 CORDS
4. UNUSED WOOD INDUSTRY RESIDUES * processing residues comprised of bark, sawdust, slabs, edgings, chips, cut-offs * currently most widely used residue for commercial energy because of accessability and low cost	100,000 CORDS
TOTAL	2,500,000 CORDS

NOTES: Sources 1, 2, and 3 could be increased an additional 60% if the total tree was harvested.
Cord = the equivalent of 79 cubic feet of solid wood or 91 cubic feet of solid wood and bark.
Surplus timber of industrial use potential is not included in this summary.

Department of Natural Resources
Division of Forestry
500 Lafayette Road - Box 44
St. Paul, Minnesota 55146

PEAT FUEL RESOURCE AVAILABILITY

Minnesota contains between 6 and 7 million acres of peatland. Deposits are found throughout the state, except in the extreme southwest and southeast. Large, contiguous peatlands occur in the northern half of the state, while smaller, scattered peatlands occur in the southern half.

Approximately 50 percent of the state's peat resource is publicly owned, with most of the public ownership concentrated in the northern part of the state. It is estimated that approximately 10 percent of Minnesota's peatlands have energy potential. About 90 percent of these peatlands would be suited for milled peat harvesting, 10 percent would be suited for sod peat.

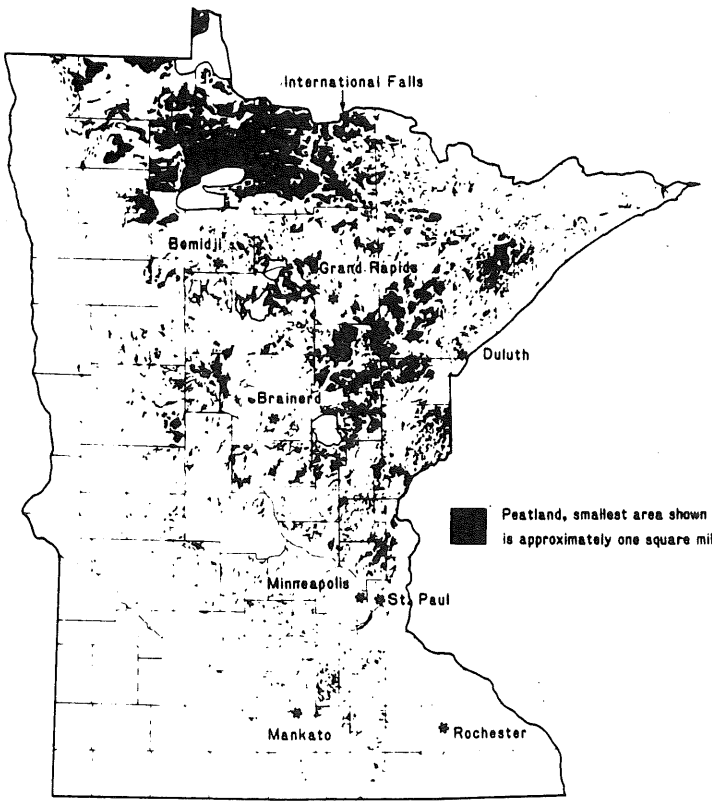
Some Milestones in Minnesota Peat Energy Development

- 1984. A private firm mined 9,500 tons of fuel peat for use in DNR testing program.
- Tests using peat pellets and sod peat have led the Virginia Public Utilities Commission to contract for up to 6,000 tons of sod peat during 1985, the first large contract for fuel peat in Minnesota.
- Tests at U of M, Duluth have shown that peat in either pellet or sod form can be used as feedstock in a gasifier.
- The largest test of fuel peat ever conducted in North America (25,000 tons of peat) will commence at the Minnesota Power and Light Laskin Station in 1985.
- Blandin Paper Company is currently testing 1,500 tons of peat fuel in their co-generation plant.
- Boise Cascade has become interested in peat fuel for their International Falls paper mill.
- The Hibbing Public Utility conducted a test burn of 1,000 tons of peat fuel in March - April 1985.
- Cambridge State Hospital has successfully tested pelletized peat fuel.

For Further Information Contact:

Minnesota Dept. of Natural Resources
Division of Minerals
Box 45, DNR Building
500 Lafayette Road
St. Paul, Minnesota 55146
(Telephone: 612-296-4807)

MINNESOTA PEAT RESOURCES



Source: Minnesota Department of Natural Resources, Peat Project, 1975.

AGRICULTURAL RESIDUE FUEL AVAILABILITY

Agricultural residue is the fiber remaining after the harvest of crops. It is estimated that Minnesota produces over ten million dry tons of crop residues every year. In addition to the residues remaining in the field there are large quantities of material produced as a result of agricultural processing operations.

The accompanying map indicates the relative distribution of residues throughout southern and western Minnesota. The figures show the average available tonnages which can be removed from the field and the percentage of total residue production which this tonnage represents. These residues constitute a large, as yet, unused, fiber fuel resource.

Plans for the removal of crop residues from the field should be tempered by the following quote from "Crop Residue Removal and Tillage" by M.J. Lindstrom, et al.

"Optimum use of crop residues will require careful consideration of alternate uses - soil and environment protection, feed for livestock, or energy and industrial purposes. We think that the need to maintain soil productivity should be the first consideration. If residues are needed for erosion control or maintenance of soil structure, and economically feasible alternatives are not available, then residues should remain on the land. However, if the soil's needs can be met with partial or total removal of the crop residues, then there should be no objection to their removal. We caution, however, that any removal of residue from the field should be done only with a full understanding of the possible consequences."

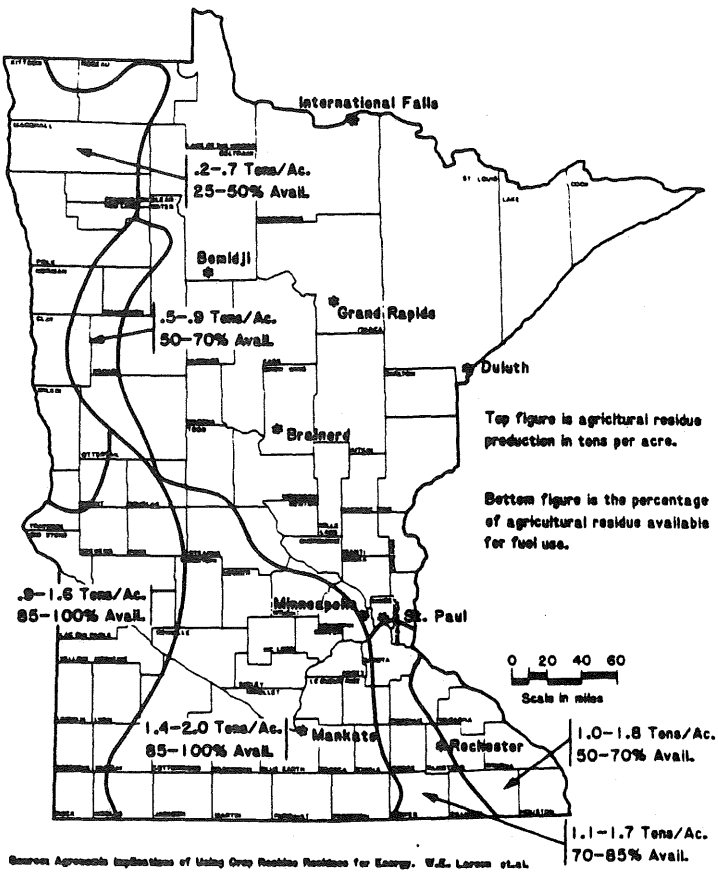
Agricultural processors produce large quantities of waste products which have potential value as an energy resource. Material characteristics and availability vary by region; for example, there is about 70,000 tons of oat hulls available annually in the Twin Cities area.

Minnesota farms also have the potential for producing energy crops as an alternative to traditional crops. Examples of such crops include sweet sorghum, sunflowers and hybrid poplars.

For Further Information Contact:

Minnesota Dept. of Energy and Economic Development
900 American Center
150 East Kellogg Boulevard
St. Paul, Minnesota 55101
(Telephone: 612-297-1291)

CROP RESIDUE PRODUCTION AND AVAILABILITY



Sources: Agronomic Implications of Using Crop Residue Residues for Energy. W.E. Larson et al.

CURRENT FIBER FUEL USERS IN MINNESOTA

The following list of institutional, commercial and industrial scale fiber fuel users is surely not complete but gives an indication of the scope of fiber fuel use in Minnesota. Information sources include Dept. of Natural Resources surveys, Dept. of Energy and Economic Development surveys and the Great Lakes Region Biomass Facilities 1985 Directory.

SCHOOLS USING FIBER FUEL

			1984/85 SEASON	
SCHOOL	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
Aitkin Jr-Sr High School	Aitkin	District Heating		District Heating
Argyle Public School	Argyle	Pellets		
Aurora-Hoyt Lakes High Sc	Aurora	Pellets	736	Suspension
Backus Public School	Backus	Pellets	221	Stoker
Badger School	Badger	Pellets	117	Stoker
Barnesville Elem. School	Barnesville	Pellets		
Barnesville High School	Barnesville	Pellets	391	Sidewinder
Barnum High School	Barnum	Green Chips		Pneu. Injector
Battle Lake Public School	Battle Lake			
Bemidji High School	Bemidji	Green Chips		Pneu. Injector
Bemidji Middle School	Bemidji	Green Chips	779	Pneu. Injector
Bemidji State University	Bemidji			
Bigfork Public School	Bigfork	Pellets	165	Stoker
Biwabik School Complex	Biwabik	Pellets	144	Stoker
Blackduck Public School	Blackduck	Briquettes	324	Pile
Carlton High School	Carlton	Green Chips		Dutch Oven
Cass Lake Elementary Sch	Cass Lake	Pellets	128	Stoker
Cass Lake High School	Cass Lake	Pellets	167	Stoker
Central Administration	Duluth	Pellets	374	Suspension
Central High School	Crookston	Pellets	720	Sidewinder
Chisholm Jr-Sr High Sch	Chisholm	Green Chips	128	Pneu. Injector
Clarissa Public School	Clarissa	Pellets	348	Stoker
Clearbrook Public School	Clearbrook	Pellets	347	Stoker
Cohasset School	Cohasset	Pellets	250	Stoker
Conner-Jasper Middle Sch	Bovey	Pellets	480	Stoker
Cromwell School	Pellets			
Dilworth Public School	Dilworth	Pellets	37	Sidewinder
Edna I. Murphy School	Grand Rapids	Pellets		Stoker
Erskine School	Erskin	Pellets		
Forest Lake School	Grand Rapids	Pellets		
Gilbert Public School	Gilbert	Pellets	181	Suspension
Gonvick-Trail School	Gonvick	Pellets (wood & marigold)	236	Stoker
Goodridge Public School	Goodridge	Pellets	217	Stoker
Grand Marais High School	Grand Marais	Green Chips		
Grand Rapids Middle Sch	Grand Rapids	Pellets	1138	
Grand Rapids Sr High Sch	Grand Rapids	Pellets		
Greenbush Community Sch	Greenbush	Pellets	277	Stoker
Greenway High School	Coleraine	Pellets		Stoker
Highland Elementry School	Crookston			
Hill City School	Hill City	Green Chips	545	Stoker
Holdingford School	Holdingford	Briquettes		
John A. Johnson School	Two Harbors			
John F. Kennedy High Sch	Babbitt	Green Chips		Gasifier
Keewatin Jr High/Elem Sch	Keewatin	Pellets		Stoker
Lafayette High School	Red Lake Falls	Pellets	206	Stoker
Laporte School	Laport	Pellets	172	Stoker
Lincoln School	Floodwood	Pellets	457	Stoker
Littlefork-Big Falls High	Littlefork	Pellets	331	Stoker
Martin Hughes School	Buhl			
McGregor Public School	McGregor	Pellets	535	Stoker

CURRENT FIBER FUEL USERS IN MINNESOTA

SCHOOLS USING FIBER FUEL

SCHOOL	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
McIntosh Public School	McIntosh	Pellets	358	Stoker
Memorial High School	Ely	Green Chips		Gasifier
Menahga Public School	Menahga	Briquettes	454	Stoker
Merritt Elementary School	Mountain Iron	Pellets		
Moose Lake Public School	Moose Lake	Green Chips		Gasifier
Motley Public School	Motley	Pellets		Pneu. Injector
Mt. Iron-Buhl High School	Mountain Iron			
Northland High School	Remer			
Northome School	Northome	Pellets	216	Stoker
Onamia High School	Onamia	Pellets	216	
Park Rapids High School	Park Rapids			
Park Rapids Middle School	Park Rapids			
Parkers Prairie High Sch	PArkers Prairie	Green Chips		
Pequot Lakes Public Sch	Pequot LAkes	Green Chips		Pile
Pine River Elementary Sch	Pine River	Briquettes	261	Pile
Pine River High School	Pine River	Briquettes	318	Pile
Remer School	Remer	Pellets		
Roseau Public School	Roseau			
Rothsay School	Rothsay	Pellets		Sidewinder
Sandstone	Sandstone	Pellets	Stoker	
St. Josephs Sch & Church	Red Lake Falls	Pellets		
St. Scholastica College	Duluth	Pellets		
Staple High School	Staples			
Staples AVTI-Main Campus	Staples	Pellets		Stoker
Staples AVTI-North Campus	Staple	Green Chips		Gasifier
Strandquist School	Strandquist	Pellets		Stoker
Swanville Public School	Swanville	Pellets	363	Stoker
Two Harbors High School	Two HArbors	Green Chips	875	
Vermillion Community Col.	Ely	Green Chips	784	
Walker-Hackensack Public	Walker	Pellets	433	Stoker
Warroad School	Warroad	Dry Wood Shavings		
Waubun Elem-Secondary Sch	Waubun	Pellets	65	Stoker
Wm M. Kelley High School	Silver Bay	Green Chips	802	

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CURRENT FIBER FUEL USERS IN MINNESOTA

GOVERNMENT AND PUBLIC ORGANIZATIONS USING FIBER FUEL

ORGANIZATION	LOCATION	FUEL TYPE
Aitkin County Courthouse		
Aitkin Public Utilities	Aitkin	
Chisholm/Hibbing Airport	Hibbing	Pellets
Community Center	Floodwood	
DNR French River Hatchery	Duluth	Pellets
DNR Gen. Andrews Nursery	Willow River	Pellets
DNR Regional Garage/Shop	Grand Rapids	
DNR Service Center	Grand Rapids	Green Chips
DOT District Office	Bemidji	
Giants Ridge Ski Complex		
Grand Marais Hospital	Grand Marais	Green Chips
Grand Marais Rec. Center	Grand Marais	Green Chips
Grand Marais Sch Bus Gar	Grand Marais	
Iron Range Interp. Cntr.		Chips, Peat
Itasca County Garage	Bigfork	
Itasca Memorial Hospital	Grand Rapids	
Northwest Exp. Sta. Barn	Crookston	
Scenic State Park Shop	Bigfork	Pellets
Shakopee Correrctional	Shakopee	Chips
St. Louis County Garage	Virginia	
Tower Soudan State Park	Tower	
Virginia Public Utilities	Virginia	
W. Lk. Superior San. Dist	Duluth	
Willow River Correctional	Willow River	

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FOREST PRODUCTS INDUSTRIES USING FIBER FUEL

BUSINESS	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
Anderson Corporation	Bayport	Sawdust	24,000	Suspension Burner
Aspen Fiber Corp.	Marcell	Green Wood Residue	5,400	Pile Burner
Bagley Kiln & Component	Bagley			
Blandin Paper Co.	Grand Rapids	Green Wood Residue	280,000	Traveling Grate; Co-Gen.
Blandin Wood Produsts	Grand Rapids	Green Wood Residue	40,000	Suspension Burner
Boise Cascade Corp.	International Falls	Green Residue, Chips	90,000	Vibrating Grate; Co-Gen.
Brainerd Hardwoods	Brainerd			
Champion International	Sartell	Green Wood Residue	50,260	Traveling Grate; Co-Gen.
Clover Valley Sawmill	Two Harbors		52	
Diamond Match Co.	Cloquet	Green Wood Residue		
Durkee Manufacturing Co.	Pine River	Green Wood Residue	2,000	Stoker
E & R Enterprises	Cook		87	
Ferche Millwork, Inc.	Rice	Dry Wood Residue	4,000	Fye Deed Auger
Foldcraft Co.	Kenyon			
Hedstrom Lumber Co.	Grand Marais	Green Wood Residue	8,000	
Hill Wood Products	Cook	GReen Wood Residue		

CURRENT FIBER FUEL USERS IN MINNESOTA

FOREST PRODUCTS INDUSTRIES USING FIBER FUEL

BUSINESS	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
Indian Wood	Ogema			Garn
Lake Elmo Hardwood	Lake Elmo	Dry Wood Residue	300	Pnuematic Injection
Land O Lakes Wood Pres.	Tenstrike	Green Wood Residue		
Marcell Mill & Lumber	Marcell	Pellets	5	Underfeed Stoker Furnace
Marvin Windows	Warroad	Dry Wood Residue	4,500	Injection Over Grate
Minn. Sawdust & Shavings	Anoka		1,950	Suspension Burner
Northwood Panelboard	Bemidji	Green Wood Residue	60,000	Stationary Grate
Potlatch Corp.	Bemidji	Green Wood Residue	50,000	Suspension Burner
Potlatch Corp.	Cloquet	Green Wood Residue	258,700	Ware Tube - Grate
Rajala Mill Co.	Bigfork	Green Wood Residue	2,565	Auger Fed Stoker
Rajala Timber Co.	Deer River			
Seven Star Lumber Co.	Milaca		40	
Sleepy Hollow Millwork	Fort Ripley	Dry Wood Residue		
Steamboat Sawmill	Bemidji		58	
Super Wood Corp.	Duluth	Green Wood Residue	18,000	Grate and Suspension
Superwood Corp.	Bemidji	Green Wood Residue	25,000	Stnry Grate, Dutch Oven
Thompson Hardwood Lumber	Minneapolis	Dry Wood Residue	200	Suspension Burner
Toms Wood Service	Bemidji		32	
Touhy Furniture	Chatfield	Dry Wood Residue	550	
Tri-State Forest Products	Hokah	Green Residue, Chips	200	Trvlg Bed, Underfire Stkr
Warrenwood, Inc.	Rice			
Winkelman Bros.	Northtome		167	
Woodcraft Indust., Inc.	Foreston	Dry Wood Residue	3,000	Suspension Burner
Woodcraft Indust., Inc.	St. Cloud	Dry Wood Residue	3,000	Suspension Burner
Woodland Container, Inc.	Aitkin		3,500	
Woodland Container, Inc.	Staples			

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PRIVATE BUSINESSES AND ORGANIZATIONS USING FIBER FUELS

FIRM or ORG	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
A&E Industries	Avon			
Aitkin Ironworks	Aitkin	Green Fuel		
Anaco Inc.	Crosby	Pellets	20	Stoker-Forced Air Furnace
Anderson Construction	Brainerd			
Assoc. Plumbing & Heating	Crookston	Pellets (wood, sunflower)	24	Hot Water Boiler
Baptist Church	Floodwood			
Bearskin Lodge	Grand Marais	Green Fuel		
Bel Air Motel	Bemidji	Chunk Wood		Garn
Berger Apartments & Store	Erskine			
Camp Shaminean	Crookston		55	Low Pressure Boiler
Coca Cola Bottling	Brainerd	Pellets	40	Auto Stoker
Combo Furnace Sales	St. Francis	Pellets		
Crest Motel & Supper Club	Caledonia			
Crosby Car Wash & Laundro	Crookston	Green Wood Residue	500	Auger-Stoker
Crosby Carwash & Laundry	Crosby	Sawdust	500	
Crosby Theater	Crosby			
D & J Machining	Brainerd	Pellets	30	
Dan & Jerry's Greenhouse	Buffalo			
Earl Holasek Greenhouse	Chanhassen	Green Fuel		

CURRENT FIBER FUEL USERS IN MINNESOTA

PRIVATE BUSINESSES AND ORGANIZATIONS USING FIBER FUELS

FIRM or ORG	LOCATION	FUEL TYPE	TONS per YR	SYSTEM TYPE
Eichof Building	Crookston			
Fabridyne & Custom Prod.	Litchfield	Pellets	350	Under Feed Stoker
Fleet Supply	Mora	Pellets		
Floodwood Hardware	Floodwood			
Galloway Boys Ranch	Wahkon	Chunk Wood		Garn
Garth Meschke Turkey Farm	Little Falls			
Gehling Implement	Preston			
Gessel Feed Mill	Swanville	Pellets (sunflower)	500	
Glenmore Foundation	Crookston			
GT Auto Parts	Floodwood			
Gustafson Apartments	Warren			
Herbies MArket	Red Lake Falls			
Humble Stove Co.	Rushford.	Green Fuel		
Isle Automotive	Isle	Pellets		Under Feed Stoker
Jesus is King Church	Thief River Falls	Flower Hulls	12	Auger-Stoker
Len Busch Greenhouse	Hamel	Green Fuel		
LePier Tire	Crookston			
Loodwood Catholic Church	Floodwood			
Luthern Church	Floodwood			
Midway Service Station	Grand Marais	Green Fuel		
Mills Fur Farm	Eden Valley			
Mjolsness Shop	Felton			
North Country Tire	Hackensack			
North Shore Building	Grand Marais	Green Fuel		
North Shore Dairy & Laund	Grand Marais	Green Fuel		
Northern Manufacturing	Staples			
Northwest Hospital	Thief River Falls			
Osterberg Furniture	Mora			
Park Rapids Greenhouse	Park Rapids	Green Fuel		
Pine River Group Home	Pine River	Pellets	21	Forced Air Furnace
Poly Foam, Inc.	Lester Prairie	Green Chips	5,200	Injector
Red Pine Alfalfa	Crookston			
Rivard Quality Seeds	Argyle	Sunflowers	500	Stoker
Roy Apartments	Grand Rapids			
Sears Store	Litchfield	Pellets	15	Under Feed Stoker
Solbakken Resort		Chunk Wood		Garn
Spalding House	Crosby	Pellets	100	
Spectrum Metals	Isle	Chunk Wood		Garn
St. Francis Hospital	Little Falls	Chips		
Thompsen Greenhouse	Thief River Falls	Pellets	150	Stoker-Forced Air Furnace
Tomteboda Motel	Grand Marais			
Village Launromat	Aitkin			
Village of Smokey Hills	Osage	Chunk Wood		Garn
Wadena Floral	Wadena			
Wilder Boys Camp		Chunk Wood		Garn
Wilder Girls Camp		Chunk Wood		Garn

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CONSULTANTS IN THE FIBER FUELS INDUSTRY

The following is a list of consultants providing services in the fiber fuels industry. Inclusion on or omission from this list does not constitute endorsement by the publishers of this report.

CONSULTANTS	SERVICE	SYSTEM TYPES	SIZE
1) Architectural Resources Inc. 704 East Howard St. Hibbing, MN 55746 (218/263-6868) Parnell Satre P.E.	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification	Residential Commercial Institutional Industrial
2) Blesi-Evans Co. 2533 24th Ave. So. Minneapolis, MN 55406 (612/721-6237) Mark Evans	Equip. Supplier Design Project Feasibility System Analysis	Green Fuel Densified Fuel Co-Generation Etc.	Commercial Institutional Industrial
3) Diversified Energy Consultants P.O. Box 387 Oakland, Iowa 51560 (712/482-3666) Oren Hodges/Dave Merril	Equip. Supplier Design Project Feasibility System Analysis	Green Fuel Densified Fuel	Residential Commercial Institutional Industrial
4) Energy Research Associates 2115 West Norfolk Meguen, Wisconsin 53092 (414/242-6427) Richard C. Wright P.E.	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
5) Energy Resource Systems Inc. 424 West County Road D Roseville, MN 55112 (612/631-1681)	Equip. Supplier Design Project Feasibility System Analysis Installation Testing	Green Fuel Densified Fuel Co-Generation Etc.	Commercial Institutional Industrial
6) Equipment Engineering Corp. 5900 Olson Memorial Highway Minneapolis, MN 55422 (612/377-9156)			
7) Eumurian Associates 9707 Janero St. No. Mahtomedi, MN 55115 (612/631-1681)	Design Project Feasibility System Analysis	Gasification	Industrial
8) Forest Fuels Inc. 1020 Washington St. Brainerd, MN 56401 (218/828-0904) Bob Despot	Equip. Supplier Design Project Feasibility Systems Analysis Installation Testing	Green Fuel Densified Fuel	Commercial Institutional Industrial
9) Garn Inc. 384 West County Road D St. Paul, MN 55112 (612/633-1357) John Terpstra	Equip. Supplier Design Project Feasibility System Analysis	Green Fuel	Residential Commercial Institutional Industrial
10) General Heating & Engineering 1922 W. Superior St. Duluth, MN 55806 (218/727-1888) Brian Broden	Equip. Supplier Design Project Feasibility System Analysis Installation Testing	Green Fuel Densified Fuel	Commercial Institutional Industrial
11) HDR Techserv Inc. 5401 Gamble Drive Suite 300 Minneapolis, MN 55416 (612/544-7741) Don Krebs	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial

CONSULTANTS IN THE FIBER FUELS INDUSTRY

CONSULTANTS	SERVICES	SYSTEM TYPES	SIZE
12) Horty-Elving & Associates 505 East Grant St. Minneapolis, MN 55404 (612/332-4422) Jim Elving	Design Project Feasibility System Analysis	Green Fuel Densified Fuel	Commercial Institutional
13) I.E. Associates 3704 11th Ave. South Minneapolis, MN 55407 (612/823-3154) Tom Abeles	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
14) Jacobson Machine Works, Inc. 2445 Nevada Ave. No. Minneapolis, MN 55427 (612/544-8781) Bob White	Equip. Supplier System Analysis	Green Fuel Densified Fuel Gasification	Commercial Institutional Industrial
15) John E. Foss P.E. 3215 Riverside Drive Moorhead, MN 56560 (218/236-1540)	Design Project Feasibility System Analysis	Densified Fuel	Commercial Institutional
16) Joseph V. Edeskuty & Associates 15255 Minnetonka Blvd. Minnetonka, MN 55345 (612/933-5677) Robert Von Edeskuty	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
17) JRJ Inc. - Engineering Services R.R. 1, Box 90 Pengilly, MN 55775 (218/885-1525) Ray Jacobson	Design Project Feasibility System Analysis	Green Fuel Densified Fuel	Commercial Institutional Industrial
18) KMW Systems Inc. Wolf Island Road, Box 4101 Hayward, Wisconsin 54843 (715/462-3212)	Design Project Feasibility System Analysis Installation	Green Fuel Densified Fuel Co-Generation Etc.	Commercial Institutional Industrial
19) Lundquist, Wilmar, Schultz & M 821 Raymond Ave., Suite 300 St. Paul, MN 55114 (612/642-9771) Len Lundquist	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Co-Generation Etc.	Residential Commercial Institutional Industrial
20) Michaud, Cooley & Erickson 625 4th Ave So., Suite 1325 Minneapolis, MN 55415 (612/475-3419) Doug Cooley	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
21) Peat Energy Systems P.O. Box 69 Rosemount, MN 55068 612/423-5181 Ron Carlson	Design Project Feasibility System Analysis		
22) Peatalizer People P.O. Box 305 Red Lake Falls, MN 56750 (218/253-4243)	Design Project Feasibility System Analysis	Densified Fuel	Commercial Institutional Industrial
23) Posko Associates Inc. 20720 W. Watertown Rd, Suite 200 Waukesha, Wisconsin 53186 (414/786-7200) Tom Posko	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial

CONSULTANTS IN THE FIBER FUELS INDUSTRY

CONSULTANTS	SERVICES	SYSTEM TYPES	SIZE
24) R.W. Gorman Associates Inc. P.O. Box 548 Washburn, Wisconsin 54891 (715/373-2632) Richard Gorman	Equip. Supplier Design Project Feasibility System Analysis Installation	Green Fuel Densified Fuel Co-Generation Etc.	Residential Commercial Institutional Industrial
25) Richwood Company 310 Snelling Ave. No. St. Paul, MN 55104 (612/641-0460)	Equip. Supplier Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification	Commercial Institutional Industrial
26) Robert Massengill Inc./CPM 2524 118th Lane NW Coon Rapids, MN 55433 (612/332-1400)	Design Project Feasibility System Analysis	Densified Fuel	Residential Commercial Institutional Industrial
27) Robert O. Brown Co. 6885 Washington Ave. So. Edina, MN 55435 (612/941-8843)	Design Project Feasibility System Analysis Testing	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
28) Spaulding Engineering Ltd. 1821 University Ave. St. Paul, MN 55104 (612/644-5676) Roy Spaulding	Design Project Feasibility System Analysis Installation Testing	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
29) Sylva Energy Systems Inc. 519 Richard St. Thunder Bay, Ontario Canada P7A1R2 (807/683-6795) Terry Gunnell MN Contact: Wells Oswalt (612/251-6079)	Equip. Supplier Design Project Feasibility System Analysis Installation Testing	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Residential Commercial Institutional Industrial
30) Toltz, King, Duvall Anderson & Associates 2500 American Nat'l Bank Bldg. St. Paul, MN 55101 (612/292-4400) Jim Sebesta P.E.	Design Project Feasibility System Analysis	Green Fuel Densified Fuel Gasification Co-Generation Etc.	Commercial Institutional Industrial
31) T.S.P. 7301 Ohms Lane, Suite 480 Minneapolis, MN 55435 (612/830-0070) Rochester: (507/288-8155) Duluth : (218/722-6892)	Design Project Feasibility System Analysis Installation	Green Fuel Densified Fuel Co-Generation Etc.	Commercial Institutional Industrial

SOURCES OF FIBER FUEL INFORMATION

SOURCE	TYPE OF INFORMATION
Minnesota Dept. of Energy & Economic Development Energy Information Center 900 American Center 150 East Kellogg Boulevard St. Paul, Minnesota 55101 Telephone: Twin Cities: 612-296-5175 MN Toll Free: 800-652-9747	Agricultural Residue Resources General Information Financial Resources
Minnesota Dept. of Natural Resources Division of Forestry Box 44, DNR Building 500 Lafayette Road St. Paul, Minnesota 55146 Telephone: 612-296-6491	Wood Resources Fiber Fuel Users Fiber Fuel Producers
Fiber Fuels Institute 3072 Ranchview Lane P.O. Box 41191 Minneapolis, Minnesota 55447 Telephone: 612-559-8164	Fiber Fuel Standards Fiber Fuel Sources, Users, Producers General Information
U.S. Dept. of Energy 1617 Cole Boulevard Golden, Colorado 80401 Telephone: 303-231-1000	Information on all areas of renewable energy, including fiber fuels.
University of Minnesota 202 Kaufert Lab 2004 Folwell Avenue St. Paul, Minnesota 55108 Telephone: 612-624-3407	General information on the industrial/commercial use of wood for energy.
Minnesota Dept. of Natural Resources Division of Minerals Box 45, DNR Building 500 Lafayette Road St. Paul, Minnesota 55146 Telephone: 612-296-4807	Peat Resources Peat Combustion Peat Energy Development
Iron Range Resources & Rehabilitation Board Box 411 Eveleth, Minnesota 55734 Telephone: 218-744-2993	Peat Harvesting Financial Resources

Synopsis of State Rules That Apply to Fiber Fueled Installations and Conversions

The following is a brief synopsis of State statutes and rules that pertain to air pollution and the owners or operators of fiber fueled boilers or heating equipment.

This synopsis is not intended to represent any State statute or rule in its entirety. Please consult the appropriate reference or the Minnesota Pollution Control Agency (MPCA) for additional information.

Permits

An owner or operator of any fiber fueled boiler or heating device that has a rated heat input of more than five (5) million BTU's per hour is required to obtain a permit from the MPCA. Such a permit is required prior to construction of new equipment or modification of existing equipment. Minn. Statute 116.081, Subd. 1, (1982); 6 MCAR § 4.4303; 6 MCAR § 4.4001.

The owner/operator of fiber fueled equipment, should be prepared to provide the following information which is routinely requested by the Agency for issuance of a permit:

1. A completed MPCA boiler data sheet for the new or modified boilers and for any remaining boilers at the site.
2. Available test data of a similar installation provided by the equipment suppliers or other sources.
3. Layout and detail drawings that are available for the boiler, the building, the wood products fueling system and the wood products storage facility.
4. A listing of the suppliers and specifications of the wood fuel.
5. The anticipated annual usage of the wood fuel.
6. Assurance from the manufacturer that the equipment will meet all applicable State and federal air emission standards.
7. Written manufacturer's operating instructions which will result in the most efficient combustion and will enable the equipment to meet emission limits. Assuming they are available, and if not, they should be created by the manufacturer at the user's request.

Permit Applications or Additional Information can be Obtained by Contacting:

George Vasilakes
Division of Air Quality
Minnesota Pollution Control Agency
1935 West County Road B2
Roseville, Minnesota 55113
(Telephone: 612-296-7325)

Emission Standards

The owner or operator of a fiber fueled boiler or heating device must meet two (2) criteria to be in compliance with State emission limits.

First, gases emitted to the atmosphere from the device must not exceed 20% opacity (smoke density). 6 MCAR § 4.004.

Second, particulate matter in the exhaust gases must not exceed 0.4 or 0.6 pounds of particulate matter per million BTU's of heat input, depending on the age of the device and location in the State. 6 MCAR § 4.004.

Note: Units smaller than five (5) million BTU's heat input per hour are not exempt from these standards.

Stack Testing

The MPCA has the authority to request the owner/operator to conduct a stack test in order to demonstrate compliance with emission standards. The cost of stack testing is the responsibility of the owner/operator. 6 MCAR § 4.4304.

Enforcement

The MPCA has the authority to seek prosecution, civil penalties, injunction, or other legal remedies for violations of emission standards or permit requirements. Minn. Statute 115.071 (1982).

FIBER FUELS INSTITUTE

3072 Ranchview Lane
P.O. Box 41191
Minneapolis, Minnesota 55447

Telephone: (612/559-8164)

Fuel Cost Comparisons
Per Million BTUs

Fuel	Price	Cost Per Million BTUs of Useable Heat
Electricity	Per KWH	Per MM BTUs
	$ .035	$10.79
3,415	.045	13.87
BTUs/kwh	.055	16.96
	.065	20.05
Eff.=95%	.075	23.11
#2 Oil	Per Gal.	Per MM BTUs
138,000	$ .90	$ 8.16
BTUs/gal.	1.00	9.06
	1.10	9.98
	1.20	10.88
Eff.=80%	1.30	11.79
Propane	Per Gal.	Per MM BTUs
90,600	$ .30	$ 8.49
BTUs/gal.	.65	9.20
	.70	9.91
Eff.=78%	.80	11.32
Natural Gas	Per MCF	Per MM BTUs
1 million	$4.00	$ 5.00
BTUs/MCF	4.50	5.63
	5.00	6.25
	5.50	6.88
	6.00	7.50
Eff.=80%	6.50	8.13
Firewood	Per Cord	Per MM BTUs
20 million	$40.00	$ 3.64
BTUs/cord	60.00	5.45
Air Dried	80.00	7.27
	100.00	9.09
Eff.=55%	120.00	10.91
#5 & #6 Oil	Per Gal.	Per MM BTUs
143,000	$ .60	$ 5.25
BTUs/gal.	.65	5.69
Low Sulfur	.70	6.12
	.75	6.56
Eff.=80%	.80	7.00

Fuel	Price	Cost Per Million BTUs of Useable Heat
Wood, Peat,	Per Ton	Per MM BTUs
Agri. Fuel	$50.00	$ 4.00
Pellets or	55.00	4.41
Briquettes	60.00	4.81
8,000 BTUs/lb.	65.00	5.21
@ 8% M.C.	70.00	5.60
Eff.=78%	75.00	6.01
Eastern Coal	Per Ton	Per MM BTUs
13,250	$70.00	$ 3.39
BTUs/lb.	75.00	3.63
	80.00	3.80
	85.00	4.11
Eff.=78%	95.00	4.60
Western Coal	Per Ton	Per MM BTUs
9,000	$40.00	$ 2.96
BTUs/lb.	45.00	3.33
	50.00	3.70
	55.00	4.07
Eff.=75%	60.00	4.44
Wood Chips	Per Ton	Per MM BTUs
4,700	$18.00	$ 2.95
BTUs/lb.	20.00	3.27
@ 45% M.C.	22.00	3.60
	25.00	4.09
Eff.=65%	30.00	4.90
Lignite	Per Ton	Per MM BTUs
7,000	$40.00	$ 3.81
BTUs/lb.	45.00	4.29
	50.00	4.76
Eff.=75%	60.00	5.71
Peat	Per Ton	Per MM BTUs
Sods or Milled	$20.00	$ 2.45
6,000 BTUs/lb.	25.00	3.06
@ 30% M.C.	30.00	3.68
Eff.=68%	35.00	4.29

*Useable heat costs are *comparable*. The cost per million BTUs as received (gross heating value) of each fuel is divided by the firing efficiency to yield the cost per million BTUs of useable (net) heat. For example: (1) #2 oil has 7.25 gal. per million BTUs. At 90¢ per gal., the as-received cost per million is 7.25 gal. x 90¢ = $6.53. $6.53 ÷ 80% efficiency = $8.16 per million BTUs of useable heat. (2) Fiber fuel briquettes or pellets have 16 million BTUs per ton as received. At $60.00 per ton, the as-received cost per million BTUs is $60 ÷ 16 = $3.75. $3.75 ÷ 78% efficiency = $4.81 per million BTUs of useable (net) heat.