Benton County Consulting Project

Economic Development Authority
Benton County Government Center
531 Dewey Street
P.O. Box 129
Foley, MN 56329

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Prepared by the St. Cloud State University Undergraduate Students,
in conjunction with the Minnesota Small Business Development Center.

Business Consulting 498
Professor Barry C. Kirchoff
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Table of Contents

Cover Page 1
Table of Contents 2
Consultants 4
Methodology 5
Introduction 6
- Project Summary 6
- Benton County Overview 8
- SWOT Analysis 9

Wind Energy 10
- Wind Energy Resource Guide 10
- Background and Overview 11
- Advantages and Disadvantages 12
- Engineering 13
  - Horizontal Axis Wind Turbines 13
  - Vertical Axis Wind Turbines 15
- Turbine Manufacturing 16
- Wind Application Criteria 17
- Minnesota Wind Speed Map 19
- Recommendation 20

Solid Waste 21
- Solid Waste Incineration Resource guide 21
- Solid Waste Overview 22
- Solid Waste Classification 23
  - Residential Waste 23
  - Industrial and Commercial Waste 24
  - Institutional, Construction and Demolition Waste 25
  - Municipal Service and Process Waste 26
  - Agricultural Waste 27
- Benton County Waste Production 28
- Waste-to-Energy Facility 29
- Recommendation 31

Green Business 35
- Green Business Overview 35
- Switchgrass 36
- Wood Waste 41
- Organic Composting 45
- Tire Recycling 53
- Biomass Pellatization 56
- State and Federal Funding 61

Works Cited 66
Appendix 70
A1: Terminology Definitions 70
A2: Minnesota Wind Turbine Locations 72
A3: Supplemental County Information 73

Consultants

Student Consultants	Business Degree	Occupational Background
Luke Braun	B.S in Accounting, Minor in Finance	Account Management, Tax Consultation, Financial Statement Preparation
Misty Ferrell	B.S. in Entrepreneurship, Minor in Public Relations	Sales, Management, Medical Records
Philip Hedlof	B.S. in Entrepreneurship	Academic Advisor, Sales
Tony Janckila	B.S. in Entrepreneurship Minor in Communication Studies	Small Business Proprietor, Investment Coordination and Advisement, Sales
Anthony Rank	B.S in Management	Food Service, Retail Sales, Air National Guard
Lindsey Regel	B.S. in Management	Office Assistant, Residential Construction, Accessible Housing, Sales
Tyler Schneider	B.S in Management	Recreational Manager, Materials Distribution Engineer, Retail Sales and Organization
Ben Stonehocker	B.S in Entrepreneurship	Sales

Methodology

The consulting team, comprised of undergraduate business students at St. Cloud State University, prepared this project working in teams. One of the teams focused on Solid Waste Incineration, while the other team focused on Wind Energy. Once these two sections of research were complete, the team, as a whole, focused on other green business opportunities for Benton County. All of the research was compiled to develop our recommendations, using existing business models as a benchmark of what has worked successfully for others.

The information in this report is by no means permanent. 'Green' standards are developing rapidly, and there are express variances in all green businesses throughout the country. This report is designed to look at green businesses in a broad and general sense, and from this, develop ideas and recommendations for Benton County to utilize. Throughout this document, the consulting team used a variety of industry terms, and these terms are listed in the appendix for the convenience of the reader.

Project Summary

Benton County, MN is in the process of developing a strategic plan for 2008 and has requested help researching and presenting ideas for economic development within the county. Benton County is particularly interested in the feasibility of wind energy and solid waste incineration along with other green businesses. These ideas should fit the geographic and economic environment of the county. As the consulting team assigned to this project, our intention is to research and conduct preliminary feasibility studies into the application of wind energy and solid waste incineration. Additionally, the consulting team will be researching possible green business opportunities for local entrepreneurs.

The research into wind energy and solid waste incineration are of particular interest to Benton County because they feel that their county would be a great candidate for such projects. Ideally, they would like to become a leader in the renewable energy for the state of Minnesota. Along with the research of renewable energy sources, Benton County is also looking for other green business opportunities that will help their county become a local leader in environmental responsibility.

Wind Energy is a very popular source of renewable energy and has been implemented in other regions of the state and country. Our research will investigate the logistics and the possibilities that wind energy could bring to Benton County as a viable energy source. The research will include different types of wind energy turbines, the requirements for implementation of such turbines, and whether the county is a candidate for such energy.

Solid Waste incineration is another popular source of renewable energy and has been considered for implementation in the county, but remains in the research stages. Much like wind energy, solid waste incineration could be a viable energy source and a boost to the economy. Our research will include the different types and sources of solid waste incineration along with the by-products it produces. The consulting team will also analyze and compare the requirements for solid waste incineration to determine if Benton County is a candidate for a solid waste incineration plant.

The third aspect of our consulting project will include the presentation of other green business opportunities and environmentally friendly business ideas. The consulting team will examine different business ideas that have already been presented, or implemented in other regions of the state and country and determine if Benton County would be able to market and/or implement these business opportunities.

The Benton County consultation project will commence with a written report and a presentation of all applicable ideas for wind energy, solid waste incineration, and green business opportunities within the county. It is our hope that this project will lead to increased awareness within the local government, and possibly the implementation of environmentally friendly businesses that will propel Benton County to a leadership position in the green business industry as well as a leader in renewable energy for the state of Minnesota.

Benton County Overview

Benton County was established in 1849 as one of the founding three counties of Minnesota. The early settlers were drawn to Benton County because of its location on the Mississippi River. The proximity to trading routes, such as the Mississippi River, attracted early settlers, fur traders and lumberjacks to the area. Benton County experienced a rapid population growth in the late 1800's when immigrants from northern Europe recognized the agricultural potential. Even to this day Benton County still has a strong agricultural presence, as well as a growing manufacturing industry.

Located in central Minnesota, Benton County is surrounded by Morrison, Stearns, Sherburne, and Mille Lacs counties. It includes eight cities within its 261,000 acre landmass. Benton County's infrastructure includes a railway system and various highways that connect it to major economic centers such as St. Cloud, Duluth, and the Twin Cities Metro. Since it has an extensive infrastructure, Benton County is conveniently accessible to the flow of goods throughout the state.

Benton County's economy is supported by businesses such as Knife River, International Paper, and Stearns Manufacturing which are the three largest employers in Benton County. Another large employer is the two school districts within the county, Sauk Rapids ISD #47 and Foley ISD #51. There are also 209 small farming operations on 196,000 acres consisting primarily of livestock, making a large contribution to the economy as well.

The current goals of Benton County and its commissioners are to diversify the economy by attracting new businesses with a focus on renewable and alternative energy sources. By attracting new businesses and assisting in the growth and development of current businesses, the county will be able to increase their revenues by expanding their tax base and also achieve their third goal of expanding employment opportunities. Lastly, Benton County strives to support regionally appropriate economic development through its renewable and alternative energy efforts.

SWOT Analysis

Strengths

1) Large Supply of Undeveloped Land
2) Access to Major Highways: Hwy 10. Hwy 23
3) Heavy Manufacturing Industry
4) Strong Agriculture Background
5) Centralized Location
6) Close Proximity to St. Cloud Metro
7) Supportive Surrounding Counties
8) Progressive Economic Development Plan

Weaknesses

1) Distance from Twin Cities Metro
2) Lack of Population and Workforce Diversity
3) Decentralized Population
4) Limited Entertainment and Attractions
5) Tight Budget Constraints

Opportunities

1) Land Development Opportunities
2) Business Expansion Possibilities
3) Growing Work Force
4) Collaboration Possibilities with Surrounding Counties

Threats

1) Competition from Surrounding Communities for Economic Development
2) Limited Financial Support from Government
3) Threat of Technical Obsolescence
4) Possible Public Resistance to New Ideas

Wind Energy Resource Guide
To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Wind Energy industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

General Electric

http://www.gepower.com/businesses/ge_wind_energy/en/index.htm

MidAmerican Energy

http://www.midamericanenergy.com/wind/

Invenergy

http://www.invenergyllc.com/

Horizon Wind Energy

http://www.horizonwind.com/about/ftkc/

Department of Energy

http://www.eere.energy.gov/de/wind_power.html

American Wind Energy Association

http://www.awea.org/pubs/factsheets/Wind_Energy_An_Untapped_Resource.pdf

Wind Energy

Background & Overview

Wind power has been used extensively for centuries. It is a form of solar energy, created by patterns of the earth and its position to the sun. This clean, renewable energy has been used for sailing ships, pumping water, grinding grain and, obviously, generating energy to produce electricity. Old windmills dot the countryside and are still used to produce small amounts of energy for farms and homes. People have been experimenting with uses of wind power and its ability to produce mass amounts of usable energy. This has created the fastest growing energy source in the world. It's rapid growth could be attributed to high gasoline and other fossil fuel prices. Nevertheless, wind energy has been gathering the interest of millions of people. (Distributed Energy Program: Wind Power.)

Wind power has been around for a long time and is known to be a very clean source of energy. Humans have been trying to find ways to harness wind as early as 5000 B.C. Boats were using it to sail up and down the Nile River. Windmills then started spreading across China to pump water. The Persians then used this exciting new technology to grind grain. By the 11th century, the Dutch were using wind power to drain lakes and marshes. Settlers took this technology and began to pump water and later use it for electricity. The European industrial revolution lead to the temporary downfall of wind energy. After the industrial revolution, Denmark adopted the windmill idea and began to create wind turbines that could be used to produce mass amounts of energy (History of Wind Energy).

The U.S. Department of Energy states that the world's winds could possibly supply more than 15 times the current world energy demand (Wind Energy Potential). The good news is that the United States has the wind potential to generate three times the electricity it consumes daily. That is if the country could somehow find a way to pipe or transmit all that energy to where it is needed. Minnesota is ranked 9th in the United States in wind potential (Wind Energy…). Unfortunately, most of the wind is found in the Southwestern part of the state. Our map shows how Benton County has a wind corridor that could possibly be used for setting up wind farms (see pg. 18-19). In comparison to the southwest Minnesota and other states, it might not be feasible. North Dakota could produce up to one third of the needed electricity of the United States (Wind Power Today). Benton County could possibly harness this energy production by

setting up a transmission plant that would distribute the energy received from North Dakota. This is the only feasible application that is recommended and is in itself questionable.

Advantages of Wind Energy

Advantages are abundant when considering wind energy. The U.S. Department of Energy has listed wind energy as the fastest-growing energy source today and here is why:

- Wind is a very clean energy source. It does not pollute the air with atmospheric emissions like toxic metals and greenhouse gases (Wind Energy: How Does It Work.).
- It is a domestic form of solar energy which cannot be used up.
- Costs between 4 and 6 cents per kilowatt-hour.
- Wind energy provides the most jobs per dollar invested (Distributed Energy…).
- Benefits rural economies by not interfering with farmers operations.
- Midwestern states have found that farmers earn roughly $40 -$55 per acre a year to lease out land.

Disadvantages of Wind Energy

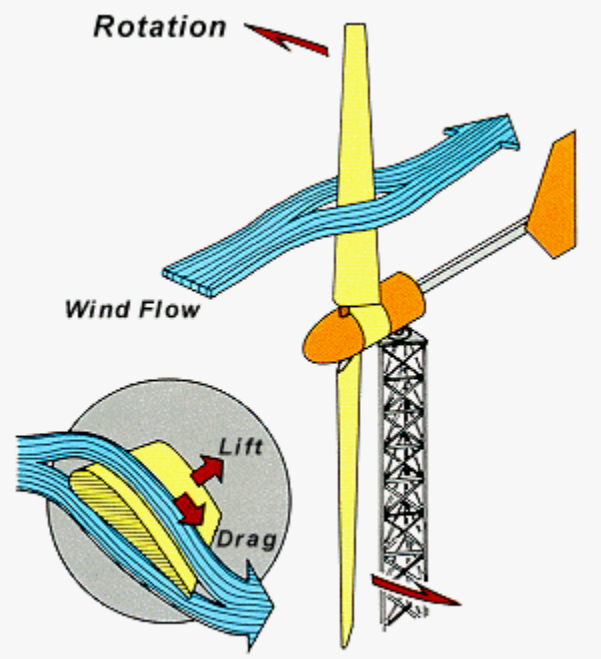
Disadvantages are few but may be significant:

- In most areas wind energy cannot compete on a cost basis with conventional sources.
- Wind production can be intermittent, and a sufficient way to hold all the harnessed energy has not been created.
- Usually excellent sources of wind are in remote locations which makes it difficult to transfer the power that the turbines generate.
- The noise from the spinning of the turbine blades can be problematic.
- Wind farms may not be visually appealing.

ENGINEERING

When referring to Wind Turbines it is important to understand the different types. There are two basic types of wind turbines, Horizontal Axis Wind Turbine (HAWTs), and Vertical Axis Wind Turbine (VAWTs)("Basic Aerodynamic Operating Principles of Wind Turbines").

HAWTs generally have the appearance similar to that of the normal household fan. They generally have a tower and at the top of the tower sits a generator and the rotor shaft. An old windmill that you would see on a farm is an example of a HAWT. HAWTs can be further subdivided into upwind or downwind turbines ("Basic Aerodynamic Operating Principles of Wind Turbines"). An upwind turbine is where the wind hits the blades before the tower (Upwind) and a downwind turbine is where the wind hits the tower before the blades (downwind) ("Wind and Hydropower Technologies Program: Wind Energy Technologies"). Typically, the tower will cause turbulent downwinds and that is why most HAWTs are Upwind Turbines. The downwind turbines were developed to allow the blades to warp with the wind, however, this can cause undue stress on bearings and the blades themselves ("Basic Aerodynamic Operating Principles of Wind Turbines").



Principles of Wind Turbine Aerodynamic Lift

HAWTs

Advantages

- Wing warping is possible. This allows the blades to be set for the best angle of attack towards the wind for the wind speed and conditions.
- Tall towers can allow placement on uneven land, offshore locations, or even within forests above the tree line.
- Blades are situated to the sides of the turbine which creates more stability and a better center of gravity.
- Nearly all designs are self starting.
- Rotor blades can be pitched at different angles within a storm to minimize possible damage.
- Tall towers allow access to stronger wind sites.

Disadvantages

- The towers and blades tend to be difficult to transport and transportation costs can account for up to 20% of total Cost.
- Turbine height can cause local opposition based on visual pollution.
- Downwind variants tend to be plagued with problems such as fatigue and structural failures.
- FAA is currently looking into possible radar problems caused by the towers.
- Turbines may have difficultly operating near the ground in turbulent winds, they tend to need smoother more laminar flow of wind.
- Difficult to install and may require specialized cranes.

VAWTS

Vertical Axis Wind Turbines are different from Horizontal Axis Wind Turbines because the wind does not strike the blades directly. The wind strikes the blades coming from the edges. This variety offers distinct advantages and disadvantages ("Electricity Generation Using Small Wind Turbines At Your Home Or Farm.").

VAWTS

Advantages

- Ease of maintenance due to moving parts located on or near the ground.
- Improved aerodynamics and lower drag at low and high pressures.
- Ridges, hilltops, and mesas can have a higher speed and more powerful wind near the ground due to the speed-up effect of the wind increasing with elevation.
- Low height does not add to visual pollution.
- Much easier to transport and install.

Disadvantages

- Most VAWTs are only 50% as effective as HAWTs due to drag caused by their blades rotating into wind.
- Most VAWTs place higher stress on the lower bearings.

- Need to be installed on a relatively flat piece of ground.
- Low starting torque.
- Higher fatigue on rotor shaft unless a support superstructure is created with a bearing at the top as well.

Turbine Manufacturing

With the increasing demand for alternative energy sources, the demand for wind turbines has dramatically grown. Here in the Midwest, a few energy companies have invested in this demand and are supporters of renewable energy. A few companies that have done local wind projects are General Electric (GE), MidAmerican Energy, Invenergy, and Horizon Wind Energy. Each of these companies has their own niche in the process of designing, building, constructing, and managing the turbines and wind fields once constructed.

General Electric offers installation, operation and maintenance services for wind turbines. They also engineer, procure, construct, and operate wind projects (General Electric). Other companies that are building wind fields often buy turbines from GE, and if they wish, can bring them in as partners or customize what amount of assistance they would like GE to supply for the project (General Electric).

MidAmerican Energy Company is rated #1 in the nation in ownership of electric generation among rate-regulated utilities (MidAmerican Energy). Currently they have 695.5 megawatts of wind energy facilities in operation, under construction or under contract in Iowa; with 459.5 of the 695.5 up and running (MidAmerican Energy). Creating 459.5 megawatts of energy can power 144,000 homes when the turbines are running at capacity (MidAmerican Energy). In addition, another 123 megawatts of wind energy is expected to be added in Pocahontas County by the end of 2007 (MidAmerican Energy).

Invenergy is a developer, owner and operator of large-scale electricity generation assets in the North American and European energy markets. Their company functions include building, owning, and operating large scale wind energy and thermal generating facilities. Primarily, Invenergy's wind projects range from 25-400 megawatts and, as a company, they take care of originating, developing, constructing, and long-term operation of their projects (Invenergy). Examples of their work can be found in Carroll and Crawford Counties of Iowa where 66 General Electric 1.5sle wind turbines were constructed, with each of these capable of producing 1,500 kilowatts and having a total capacity of 99 megawatts (Invenergy). This project was then sold to MidAmerican Energy who now owns and operates the facility.

Horizon Wind Energy is another notable wind energy company. They have constructed wind farms all across the United States including Southern Minnesota and Northern Iowa. Horizon works with landowners, local governments, and citizens to make sure that they minimize the disturbance of land and attempt to keep everyone as happy as possible before, during, and after the project is complete (Horizon Wind Energy). Listed below are the steps that Horizon Wind Energy takes when they develop a wind farm.

Wind Application Criteria

1) ***Find a windy site.***
   Horizon Wind Energy performs meteorological investigations all over the country and the world looking for sites where the average wind speed is above 17 MPH.

2) ***Make sure the site has nearby transmission lines.***
   It's not enough to find wind. There has to be a way to transport the electricity generated by a wind farm to a main power grid.

3) ***Define the boundaries.***
   After finding a windy place that is near a power grid, the boundaries of the prospective area must be defined.

4) ***Determine who owns the land within the prospect boundaries.***
   The owners of the land within the prospective boundaries are the potential partners.

5) ***Contact the landowners.***
   In order to gauge interest in wind farm development, Horizon Wind Energy contacts the landowners about the possibility of a partnership.

6) ***Call a town meeting.***
   If there are many landowners in the same area, a town meeting helps Horizon explain the ins and outs of wind farm royalty payments and natural resource management.

7) ***Settle the contracts.***
   Horizon Wind Energy and the landowners negotiate agreements for test towers and options for lease agreements.

8) ***Draw up blueprints.***
Horizon Wind Energy lays out potential wind farm configurations to give landowners an idea of where the turbines might be placed.

9) ***Watch the wind.***
Horizon Wind Energy monitors the wind for 6 months to 2 years to corroborate their data with publicly available wind data.

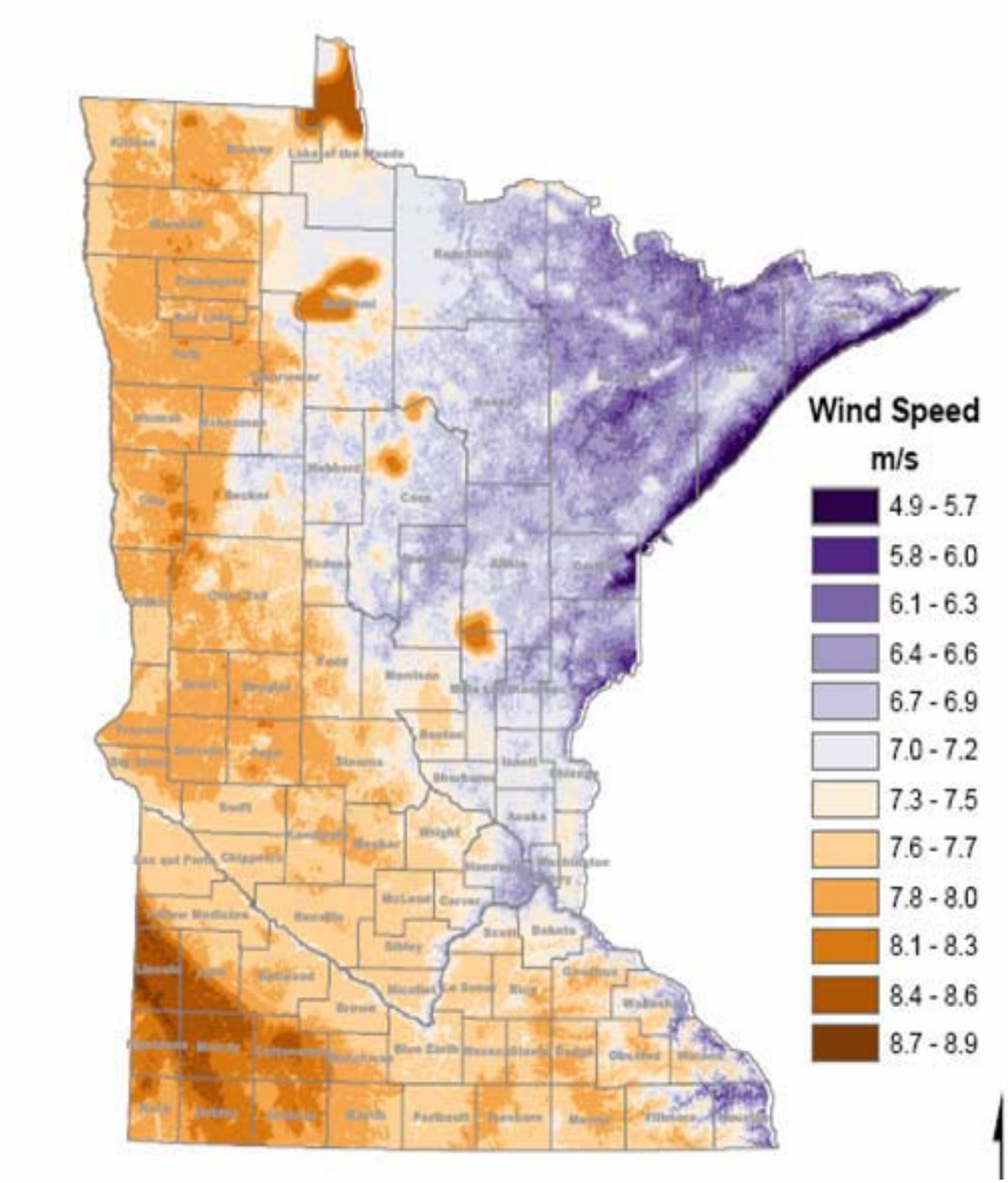
10) ***Get the necessary permits.***
While testing the wind's power, the necessary permits at the federal, state, and county levels must be acquired.

11) ***Perform environmental analyses.***
Horizon Wind Energy wants to ensure the safety of local wildlife and the environment. Horizon performs environmental analyses at every wind farm location.

12) ***Test the wires.***
Testing grid connections is very important, so Horizon Wind Energy performs additional transmission research.

13) ***Sell the electricity.***
Selling wind generated electricity is the Holy Grail in the wind energy business, because of the huge upfront costs, projects are feasible only after a customer, such as a large utility, has committed to a long-term energy purchase of 10 to 20 years in duration. Like just about all other wind energy companies, Horizon cannot build projects until a customer is found.

Minnesota Wind Speed Map



Average wind speeds at 80 meters (262 feet)

Recommendation

Wind energy, as previously mentioned, is one of the fastest growing energy sources in the world. It has been around for centuries but only in the past few decades has it become more and more popular, most likely due to high oil prices and advanced technology creating greater efficiency. Public demand for renewable energy production has pushed governments, both local and national, to concentrate on the issue. Lawmakers are introducing policies to assist counties and local communities to build wind turbines. In hopes of satisfying this demand Benton County has taken the initiative to seek out the plausibility of a wind field in their county.

Benton County does have a moderate wind corridor moving through their county. The map of Minnesota shows how the corridor is located along the Mississippi River (see pg. 18-19). The speed of the wind in this region is mostly moderate when it comes to average wind speeds. Even with the advancement of wind turbines, companies likely will not invest in bringing wind energy to the county. Construction companies have been found to require an average wind speed of 17 mph to make it profitable. These constant averages are not found in Benton County.

In concluding this section the consulting team has explained the background and facts of wind, specifications of wind turbines, and introduced credible construction companies of these turbines and wind fields. Benton County does have scattered windy spots that could be harvested for the uses of farms, households, or small buildings but the area of land does not have the potential to produce the wind energy that is found in Southern Minnesota and Western Iowa. With this, it is not advisable to pursue energy companies with hopes of bringing them to Benton County as they would likely conclude that there is not a high enough average wind speed to make it worthwhile for them to install a wind field.

Solid Waste Incineration Resource Guide

To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Waste Incineration industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Solid Waste Management

http://civcal.media.hku.hk/solidwaste/introduction/default.htm

Anneberg Media

http://www.learner.org/interactives/garbage/solidwaste.html

Environmental Strategies

http://web.mit.edu/urbanupgrading/urbanenvironment/sectors/solid-waste-sources.html

Environmental Protection Agency

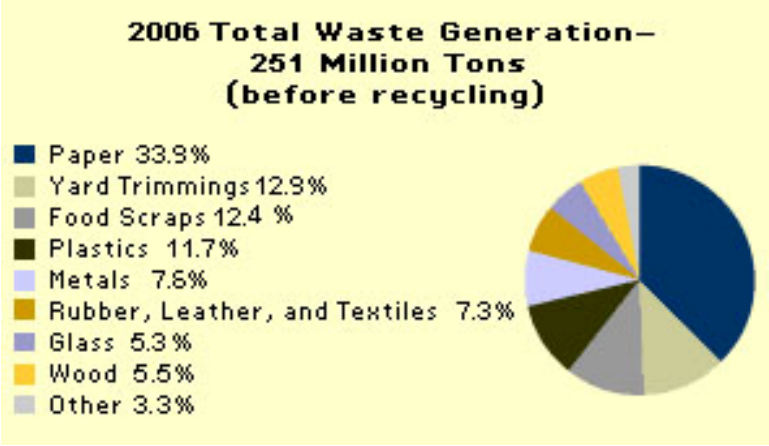
http://www.epa.gov/garbage/facts.htm

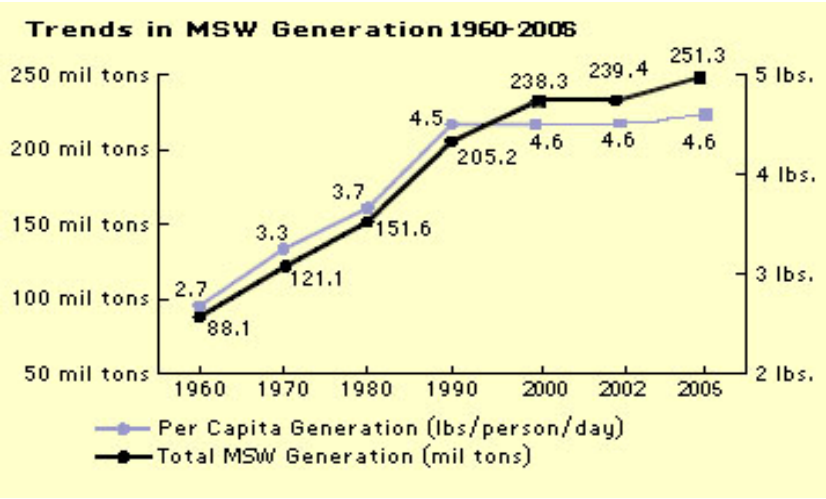
Solid Waste Overview

Solid waste is discarded or useless items from humans and animals other than fluids. “It encompasses the heterogeneous mass of throwaways from the urban community as well as the homogeneous accumulations of agricultural, industrial, and mineral wastes” (“Introduction”).

Municipal Solid Waste

Municipal solid waste (MSW) consists of everyday trash. Every year approximately 230 million tons of garbage is generated by the United States (“Solid Waste”); trends continue to show that MSW is increasing immensely, especially in how much trash people produce each day. Statistics show that in 2005, on average a person produces 4.6 pounds of trash per day (United States). This garbage typically includes items such as: product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint and batteries (United States). In a 2006 study, over 251 millions tons of MSW was generated by “U.S. residents, businesses and institutions” (United States). This included paper, yard trimmings, food scraps, plastics, metals, rubber, leather, textiles, glass, wood, and other types of trash.





Solid Waste Classification

There are several different types of MSW that contribute to the millions of tons that the United States produces annually. There is residential waste, industrial waste, commercial waste, institutional waste, construction and demolition waste, municipal service waste, process waste, and agricultural waste.

Residential Waste ("Sources and Types of Solid Wastes")

Residential waste is composed from single and multifamily homes.

<u>Types of Solid Residential Waste:</u>

- Food Waste
- Paper cardboard
- Plastics
- Textiles
- Leather
- Yard wastes
- Wood glass
- Metals
- Ashes
- Special waste
    - Bulky items
    - Consumer electronics
    - White goods: bed sheets, tablecloths, towels, bleached goods, large household appliances, alcoholic liquors without color (vodka, gin, tequila)
    - Batteries
    - Oil
    - Tires
    - Household hazardous wastes

Industrial Waste ("Sources and Types of Solid Wastes")

Industrial waste comes from manufacturing sites, construction sites, fabrication, chemical and power plants.

Types of Solid Industrial Waste:

- Housekeeping wastes
- Packaging
- Food wastes
- Construction and demolition materials
- Hazardous wastes
- Ashes
- Special wastes

Commercial Waste ("Sources and Types of Solid Wastes")

Commercial waste includes waste that comes from stores, restaurants, hotels, office buildings, markets, etc.

Types of Solid Commercial Waste:

- Paper
- Cardboard
- Plastics
- Wood
- Food wastes
- Glass
- Metals
- Special wastes
- Hazardous wastes

Institutional Waste ("Sources and Types of Solid Wastes")

Institutional waste comes from hospitals, prisons, schools, and government centers.

Types of Solid Institutional Waste:

- Paper
- Cardboard
- Plastics
- Wood
- Food wastes
- Glass
- Metals
- Special wastes
- Hazardous wastes

Construction and Demolition Waste ("Sources and Types of Solid Wastes")

Construction and demolition waste is produced by new construction sites, renovation sites, road repair, and demolition of buildings.

Types of Solid Construction and Demolition Waste:

- Wood
- Steel
- Concrete
- Dirt, etc.

Municipal Service Waste ("Sources and Types of Solid Wastes")

Municipal service waste comes from water and wastewater treatment plants, street cleaning, landscaping, beaches, parks, and other recreational vicinities

Types of Solid Municipal Service Waste:

- Street sweepings
- General waste from parks
- Landscape trimmings
- Tree trimmings
- Beaches
- Sludge: mud, mire, ooze, or slush, typically found at the bottom of a body of water or sediment in a water tank

Process Waste ("Sources and Types of Solid Wastes")

Process waste includes manufacturing plants, refineries, power plants, chemical plants, mineral extraction and processing plants.

Types of Solid Process Waste:

- Industrial process wastes
- Off-specification products
- Slay
- Scrap materials
- Tailings: residue of any product, such as from mining

Agricultural Waste ("Sources and Types of Solid Wastes")

Agricultural waste is comprised of crops, vineyards, orchards, feedlots, dairies, and farms.

Types of Solid Agricultural Waste:

- Spoiled food wastes
- Agricultural wastes
- Hazardous wastes (pesticides)

Benton County Waste Production

2003 MSW Disposal

Benton County sent 19,932 tons of municipal solid waste (MSW) to these facilities in Minnesota and surrounding states in 2003.

Landfill	**Tons**
Elk River Sanitary LF	8,618
Sarona LF (BFI), WI	885
Resource Recovery	**Tons**
Elk River RDF Processing facility	10,429
Benton County Total	19,932

2003 Recycling Data

Recycling programs in Benton County collected 26,889 tons of recyclable materials from residents and organizations in 2003.

Banned	**Tons**
Antifreeze	2
Fluorescent & HID lamps	0
HHW	1
Latex paint	2
Major appliances	222
Used oil	469
Used oil filters	17
Vehicle batteries	227
Waste tires	74
Glass	**Tons**
Food & beverage	573
Other glass	4
Metal	**Tons**
Aluminum	202
Co-mingled alum/steel/tin	86
Other ferrous & non-ferrous	6,282
Steel/tin cans	2,561
Other	**Tons**
Unspecified or Other	2
Paper	**Tons**
Corrugated	2,046
Magazine/catalog	11,719
Mixed paper	383
Newsprint	1,259
Office paper	211
Other paper	239
Phone book	15
Plastic	**Tons**
Film plastic	49
HDPE	32
Mixed plastic	181
Other plastic	12
PET	19
Benton County Total	26,889

(2003 SCORE Report)

Waste-to-Energy Facility: Potential Capacity

The most recent figures for the local area for waste production are as follows, according to the 2004 Solid Waste Management Plan of Benton County:

BENTON COUNTY WASTE PRODUCTION (2004)

Paper	40.5%	Glass	3.2%
Food Waste	11.7%	Adult & Infant Diapers	2.6%
Plastic	9.5%	Other Organics	2.5%
Wood Waste	6.7%	Hazardous Waste	0.9%
Metal	4.8%	Small Appliances	0.3%
Demolition/Construction	4.7%	Oil Filters	0.2%
Yard Waste	4.4%	Major Appliances	0.1%
Other Inorganics	4.2%	Textiles	3.7%

It should be noted that these figures do not represent the actual waste production that is transported to the waste-to-energy facility in Elk River. Benton County recycles approximately 68% of its solid wastes, which only leaves 32% of these materials to manage. Of the 32% that is not recycled, 50%, or 16% of the overall MSW, is transported to the RDF facility in Elk River, while the other 50% is taken to landfills. These percentages are taken from the 2003 SCORE report, and may be higher now.

To fully identify the potential capacity for a waste-to-energy facility in the Tri-County area, waste production within surrounding areas should be considered. The Elk River facility is located in Sherburne County and it can be expected that areas close to that facility would continue to transport their solid waste there. Sherburne County may even re-sign the contract with NRG. That being said, there are areas all around Benton County that would benefit from a new facility and potentially transport their waste materials into Benton County for incineration.

With a small population in comparison to surrounding counties, it can be expected that solid waste production in those counties would come in at much higher rates. According to data reported by the EPA for 2005, waste production per person is as follows:

Table 3

Generation, Materials Recovery, Composting, Combustion with Energy Recovery, and Discards of Municipal Solid Waste, 1960 – 2005
(In pounds per person per day)

Activity	1960	1970	1980	1990	2000	2003	2004	2005
Generation	2.68	3.25	3.66	4.50	4.63	4.53	4.61	**4.54**
Recovery for recycling	0.17	0.22	0.35	0.64	1.03	1.05	1.07	1.08
Recovery for composting*	Neg.	Neg.	Neg.	0.09	0.32	0.36	0.38	0.38
Total Materials Recovery	0.17	0.22	0.35	0.73	1.35	1.41	1.45	1.46
Combustion with Energy Recovery†	0.00	0.01	0.07	0.65	0.66	0.63	0.64	**0.62**
Discards to Landfill, Other Disposal‡	2.51	3.02	3.24	3.12	2.62	2.49	2.52	2.46
Population (millions)	179.979	203.984	227.255	249.907	281.422	290.850	293.660	296.410

* Composting of yard trimmings, food scraps, and other MSW organic material.
Does not include backyard composting.
Details may not add to totals due to rounding.
† Includes combustion of MSW in mass burn or refuse-derived fuel form, and combustion with energy recovery of source separated materials in MSW (e.g., wood pallets and tire-derived fuel).
‡ Discards after recovery minus combustion with energy recovery.
Details may not add to totals due to rounding.

According to these figures, of the 4.54 pounds of solid waste generated per day per person, only 0.62 pounds, or 13.6%, were combusted with energy recovery (NOTE: see footnote †). A conservative estimation of the potential capacity for a new facility in the Tri-County area would be to multiply the populations of targeted surrounding areas by this per-person pound generation and then multiply by 13.6%.

It is the consulting teams' understanding that the Tri-County contracted with a private consulting firm for the feasibility of a 500 ton-per-day WTE facility, and the team therefore suggests using capacity estimates from that study for more accurate data.

Recommendation

The waste incineration industry is a very sensitive industry with a lot of unknowns. Incineration facilities have been built and used successfully, helping their local communities become greener and more environmentally friendly. There are also communities who have built the waste incineration facilities and have used them for short periods of time, but have been forced to close, due to economic decisions and costs. These communities have stuck significant amounts of public funds into creating these facilities and they currently sit idle with little hope of ever returning to use. The reasons why some facilities succeed and some fail are numerous and must be looked at carefully and the decision to create a waste incineration facility should be contemplated from every angle. In the following sections, reasons will be given why a waste incineration facility is neither a good idea for location in Benton County, and why it is not economically feasible. When weighing the economics of making the decision of whether to build a waste incineration facility one must look at costs, supply and demand, and competition.

The first reason why Benton County is not a great location for a waste incineration facility is because of its population. With a population of around 36,000 residents, Benton County will not be able to produce enough waste to support a waste incineration facility. In general, a person creates 4.6 pounds of waste per day, only about 50% of which is able to be placed in a waste incinerator. The minimum size for a waste incinerator, to be effective, is one that can handle 100 tons of waste per day. In order for a waste incinerator to be supported and run at full capacity, which is the only way that would make it profitable or feasible, would be to have other counties haul in their garbage. This in itself creates many problems including: higher tipping fees due to distance traveled and competition among local waste incinerators in Douglas county and Elk River.

The disperse location of Benton County's residents and the surrounding counties' residents also makes the implementation of an incineration facility economically unfeasible. The Elk River waste incinerator is located near many suburbs, which have a higher population density, of population and thus create shorter, more productive hauling routes, which make them more profitable for the hauling company. Benton County and surrounding communities have a more disperse population density which creates longer drive times for hauling companies who collect the waste. This will drive up the cost of collecting garbage because of the infinite

influences of gas prices; the longer the routes, the more gas, less garbage, and the higher the costs. In order to compensate for higher prices of collecting the garbage, hauling companies are going to need higher tipping fees which will cut into any profitability the waste incineration facility will have. An option to counter that measure would be to create a governmental entity to do the hauling; however, this creates a bigger investment and another risk factor in the success of the waste incineration facility. Creating a special entity to collect garbage which is ran by the government only increases sunk costs and risk, so therefore should be ignored.

Another waste production and collection problem with Benton County and the surrounding communities and counties is their propensity to recycle. On average, the population of central Minnesota has a lower propensity to recycle and is more likely to throw everything together in one bin or garbage container. The problem that this creates can be solved by a waste sorting facility, but the creation of a waste sorting facility is another significant investment and must be looked at completely separate from the waste incinerator. The reason that a waste sorting facility is not as significant of a factor in the southern suburbs is because the residents tend to be more environmentally aware and are more willing to separate their waste into different bins for collection. Along with the separation of the waste before or after the collection by the hauling company, there is also another problem that presents itself to Benton County. That problem is the large recycling percentage of what is considered good incineration fuel. These fuels are cardboard and other paper products. Currently, Benton County has a high recycling percentage per capita, much higher than the national average. This statistic is misleading however because the percentage is driven up, not by the residential recycling, but by the huge recycling process at the paper mill. They recycle a very high percentage of production materials which come from local communities, waste hauling companies, and facilities. The paper mills' large recycling program, although very good for the environment, creates a huge problem for any consideration of a waste incineration facility. The paper mill uses most of the paper and cardboard waste for its production, causing the amount that would be brought to a waste incinerator in Benton County to be very minimal. This would create higher burning costs because of the less than ideal materials which would have to be burned at higher temperatures and for longer periods of time.

The third reason why Benton County would have a problem with the production and collection of waste within the county and the surrounding communities is the implementation of

contractual agreements between counties and haulers, and counties and waste incineration facilities. Currently, haulers are contracted through the Tri-County Solid Waste Commission to haul 150,000 tons of waste to the Elk River plant every year. This waste is brought to Elk River by hauling companies that serve Stearns and Sherburne County. These haulers also serve border cities in Benton County such as Sauk rapids, Sartell, and St. Cloud. The inability of the haulers to distinguish routes by county, creates a benefit for Benton County that must be considered under current situations. This benefit is created when hauling companies who are contracted with one county, have routes in another county. For those counties where garbage is collected without a contract, they will not get billed for those services. This benefit is hard to measure but exists in the routes that cover Sauk Rapids, Sartell, and St. Cloud.

When looking at the competition for a Benton County waste incineration facility, another problem immediately presents itself. That problem is the Elk River and Douglas County facilities. These facilities have been in the industry for years and have fine tuned their processes and relationships with haulers and counties.

The Elk River facility is a large facility that can handle 500,000 tons of waste per day. They have contracts with many local counties for the disposal of waste. There could be a couple of reasons attributed to this; their ability to keep costs down, which in return lowers contract costs for counties; location of facilities allows them to derive the most profit and return on their investment, and; the ability to handle a large quantity of waste.

Elk River's ability to lower contract costs comes from their specialization. They are able to efficiently handle waste and have been doing so for years, which has lead to an increased competitive advantage. If a production facility were to be created in Benton County, it would be in direct competition with Elk River and they would have to fight over suppliers and contracts. Benton County's facility would lose this battle because they would incur a large amount of fixed costs to build their facilities and would have to increase their contract prices. If they were to charge more for their contracts, all of the suppliers and haulers would go to the cheaper Elk River Facility, which illustrates the law of supply and demand. With such a large production facility, Elk River is also able to spread its fixed and variable costs over more waste, which in turn, lowers all costs and increases profits making it more profitable in the long run.

Another advantage of Elk River is their location. They are located close to other businesses in the industrial park that can use the byproducts of the waste incineration. When Elk River burns their solid waste, they produce steam, as would Benton County. However, the location of the Elk River facility allows them to capitalize on other business opportunities. These opportunities include selling steam to heat other businesses and city facilities, and create energy by way of steam turbine. The creation of energy is then sold to the local power facility which is another source of revenue for the Elk River waste incinerator. Benton County has no such location that would allow them to take full advantage of these by-products. In the consultation report previously done by Wenck, the best location for any such facility in this area is located in the industrial park south of Opportunity Drive in Saint Cloud, MN.

No matter what size incinerator is built in Benton County, there would be the problem of support. Both community backing and waste production requirements are huge elements that must be considered. When a waste incineration facility is constructed it is not a small facility, no matter how small of an incinerator is used (i.e., 100,000 ton per day). How accepting would the local community be of the location of a large waste dumping site in their county? The potential smells that could be perceived to come from such a facility may weigh heavy on public opinion. Not only would they have an incineration facility in their community, there would also need to be a waste sorting facility and an incineration ash landfill. With the location of a solid waste incinerator in Benton County, the local community would also notice a sizable increase in the amount of larger trucks on the major streets and highways. This could increase traffic congestion and noise for the local community.

The aforementioned reasons are only the tip of the iceberg; there are many more things that must be taken into consideration. Our research indicates that Benton County should not consider solid waste incineration, but should focus its resources elsewhere, on other alternative energy resources.

Green Business Overview

The investment in green businesses and the green business industry is a growing trend towards a more environmentally friendly economy. With the growing economic trend towards going green, Benton County is looking to become a local leader in green business and renewable energy technology. With the encouragement of the local and federal government and with the approval of the local community, Benton County could benefit from implementing green business ideas into their economic development strategies. Due to the increase in global warming and media attention on this issue, there has been a worldwide change in social and economic trends towards preserving the environment. Many governments are implementing policies to induce or assist in the development and expansion of green businesses within their communities.

Benton County Economic Development Team is looking to gain an economic advantage by attracting environmentally friendly businesses or industries. They have requested that research be done on green business opportunities and to identify if Benton County would be a good candidate for green business locations and development.

The consulting team explored the possibilities of a variety of green businesses for Benton County. With new and emerging technologies, the team feels that there are many viable options for Benton County to consider. The following are options the Consulting group would like to present:

1. Switchgrass
2. Wood Waste
3. Organic Waste Composting
4. Tire Recycling
5. Biomass Pellatization

The group will visit each of these green business opportunities individually, with more in-depth explanations of what is involved with the processes and procedures. There will also be an introduction of funding options and business incentives that will assist the county in attracting businesses for the purpose of fulfilling their economic development initiatives.

Switchgrass Resource Guide
To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Switchgrass research and utilization industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Auburn University

http://bioenergy.ornl.gov/papers/misc/switchgrass-profile.html

Agricultural Utilization Research Institute

http://www.auri.org/news/ainjan99/14.htm

The Journal

http://midwestagenergy.net/summit/downloads/New%20Ulm%20Jouranl-editorial%20on%20MAEN.pdf

Rodale Institute

http://www.newfarm.org/news/2005/0805/082305/swtichgrass.shtml

Michigan State University

http://www.anrcats.msu.edu/press/050306/052506_energyfromgrass.htm

Oak Ridge National Laboratory

http://bioenergy.ornl.gov/papers/misc/switgrs.html

United States Department of Energy

http://www.nrel.gov/docs/fy00osti/28024.pdf

Switchgrass

"Switchgrass (*Panicum virgatum*) is a warm season grass and is one of the dominant species of the central North American tallgrass prairie. Switchgrass can be found in remnant prairies, along roadsides, pastures and as an ornamental plant in gardens ("Switchgrass"). The grass "can grow up to 1.8-2.2 meters in height" ("Switchgrass") and the roots extend almost as far in the ground as it does above ground, creating strong environmental roots ("Biofuels From Switchgrass: Greener Energy Pastures"). By having such deep roots, it is able to hold onto the soil better during the winter to prevent erosion

Although, switchgrass adapts better in the Southeastern part of the United States, due to its better grasp at adaptation and the longevity of their seasons; this does not rule out the Midwest as an adequate harvesting area (Bransby). Switchgrass is not new to Minnesota farmers, but the newly developed ideas and uses for this crop are ("The Textures of Strength"). The article "Midwest Agriculture Holds Energy Key", by Fritz Busch, a staff writer for the New Ulm Journal, discusses how "up to half of America's energy needs could be produced with biofuels" (1) and how switchgrass will eventually be used to produce ethanol and by doing so, it will use less energy than corn ethanol production(2).

Uses of Switchgrass ("Biofuels From Switchgrass: Greener Energy Pastures")

- Ethanol feedstock
- Co-firing
- Food for farm animals
- Great source for ground cover

Switchgrass as an Energy Source

The U.S. Department of Energy (DOE) has faith that biofuels made from switchgrass, will contribute to the reduction of “the nation’s dependence on foreign oil, curb emissions of the ‘greenhouse gas’ carbon dioxide, and strengthen America’s farm economy” ("Biofuels from Switchgrass: Greener Energy Pastures"). A group of scientists from Oak Ridge National Laboratory and other researchers from additional laboratories and universities are on a quest to create the “foundation for a biofuels industry that will make and market ethanol and other bio-fuels from switchgrass” ("Biofuels from Switchgrass: Greener Energy Pastures"). Their hopes are to market the ethanol at a competitive price with diesel and gasoline.

Switchgrass can also be used for co-firing. The initial process of co-firing first begins with seeding, “which can be done by normal grass seeding methods” (Whitaker, 1). Once the grass has matured, “it is cut, raked, and baled in large round or square bales” and then delivered to the power plant (Whitaker, 1-2). Once the power plant is ready to use the bales, they will place them on a conveyer belt to prepare them for the burning process. The twine is detached from the bales and put into a grinder where it is grounded up, producing “finely chopped dry matter” (Caldwell). This dry matter is then blown from pressurized air into the underground pipes that are connected to the power plants boilers, where it will then “burn with the coal” (Whitaker, 2).

In a June 2000 document by the National Renewable Energy Laboratory, it is discussed how the State of Iowa is partnering up with public and private sectors to generate energy by growing switchgrass. To create this energy, the switchgrass is co-fired in coal boilers and has the ability to “generate about 35 megawatts of electrical power, enough to serve about 30,000 homes” ("Biomass Power for Rural Development") and is purer than coal (“The Textures of Strength”). Iowa has received $10 million in grants, $6 million of that was given by the U.S. Deptartment of Energy and other $4 million was given by the U.S. Deptartment of Agriculture (“The Textures of Strength). Switchgrass is also being looked at as potential fuel for heating residential homes or possible “burners for drying corn” (“The Textures of Strength”).

An article from May 2006, titled *MSU Researchers Study How to Make Energy From Grass*, discusses a study that was done in Northern Michigan. This study was funded by Project GREEEN, which stands for Generating Research and Extension to meet Environmental and Economic Needs. The purpose of the study was to determine how switchgrass can be an alternative energy source and assist in creating economic opportunities for the community. The grass was a high generation crop in the State of Michigan and was able to adapt to the states "cold winters, marginally fertile soils, and shorter growing season…", which are quite similar to Minnesota's winter season. This study consisted of growing switchgrass, converting the harvested grass into "energy pellets", and then using those pellets for heating purposes. By using these energy pellets to produce heat, it cost less money than using wood or fuel oil. The study concludes that by developing a new industrial and manufacturing source, such as growing switchgrass in the area, could create many opportunities for farmers and others within the community (Long).

Advantages of Switchgrass

- It is very adaptable and has multiple uses.
- The grass grows fairly fast and needs very limited water.
- It has the ability to capture solar energy and turn that energy into chemical energy.
- Reaches deep into the soil for water, restores vital organic nutrients, and prevents soil erosion.
- It can be cut and baled with standard farm equipment.
- Replanting is typically needed after 10 years.
- Excellent habitat for a wide variety of birds and small mammals.
- Attractive to farmers because it has been proven to be economically competitive with petroleum and coal.
- Possibilities of yielding numerous useful fuels: diesel fuel, ethanol, methane gas, hydrogen and making chemical by-products that are used to make plastics, fertilizers, and solvents.

- If planted along stream banks or wetlands, switchgrass can remove soil particles, pesticides, and fertilizer residue from the surface water before it reaches groundwater or streams.
- Recycles CO2 continuously, which slows the buildup of carbon dioxide gas in the atmosphere.
- Output net energy is about “20 times better” than ethanol made from corn.
- Potential of yielding 5 times more energy of ethanol from switchgrass and creating 15 tons of switchgrass per acre.
- Replaces fossil fuels, which reduces global warming.
- Removes carbon dioxide from the atmosphere and integrates it into plant tissue.
- Can produce over 1,000 gallons per acre, more than 3 times the yield of corn.
- Minimum use of insecticides and/or fertilizer.
- Less expensive than fossil fuels and is better for the environment.

Disadvantages of Switchgrass

- Crops cover a large area of land.
- There is an increased risk of wildfires.
- Only feasible if it is in close proximity to switchgrass facilities.
- End power output is not as efficient compared to fossil fuels.

Since Benton County has an immense amount of open land, the consulting team feels that switchgrass could be a great possibility. Research conducted by other Midwest states, along with further studies by the Oak Ridge National Lab and Universities, points to numerous advantages in harvesting switchgrass. However, further examination is needed to determine if Benton County and its community should invest in growing switchgrass, since it is in its infancy stage of development and implementation.

Wood Waste Resource Guide

To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Wood Waste Energy and Recycling industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Lumber Waste and Urban Wood Waste Information

www.ciwmb.ca.gov

Basic Facts on Wood Waste – EPA

http://www.epa.gov/epaoswer/non-hw/organics/wd-basic.htm

USDA Forestry Labs

http://www.fpl.fs.fed.us/documnts/pdf1993/falk93a.pdf

WOOD WASTE

Introduction to Wood Waste

It is unlikely that many of us view pruned branches, tree stumps and whole trees from street and park maintenance, shipping pallets, construction lumber and other wood debris as a major contributor to our waste stream in the United States. However, the fact is that these elements of urban wood waste are a significant part of the solid waste stream. New residential lumber accounts for up to 50% of construction and demolition debris, which is a classified division of solid waste.

According to a study by the USDA Forest Service, we are facing a serious challenge in the United States in dealing with municipal waste landfills that are near or at capacity. According to their findings, wood waste, including wastepaper, construction waste, demolition waste, and tree trimmings make up a significant portion of this municipal waste. The study found that wastepaper is the single largest component of our Nation's waste stream. At more than 70 million ton/year, wastepaper accounts for nearly 40% of all landfilled material. Another 6% of landfilled material is wood waste (excluding paper). The focus on wood waste production can lead to many potential benefits of wood waste recycling for Benton County's economic development strategy

Opportunities for Benton County

Benton County has an obvious drawback over other counties by housing a large paper company and many lumber manufacturing and wholesale companies. Although the waste these industries produce is unfavorable, it does leave Benton County with the chance to be proactive while supporting the largest contributors to its economy and employment. Considering the promotion of alternatives to wood waste disposal is a wonderful opportunity for Benton County to contribute to environmental causes.

Alternatives to Disposal

Most of the options for decreasing the waste of wood products involve reuse or recycling. When either of those options is not available, it is best to make the wood waste available to biomass companies using the wood for fuel to produce electricity, or in some cases, steam.

The EPA estimates demand for a variety of markets in the recovered wood industry across the United States. The most dominant market is mulch and fuel applications that pay between $12 and $24 per ton for processed wood. Reused wood products are the highest in value, but typically require the highest costs for sorting, processing, and grinding or chipping. Many of these reused wood products include moldings, casings, banisters, doors, windows, and flooring. These materials can be referred to as recovered or reclaimed materials as well.

Although many recovered products are ready for reuse after grinding, some materials may not meet specifications or certain structural codes. The materials that are not ready for reuse require being chipped along with a variety of other materials. This mixture of species of wood makes it difficult to create a uniform product. Another consideration for processing recovered materials is whether the pieces have been treated with harmful or toxic chemicals, such as, preservatives, fire-retardant chemicals, or lead-based paints.

According to the EPA, wood waste from construction and demolition activities is great fuel because of its low moisture content. Recovered wood can be used to manufacture medium density fiberboard and particleboard. Again, because the end product is being made from MSW, it is hard to get a consistent product. Many lumber companies are finding ways to incorporate scraps from production into other value added products and so are good sources for wood waste disposal.

As technology in this field is studied and sampled, many new ideas are being created for the use of wood waste. Some interesting materials are being tested by the USDA Forestry Laboratories at the University of Wisconsin. These include Reconstituted Wood Composites, Wet-Formed Structural Fiber Products, Wood/Plastic Composites, and Wood/Inorganic Composites. Many of the processes and properties are still being evaluated and investigated for these materials, but are the beginning of a very promising conservation effort.

For Benton County to begin an active involvement in the reduction of wood waste would benefit the county in its present and future development strategies. The consulting team sees the benefits of taking this issue on as only being positive, even if the costs of managing wood waste are elevated to begin with. This is an environmental issue that can be addressed within Benton County borders, and that has a direct impact on the county's economy. Benton County should also keep a continual watch on the emerging technologies in the wood waste industry. As the industry refines its research and processes many opportunities may present themselves to Benton County.

Organic Waste Composting Resource Guide

To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Organic Waste Composting industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

United States Environmental Protection Agency

http://www.epa.gov/msw/compost.htm

University of West Virginia

http://www.wvu.edu/~agexten/ageng/resource/utiliow.htm

Waste Online

http://www.wasteonline.org./resources/InformationSheets/Compost.htm

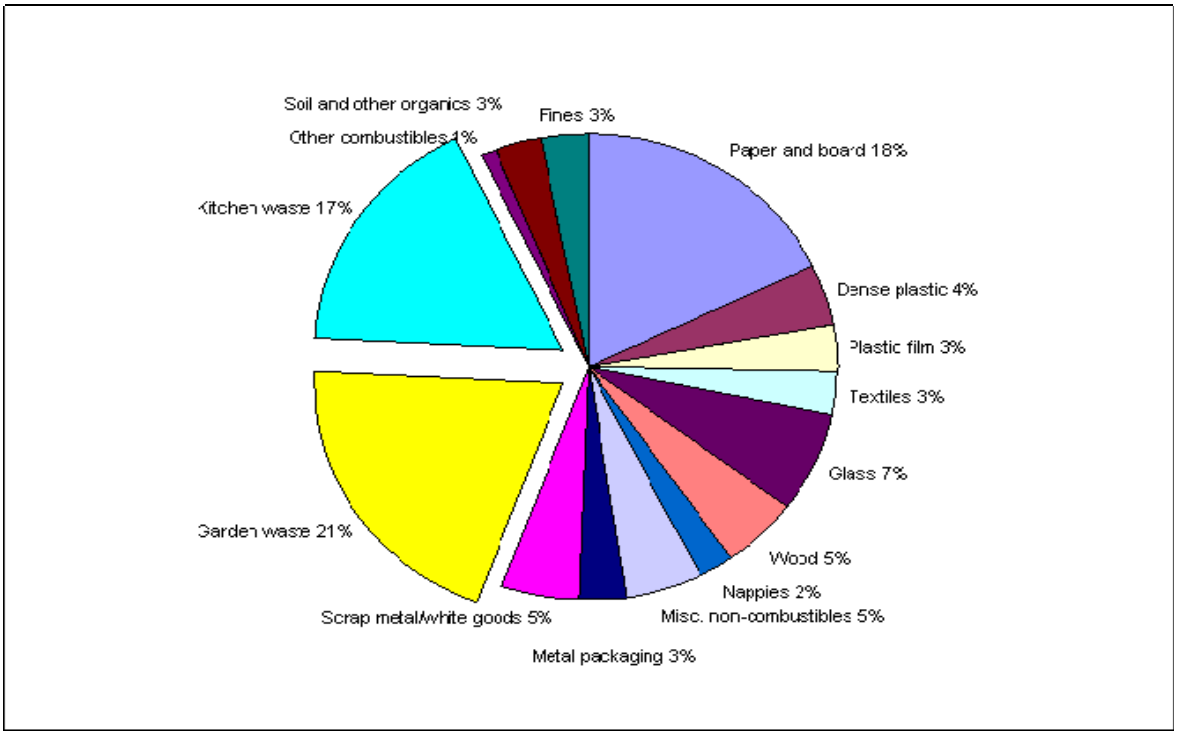
American Bio Tech

http://www.abt-compost.com/need.html

Organic Waste Composting

With environmental awareness increasing both nationally and globally, the economy is slowly embracing green businesses. A process which has been around for a long time but has never really been applied on a large scale until recently is, Organic Waste Composting. Organic waste composting is the controlled decomposition of organic materials and waste. The decomposition of the organic materials creates a nutrient rich fertilizer or compost spread. Large-scale organic waste composting is in the infancy stages of development and implementation, but continues to draw attention because of its environmental friendliness and potential to produce products and profits.

Organic waste can be categorized into two categories; Green and Browns. Green organic waste matter is waste that is high in nitrogen. Its waste products can be found at local restaurants, cafeterias, and hospital. The Environmental Protection Agency estimates that 17% of all waste produced in the U.S. is green organic waste. Brown organic waste products are those which are high in carbon. It includes lawn waste, most construction site waste, and is estimated to be 39% of total waste produced.



What to Compost:

- Animal manure
- Cardboard rolls
- Clean paper
- Coffee grounds and filters
- Cotton rags
- Dryer and vacuum cleaner lint
- Eggshells
- Fireplace ashes
- Fruits and vegetables
- Grass clippings
- Hair and fur
- Hay and straw
- Houseplants
- Leaves
- Nut shells
- Sawdust
- Shredded newspaper
- Tea bags
- Wood chips
- Wool rags
- Yard trimmings

What Not to Compost:

- Black walnut tree leaves or twigs
  Releases substances that might be harmful to plants
- Coal or charcoal ash
  Might contain substances harmful to plants
- Dairy products (e.g., butter, egg yolks, milk, sour cream, yogurt)
  Create odor problems and attract pests such as rodents and flies
- Diseased or insect-ridden plants
  Diseases or insects might survive and be transferred back to other plants
- Fats, grease, lard, or oils
  Create odor problems and attract pests such as rodents and flies
- Meat or fish bones and scraps
  Create odor problems and attract pests such as rodents and flies
- Pet wastes (e.g., dog or cat feces, soiled cat litter)
  Might contain parasites, bacteria, germs, pathogens, and viruses harmful to humans
- Yard trimmings treated with chemical pesticides
  Might kill beneficial composting organisms

Organic Composting Methods

Organic composting can range from an inexpensive backyard or onsite composting method to an expensive hi-tech in vessel composting operation. The different types of composting are: Onsite Composting, Vermicomposting, Aerated (Turned) Windrow Composting, Aerated Static Pile Composting, or In-vessel Composting. The method that should be used is dictated by the results that are to be achieved.

Onsite Composting

Onsite Composting is the simplest form of composting and is usually done by residents in their backyards. It produces small amounts of organic spread and is suitable for only a few organic waste products like yard trimmings and kitchen scraps. It is very inefficient because of climate changes during the year which will prevent the small composting piles from sustaining an adequate temperature for combustion. On average, onsite composting takes between 6 months and 2 years. The result of onsite composting is a spread that can be used on lawns and gardens.

Vermicomposting

Vermicomposting is the process of red worms or fields worms breaking down the converting organic matter into castings. For this process to be completed, organic matter must be placed into bins along with an adequate amount of worms and stored in a climate of 55 to 77 degrees Fahrenheit. Vermicomposting takes between three and four months, depending on the size of the bins and amount of worms per bin. The castings produced by vermicomposting can be used for potting soils and fertilizer for household plants.

Aerated Windrow Composting

Aerated (Turned) Windrow Composting is a large scale composting operation where long piles of organic waste are periodically aerated, either manually or mechanically. Organic waste piles can reach heights of 16ft and widths of 16ft with no limit on length. Aerated Windrow Composting is able to accommodate large volumes of diverse organic waste. Careful monitoring is required because of the amount and diversity of the waste in each windrow. This method of composting is suited for large quantities of organic waste, such as waste produced by communities, local governments, and high volume food-processing businesses, that include restaurants, cafeterias, and hospitals. To prevent the waste piles from seasonal composting interruption they may be covered with plastic sheeting or tarps. This method of composting produces significant amounts of compost, which can be sold to farmers as a nutrient field spread or to individual residents for use in their yards and gardens.

Aerated Static Pile Composting

Like Aerated Windrow Composting, Aerated Static Pile Composting is a large scale composting operation. Organic waste is mixed together and then placed in large piles on top of a network of pipes which pump air into each pile. The air which is pumped into the pile helps the composting process by providing oxygen to the inner organic waste. Since the air is being supplied via a network of pipes, the piles do not need to be moved or mixed up on a regular basis. Aerated Static Pile Composting is suitable for a homogeneous mix of organic waste such as yard trimmings and compostable municipal waste. It also includes the need for more technical expertise in composting because of requirements for more equipment, such as pipes, sensors, fans, and blowers. It may also involve significant upfront costs because of such equipment. The average composting time for a pile is between three to six months.

In-Vessel Composting

The last type of organic waste composting is In-Vessel composting. In this composting process the organic waste is placed in vessels where environmental conditions are closely monitored and controlled. Each vessel usually contains a mechanism to turn the organic material for proper aeration. In-Vessel composting can process large amounts of organic waste without taking up large amounts of space. It can also handle any type of organic waste, which is to be composted. In-Vessel composting is superior to other composting methods because it is resistant to outside temperature conditions and environmental concerns because all organic waste is inside a vessel with no leakage. The requirement for numerous vessels usually drives the cost of this process up; however, this process usually uses less manual labor. It also has a very fast composting time of just two weeks per vessel, but requires a month or two for the pile to stabilize before it can be used.

Opportunities for Benton County

The last three types of composting: Aerated (Turned) Windrow, Static Pile, and In-Vessel composting are ideal for large scale composting operations. A large scale organic waste composting operation could be very beneficial for any community, especially Benton County. With a large supply of land and close proximity to many local restaurants, hospitals, and colleges, Benton County would be an ideal location for an organic waste composting operation.

Currently, there is no waste collection company in the St. Cloud or Benton County area that offers a specific collection route for organic waste. All of the organic waste that is produced by the areas hotels, hospitals, universities, and restaurants is collected and hauled away with regular garbage to a land fill. An organic waste composting operation would have to create a separate collection container and distribute them to the local facilities that would be interested in participating in an organic waste recycling program. An organic waste collection program would need to be started by such a company and they would need to go around to local businesses and explain their process.

A benefit of starting a local organic waste collection program and composting site would be the reduction in the amount of waste that is hauled to surrounding landfills. Along with the reduction in landfill waste, there would also be a cost incentive for many businesses to support an organic waste program. An organic waste collection company could charge less for the collection of the organic waste because they are able to generate revenue from the compost. This would help cover the costs of collection, whereas regular landfills do not have any revenue generation possibilities because they do not sell the end product and thus must charge higher prices for garbage collection.

The difficulties that would be associated with starting an organic waste collection program and composting site take different forms. One difficulty that would arise is the convincing of local businesses to segregate their garbage into separate containers. Many businesses may be hesitant to do this because of the extra time and money involved with such an operation, however, once they realize the cost saving potential they might reverse their decision. Public opinion could raise another problem for an organic waste composting site. The local community may not want to support a local site because they might fear the smell and vermin

problems that are often associated with sites of the past. Once the local community has been brought aware of the new composting technologies and procedures, the public opinion might change once the benefits are realized.

Organic waste composting is not a new technology or idea but it is in the infancy stages of being applied on the mass collection and production stages. Many communities locally and nationally have begun to construct and initiate organic waste composting sites. The Western Lake Superior Sanitary District located in Duluth, MN operates an Aerated Static Pile Composting system. They sell their compost to local residents for use in their gardens and on their fields. Duluth is just one example of organic waste composting, there are many more. With continual focus on the environment and ways to reduce pollution, organic waste composting has become a viable option for many communities and should be seriously considered for local implementation.

Tire Recycling Resource Guide
To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Rubber Recycling industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Rubber Manufacturers Association

http://www.rma.org/scrap_tires/.

Green Rubber

http://www.greenrubberworldwide.com/wasteRubber.html

Minnesota Pollution Control Agency

http://www.pca.state.mn.us/oea/market/markets/marketlist.cfm?materialID=58

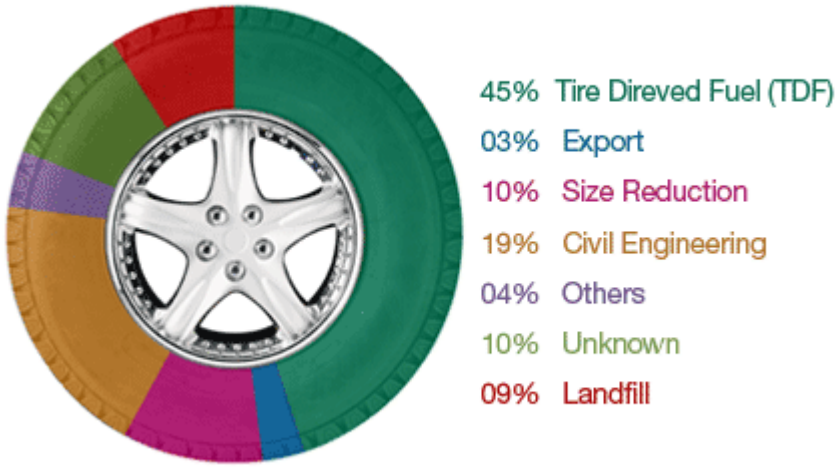
Tire Recycling

In the past 20 years, recycling has become widespread throughout the world. Public awareness, coupled with less expensive ways to recycle, is at the forefront of the rush. Celebrities are promoting it, governments are supporting it, and citizens are demanding it. Thousands of ways to recycle are introduced each year to help the surge. New technologies are being developed to assist in the transition from a garbage disposal world to a recycling world. The cost of oil and other natural resources have also helped in the drive to find ways in which to reuse world waste. One recycling method is to take old tires and use them for a variety of applications. What is tire recycling and how can they be used are commonly asked questions.

Millions of tires are collecting in landfills throughout the world. It is estimated that nearly 280 million tires are discarded in the United States annually. These piles are breeding grounds for mosquitoes, polluting groundwater, and can be potential fire hazards ("Shredded…"). China and India could possibly become the world's largest importers since their rubber consumption is projected to grow at eight percent per year. Sadly, prices of tires due to their oil composition have risen dramatically along with the fact that worldwide demand of rubber could be greater than the supply by 2017. Continents such as Europe and North America are already taking steps to curb landfill acceptance of used tires ("Why Now"). People are changing, global warming may be real, and doubts are rising fast. Current energy prices and support for recycling has been the latest trend in which Benton County could be a part of.

Goodyear tire has been the dominant tire manufacturer since the early 1800's. Vulcanization was introduced by the founder of Charles Goodyear in 1939. This is done by creating sulfur bonds between strands of carbon to make durable elastic rubber. Since then, it has been difficult for tire manufactures to recycle this new product. It is estimated that the world disposes of about one billion used tires per year (How can we…). As statistics point out, this has been detrimental because tire dumps have been growing steadily every year.

One method introduced is to burn used tires to produce energy. It is easy to see that this might not work because of the pollution it creates. This is called Tire Derived Fuel. The Rubber Manufacturers Association has put together a pie chart indicating the uses of old tires.



Source: Rubber Manufacturers Association

As noted burning tires seems to be a common way to rid the world of used tires. The next biggest percentage is taken by civil engineers who use rubber for other low profile applications. Tires are cut up into little pieces and are used as floor mats for houses, playgrounds and gyms. It can also be use for road paving. Some rubber is exported and ultimately if there is any left, it is put into landfills (Waste Rubber). Tires are very complex and can be cut up in a recycling facility to be used in other environmentally friendly applications. Some are mentioned above and do work in a variety of settings. We are looking at billions of tires that have been discarded and need to be taken care of soon.

Benton County could take part in tire recycling and build a plant to accommodate someone who could implement a recycling program. The nearest tire recycling plant is located in Brainerd, MN. Altogether there are 20 tire recyclers in Minnesota, and more tire recycling information can be found using the website in the reference section (Recycling Markets Directory). Benton County could utilize a plant to begin cleaning up the landfills around the surrounding counties including the city of St. Cloud.

If Benton County wanted to take this idea further, there is another way to use 100 percent of the waste found in tires. A process has been discovered to de-vulcanize the sulfur bonds and break down the rubber components. DeLink is a patented reactant that takes eight minutes to break down the rubber. This product is very complex and has been drastically improved over the

last few years (Technology). The company calls itself "Green Rubber" and is a subsidiary of Petra Group of Companies. Green Rubber has been around since the 1990's and is ready to expand its product into the United States. Aided by recent tire regulations and public support, the plant is utilizing the opportunity to rid the world of a potential waste product. (Turning old…)

DeLink is willing to license its name and logo to those that use its products. They realize that rubber manufacturers currently throw out waste of about 5 to 15 percent. This is who they are primarily targeting because they have a need that has to be fulfilled. Once the rubber is broken down, it can be used again for every rubber product out there. Stringent specifications reduce the chance of the "Green Rubber" to be used for automobile tires. Recent testing and development is starting to prove that it can and should be used for this application (Green Rubber Solution). This is a cutting edge product that Benton County could use to break down the rubber components of tires. New technologies like this need to be harnessed and exploited to create not only jobs but a safer place in which to live.

The benefits of providing the land and support to build a tire recycling plant are undeniable. Benton County could be the only county in the Midwest that uses the DeLink's product to break down tires. A plant could produce many jobs and incomes for those that are employed there. This section has highlighted main points of tire recycling. It explained the history of tires and current recycling methods. Also, it has provided better recycling methods and reasons as to why it would be a viable option for Benton County. In conclusion, it is recommended that Benton County at least consider this idea as a potential green facility to be built within its borders.

Biomass Pelletization Resource Guide

To Important Industry Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the Biomass Pelletization industry. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Renewable Energy Access

http://www.renewableenergyaccess.com/rea/news/story?id=47740%20

U.S. Department of Energy

http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id=1144

MSNBC

http://www.msnbc.msn.com/id/18847427/

Fibrominn

http://www.fibrowattusa.com/us-projects.cfm?id=16

http://www.bensonmn.org/fibrominn/faq.html

Minnesota Turkey Growers Association

http://www.minnesotaturkey.com/documents/MTGAfactsheet07.pdf

Biomass Pelletization

(*Turkey Litter)*

Advancements in technology and earth friendly sciences have come up with yet another possibility for what some might consider an undesirable commodity. Manure, no matter from what animal, has always been a popular fertilizer for farmers. But one animal's droppings have become increasingly popular with developments in turning the manure into energy. A power plant near Benson, Minnesota is currently being powered by turkey litter blended with the woodchips and sawdust used for their bedding. It produces 55 megawatts of electricity which is enough to power approximately 40,000 homes. The company in charge of this new plant is Fibrominn, and they will need 2,000-2,500 tons of litter a day to fuel the plant. This equates to about 100 large 18-wheel trucks per day (Renewable Energy Access).

So how do they do it? Inside the power plant the turkey litter is put into a furnace where combustion takes place at temperatures higher than 1500 degrees Fahrenheit, which then heats water in a boiler to produce steam. The steam then drives a turbine and generator to produce electricity (U.S. Department of Energy). After the combustion process is complete the leftover ash (which still has nutrients) is sent by conveyor to a nearby facility run by North American Fertilizer to be turned into high value fertilizer. Production of this fertilizer could grow up to 80,000 tons per year and is believed to be ideal for row crop farmers. If a farmer spreads 4 tons of manure per acre now, they will get the same nutrients from 400 pounds of this fertilizer (Renewable Energy Access)!

A major concern of producing power from turkey litter is that it will put more arsenic into the air. So what is arsenic? It is defined as a metalloid element most commonly occurring as a gray crystal, but also found as a yellow crystal in other forms. Arsenic and its compounds are highly poisonous and are used to make insecticides, weed killers, and various alloys (Dictionary.com). On the other hand, company officials from Fibrominn say that burning turkey litter is cleaner than burning coal and will not contribute to global warming.

Other concerns involved with the plant are that of odor, the trucks transporting the litter, and the water used in the plant. The trucks used to haul the litter have enclosed trailers making odor minimal, they also have assigned routes that they must use when hauling to the plant so

their traffic is fairly controlled. Once the trucks arrive at the plant they are unloaded in an enclosed reception area again to keep odor to a minimum. After the trucks are unloaded they will be disinfected within the plant to ensure cleanliness and reduce spread of odor (MSNBC). The third concern deals with the water used in the boiler. The plant may use several water sources to operate their facility. The first is treated water from the Benson wastewater treatment plant which would be utilized at the Fibrominn facility, rather than released into the river. The second is untreated well water from Benson city wells. Lastly, normal domestic water from Benson's municipal water distribution system will be used primarily for drinking water. All three of these water sources will be delivered to the plant in separate underground lines (Fibrominn).

Some officials say that by burning turkey manure to produce electricity instead of using it as fertilizer will force farmers to buy other chemical fertilizers for their fields. However, as previously mentioned, the leftover ash after combustion will be turned into fertilizer and farmers will not need as much of it to cover their fields as they did with manure before (Renewable Energy Access).

So why should Benton County consider getting involved with turkey litter and power plants? Well first, it is a cleaner way of producing energy and the main ingredient needed to make this energy (turkey litter) is readily available in the area. Benton County is very close to the top ten turkey-producing counties in Minnesota, statistics from 2006 show that (Minnesota Turkey Growers Association):

County	# of Turkeys
Kandiyohi	18,951,194
Stearns	4,202,041
Morrison	3,035,958
Becker	1,700,520
Lyon	1,321,012
Ottertail	1,160,891
Rice	1,151,418
Todd	868,045
Steele	858,209
Redwood	813,210

Minnesota's top two counties are also ranked in the top ten for the nation, Kandiyohi (#5) and Stearns (#9) according to 2005 figures from the National Turkey Federation.

Another benefit to this idea is that the plant in Benson can be viewed as the 'guinea pig' for this new and innovative source of energy. If it is a success then another plant could potentially be built, but with significantly less risk. The potential for more jobs gives benefit to the local economy. In Benson, they are figuring for 100 full-time jobs, 30 of these being on location, 60 in litter transportation, and 10 at the ash fertilizer plant (fibrominn).

Considering this information it is advisable for Benton County to first decide if they are interested in a similar plant and if so look into possible site locations as well as how the current plant in Benson is doing. Contacting Fibrominn or Fibrowatt (their parent company) would also be advisable. This green business idea would create jobs, boost local economy, and put Benton County on the map for being the home of innovative ideas.

State and Federal Funding Resource Guide

To Important Regulatory Agency Links

The following links are resources that the consulting team thought would be valuable for supplementary information and familiarity within the State and Federal Funding and Regulatory Agencies. Please see the works cited at the end of our report for a full list of resources and citations the consulting team used for this study.

Minnesota commerce: Renewable Energy Production Incentives

www.state.mn.us/

DSIRE: Incentives by State: Incentives in Minnesota

www.dsireusa.org

Minnesota Municipal Utilities Association

www.mmua.org

Nextstep: from Grants/Loans

www.nextstep.state.mn.us/resources.cfm?type=10

Northeast Regional Biomass Program

http://www.nrbp.org/

State and Federal Funding

Non-Profit: bring a green business into the community that will be owned by a local city.

This marketing strategy would apply to Benton county if they were not opposed to bringing in a green business that had been constructed by a private business, and then operated by a city's municipal utilities.

A positive of having the city/county own the structure would be that they would be able to apply for specific grants that the government allows to city owned municipal utilities. One of the ways the city could receive tax breaks on the program would be to apply for the government created bond called, "Clean Renewable Energy Bonds" or just CREBs. CREBs were created as part of the Energy Policy Act of 2005. CREBs are "tax credit bonds" which create incentives for public power to create renewable energy. The "tax credit bonds" are interest paid by the Federal Government in the form of tax credit. There is $800 million in CREBs available for qualified projects. The amount of money available is replenished annually. Another reason why this bond had been created was the fact that 95% of the renewable generation had been done by private investors. These bonds were created to help level the playing field for city owned utility. CREBs cannot be used for privately-owned projects, only state or city owned (MMUA).

Government bodies are qualified for these particular bonds. Wind facilities, geothermal energy, landfill gas, trash combustion, and other forms of renewable energy all qualify (MMUA).

For Profit: bring in a privately-owned green business.

This marketing strategy would be used for trying to bring in a privately-owned green business that would build, finance, and operate the green business. This would help aid in the perception of a green community in Benton County. An example of a privately owned business would be XCEL.

The most popular way to help fund a privately-owned business would be to have the business apply for the "Production Tax Credit (PTCs)."

There are numerous incentives for businesses to put up windmills or wind turbines (DSIRE).

- One of the incentives would be that all real and personal property of a wind energy system is exempt from property tax in the state of Minnesota.
- An incentive would be that once the project is up they would be qualified for business tax credit of 1.9 cents / kWh for projects installed by December 31, 2007 for ten years.
- Wind-energy conversion systems used as electric-power sources are exempt from Minnesota's sales tax.
- All materials that are used to manufacture, install, construct, and repair or replace wind-energy systems are also exempt from Minnesota sales tax. A "wind energy conversion system" (WECS) is defined as any device such as a wind charger, windmill or turbine that converts wind energy to a form of useable energy.

CREBs vs. PTCs

CREBs are a finance tool that will help aid with the construction of the project. CREBs make it cheaper to build (MMUA).

PTCs are a finance incentive received after the completion of the project and generation has commenced. PTCs make the green business cheaper to run (DSIRE).

Grants: privately-owned firm - entrepreneurial status.

Governor Tim Pawlenty has initiated the development of a new program giving incentives to rural economic development. Strategic Entrepreneurial Economic Development (SEED) is designed to strengthen communities and expand businesses throughout the state of Minnesota. SEED will target three key strategic areas: development and growing entrepreneurs, new capital for rural businesses, and sustained competitive advantage for rural Minnesota (Minnesota Department of Employment and Economic Development).

Focus on New Capital for rural businesses.

SEED, if passed, will provide an infusion of $13.5 million to encourage entrepreneurs, fuel existing business development, and encourage private investment in rural Minnesota. SEED will grant a 25 percent tax credit to investors when they invest in regional "angel" funds that are focused in new technology and emerging businesses. It will also help provide loans to small businesses which could result in $10,000-$50,000 through non-profits, foundations, or community organizations (Minnesota Department of Employment and Economic Development).

State Grants/ Loans

There are many types of grants and loans for businesses that are in the renewable energy industry. However, most of them have qualifications that must be met. Examples of these types of grants/loans are:

- Midwest Wind Finance LLC
- AgStar Wind Power Financing
- Energy Loans for MN Public Entities
- Initiative for Renewable Energy and the Environment
- MBFC "Minnesota Business Finance Corporation (Nextstep)

State Loan Program

The purpose of the Rural Wind Energy Revolving Loan is to assist the funding of wind energy feasibility and transmission interconnection studies for community-based energy developments (C-BEDs). Minnesota Department of Commerce will provide a loan up to $100,000 per project with an annual interest rate of no more than 1.5%. Loans must be paid back within thirty days of a project beginning commercial operations or within two years of the date when the loan was issued, which ever comes sooner (DSIRE).

There are also possibilities for research partnerships. One such commission, the National Renewable Energy Laboratory allows companies to apply to become a partner for research in the

renewable energy field. Currently, the NREL is working on designing, developing, and testing new wind research technology for low wind speed turbines and turbines that still operate efficiently within turbulent wind conditions. Also, the National Renewable Energy Commission is working jointly with several companies to reduce the cost of wind energy through constant technological improvements of turbines. The NREL is currently the nation's primary laboratory for renewable energy and energy efficiency research and development (National Renewable Energy Laboratory).

There are many possibilities that can be explored jointly with NREL. Some companies provide engineers, while other companies provide grounds for the NREL to send its engineers to test out the equipment. On top of wind turbines, the NREL is also looking for testing grounds for the Solar America Initiative. Working jointly through the NREL can give companies an ability to advance the green energy technology in the world today, and give the companies some supplemental funding. The NREL updates its website regularly and this is where they announce what projects they are accepting applications for and the application deadlines. (National Renewable Energy Laboratory)

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A1: Terminology

Biomass: Plant materials and animal waste used as a source of fuel.

Clean Renewable Energy Bonds (CREBs): Created as part of the Energy Policy Act of 2005 CREBs are "tax credit bonds" in which interest is paid for by the Federal Government in the form of tax credit.

Co-fire: The combining of fuels sources for incineration.

Geothermal: Utilizing the heat of earth's interior.

Hazardous Waste: Hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment.

Inorganics: Being, or composed of matter other than plant or animal.

Kilowatt Hour: A unit of work, or energy equal to that expended by one kilowatt in one hour

Megawatts: One million watt.

Off specification products: is a reference to an omission or error of a product or its specification and requests that it now be added or corrected.

Production Tax Credit (PTC): business tax credit of 1.5 cents / kWh for projects installed by January 1, 2008 for ten years.

Refuse Derived Fuel: fuel produced by shredding municipal solid waste (MSW) or steam pressure treating in an autoclave. RDF consists largely of organic components of municipal waste such as plastics and biodegradable waste.

Slay: residue created by the manufacturing and refining process of fossil fuels.

Switchgrass (*Panicum virgatum*): is a warm season grass and is one of the dominant species of the central North American tall grass prairie. Switchgrass can be found in remnant prairies, along roadsides, pastures and as an ornamental plant in gardens.

Tipping Fees: Fee charged to haulers for garbage delivery.

Tire Derived Fuel: Burning tires for the use of energy.

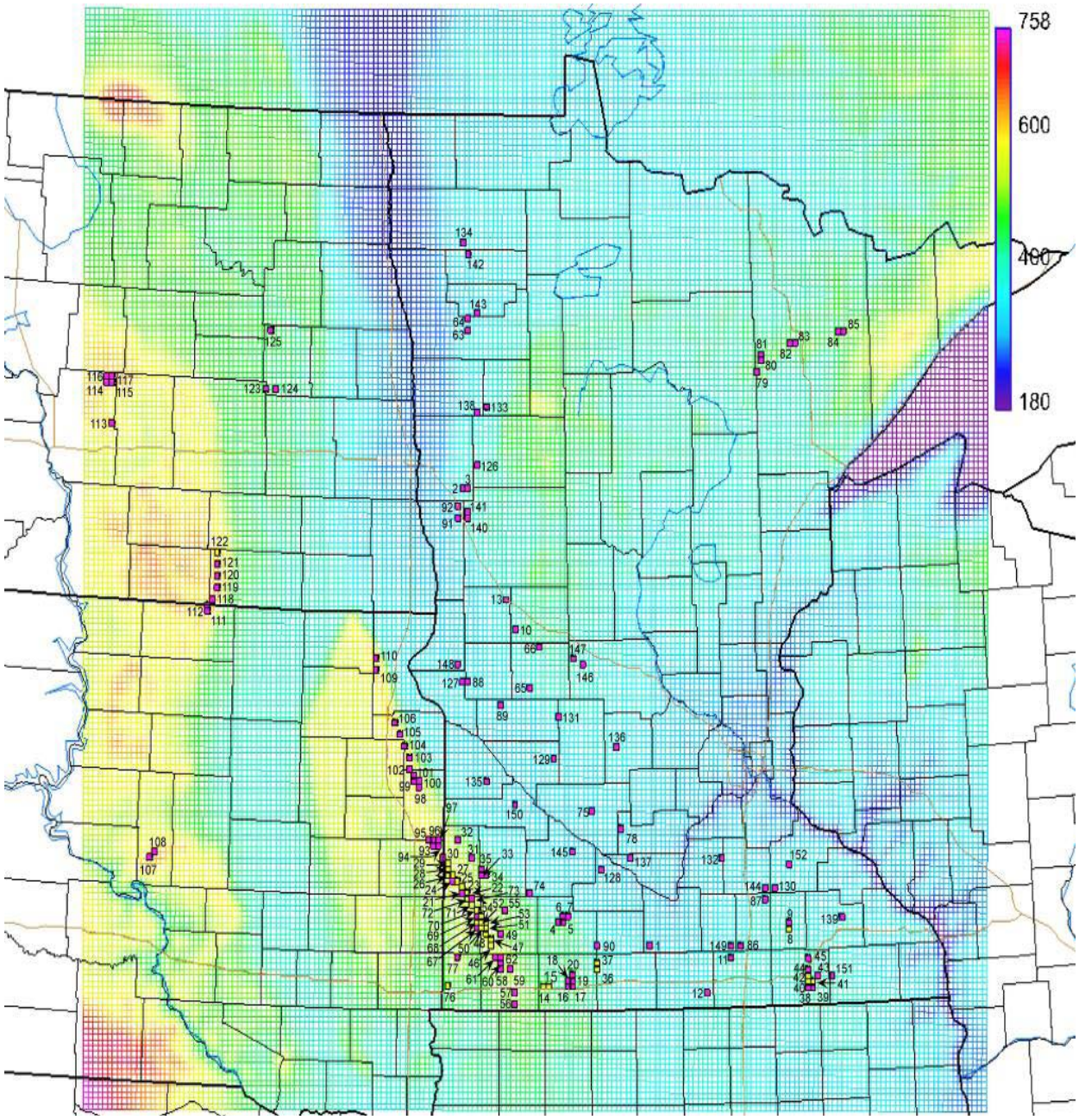
Torque: A force that produces or tends to produce rotation.

Vulcanization: Creating sulfur bonds between strands of carbon to make rubber.

Watt: The absolute meter-kilogram second unit of power equal to the work done at the rate of one joule per second, or to the power produced by a current of one ampere across a potential difference of one volt.

Wind Corridor: A channeled stream of air flow.

A2: Minnesota Turbine Locations



A3: Supplemental County Information

Population

Year	Population	Raw Change	Percent Growth
1950	15,911	N/A	-1.2%
1960	17,287	1,376	8.6%
1970	20,841	3,554	20.6%
1980	25,187	4,346	20.9%
1990	30,185	4,998	19.8%
2000	34,226	4,041	13.4%

Employment

Category	Employment	Percent
Administrative Support Occupations	1,745	14%
Operators, Fabricators, & Laborers	2,312	18%
Professional Specialty Occupations	1,346	11%
Precision Production, Craft & Repair Occupations	1,943	15%
Marketing & Sales Occupations	1,404	11%
Executive, Administrative & Managerial Occupations	1,226	10%
Ag. Service, Forestry, Fishing & Related Occupations	383	3%
Federal Workers	36	.003%
State & Local Workers	1,365	11%
Totals:		
White Collar Occupations	6,082	48%
Blue Collar Occupations	4,255	33%
Service Occupations	2,308	18%
Total All Occupations	12,645	100%

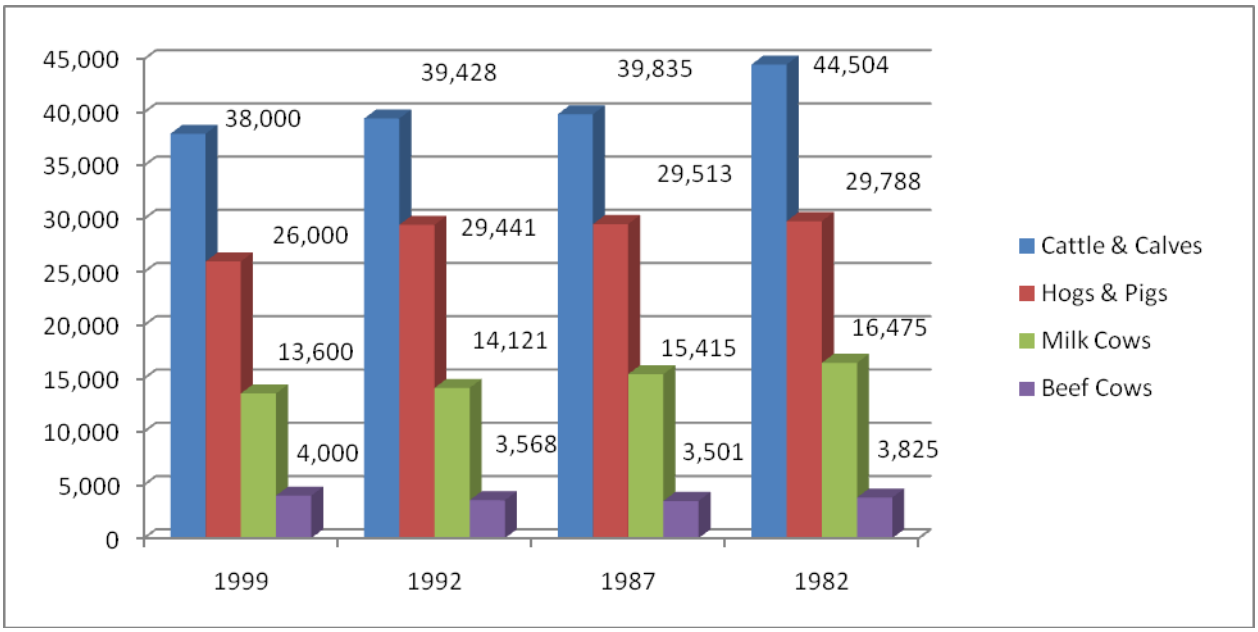
Schools

District #	School	Type	Location	Grades	Enrollment
51	Foley	Public	Foley	K-12	1,720
742	St. Cloud	Public	St. Cloud	K-12	10,063
748	Sartell	Public	Sartell	K-12	2,900
47	Sauk Rapids/Rice	Public	Sauk Rapids	K-12	3,360
47	Petra Lutheran	Private	Sauk Rapids	K-8	20
742	St. Augustine Catholic	Private	St. Cloud	K-6	220
51	St. John Catholic	Private	Foley	K-6	120
47	Sacred Heart Catholic	Private	Sauk Rapids	K-6	250
47	Trinity Lutheran	Private	Sauk Rapids	K-8	114

Economic Sectors

Sector	Number	Employees	Payroll	Share of Market
Ag Serv/For/Fish	N/D	N/D	N/D	3.24%
Construction	141	893	$26,118,594	12.65%
FIRE	*60*	*283*	*$5,208,601*	*2.43%*
Government	41	1,267	$31,815,673	9.95%
Manufacturing	62	3,405	$97,394,934	30.33%
Retail Trade	172	2,797	$42,166,120	12.68%
Services	193	2,446	$40,790,065	16.20%
Trans/ Pub. Utilities	49	298	$ 6,641,248	3.87%
Wholesale Trade	62	846	$23,107,760	8.66%

Agricultural Statistic

Category	Benton County	Minnesota
Total Area (Acres)	260,480	50,744,960
Number of Farms	834	73,367
Farm Land (Acres)	176,330	25,994,621
Average Farm Size	211	364
% Over 500 Acres	7.8%	20.8%
% Less Than 50 Acres	21.9%	47.4%
Cash Receipts	$89,610,000	$8,290,264,000
Average Prod. Value/Farm	$107,446	$112,997
Average Prod. Value/Acre	$508	$323

Livestock Inventories