BIOMASS

INTRODUCTION

Biomass, Biofuel, and Bioenergy are all being used today to describe an abundant renewable energy source, providing environmentally friendly or "green" power. Biomass is the organic matter used to produce Biofuels. Biomass takes the form of grasses and grains, forest undergrowth and wood waste from the timber industry, landfill and municipal solid waste and animal, agricultural, and food processing waste. Bioenergy is the energy, including electric power and heat, derived from these Biofuels.

THE BIOMASS INDUSTRY

Like hydropower, wind and solar power, biomass energy is not new. For centuries, people have recognized the energy value of animal and agricultural waste such as wood, peat and manure, and have burned it mostly for heat. This practice continues today in many less developed countries. As our world became industrialized, our need for power increased. Coal and oil were the most plentiful and efficient fuels but also the dirtiest. We are now coming full circle to rediscover biomass, and every day it seems another source is discovered. Some fuels can be introduced directly or co-fired with fossil fuels into generators as replacement fuels, but many must be converted either to gas or some pelletized form to achieve more efficiency to maximize Btu or combustion properties. While research progresses to further reduce any harmful emissions from the biofuels, it is understood that biofuels inherently give off far fewer harmful emissions than fossil fuels. Therefore, it makes a lot of sense to introduce biofuels as replacements for fossil fuels. Without a doubt, our fossil resources have been dramatically reduced as our demand for electricity has increased.

Over the last couple of years, we have reviewed plans for several projects using a wide variety of biomass sources. For example, projects include anaerobic digesters on dairy and swine farms, landfill methane capture, rice hulls and fruit processing plant waste, chicken litter, wood product pelletization and gasification, and ethanol production. Although technologies for burning solid and gasified fuels have been in operation for decades, the conversion processes from biomass to biofuels are constantly being tweaked to maximize energy output and reduce possible hazards. Additionally, equipment retrofits may be necessary to efficiently utilize some of the fuels. While RUS receives calls on a regular basis from people with good ideas, our regulations are pretty clear about what RUS can finance. Depending on the development stages of the project, many projects have been referred to the Department of Energy or USDA's Rural Business, our sister agency in the Rural Development mission area.

Biomass resources provide widely varying heat and moisture contents. Each source brings its own set of problems. For instance, most wood, grasses and grains must be pelletized or gasified to realize maximum efficiency. Cellulose in woody products creates problems particular in rice straw and hulls as it creates slag which gums up machinery if not properly removed prior to introduction into the generator. Capturing gases from animal waste or gasifying biomaterials is a complicated process. Collection and transportation of these resources to processing points and generators is costly and limits feedstocks for most projects to within a 50-mile radius.

In converting biomass to biofuels, other products such as, fertilizer, gases and feedstocks can be collected and marketed to provide additional economic benefits, possibly offsetting collection and transportation costs. While solving some of the community's environmental issues and providing employment, use of biomass fosters community development and economic development by working with farmer cooperatives, farmers, local businesses, and municipalities.

ANIMAL WASTE

In New York State, 700,000 dairy cows produce $1.7 billion in milk annually or 56% of the State's total agricultural receipts. At 40 pounds of waste per cow per day, the energy potential is astounding. Animal waste digestion offers many economic benefits. First, manure limits the size of the herd. By eliminating the animal waste on a farm, a farmer alleviates or eliminates environmental problems, such as odor and water pollution, and may be able to increase the size of his herd, thereby increasing his production and profits. If in fact the farmer captures and markets the by-products (fertilizer and gases from the process), he may further increase revenues. A large dairy farm could theoretically produce enough power to become energy self-sufficient and sell excess power back to the grid.

In a high temperature air-blown gasification process, excess dairy waste is converted to low-Btu fuel gas. Clean syngas can be used by the farmer to produce electricity for his farm, or he may sell it to the local utility for additional income.

A North Carolina farrow and wean swine farm uses a digester with biogas recovery. Manure is handled as liquid in a pit discharge flush system. Process water added to the manure is biologically stabilized in a covered anaerobic digester where biogas is recovered. The biogas is combusted in a generator equipped for heat recovery with a boiler, generating 60-90 kW. Excess power is sold to a nearby utility through a power purchase agreement. This process provides fuel for an electric generator; recovered heat is used to heat the houses; and hot water is circulated through the mats in the farrowing house, all offsetting the demand for power and disposing of what would otherwise be a problem waste.

LAND FILL METHANE

Landfill methane is an excellent and frequently untapped resource. Most times gases are simply flared or burned in the atmosphere. Methane has 20 times the greenhouse effect as CO2. When captured, methane can be introduced into a generator to produce electricity and heat. The U.S. Environmental Protection Agency has an outreach program to help organizations tap this resource. The Landfill Methane Outreach Program (LMOP) provides lists of landfills and their potentials and provides analysis packages and checklists to help plan recovery programs.

HARVESTING GRASSES AND TREES

In some areas fast growing grasses and trees such as switchgrass and willows, are grown specifically for energy. The Department of Energy has worked with several State energy agencies to promote the use of these products. One project in particular involves fast growing willows in western New York State, which are harvested as fuel for a coal-fired plant on Lake Erie. While the percentage of coal replaced may be small, the use of willows or grasses, could eliminate the need for some pollution control retrofits. A similar program in Iowa replaces 2% of a plant's coal with pelletized switchgrass provided by a farmers' cooperative.

GRAINS AND SOYBEANS

A study by Enersol Resources of Manhattan, Kansas, estimates corn stover and wheat straw that could be removed from agricultural cropland without exceeding tolerable rainfall and wind induced soil erosion limits in 37 States from North Dakota to Texas and eastward. The study provides county-level data on removable residue quantities and national supply estimates for 1995-1997. On average, 47 million tons of corn stover and 8.8 million tons of summer and winter wheat were potentially available representing 20% and 8%, respectively, of the total produced in the United States. Oak Ridge National Laboratory in conjunction with this study estimated edge-of-field transport costs to include collection and baling. For about 24 million tons of corn stover and 4.4 million tons of wheat straw the cost is $25 per ton; for about 22 million tons of corn stover and 3.8 million tons of wheat straw the cost is $10 - 20 per ton.

A consortium in California has approached RUS with a project using rice hulls and straw and fruit waste from a local cannery. Rice straw is currently left to decompose or be burned in the fields. In both cases air quality is compromised. By 2003, California will no longer allow these practices, forcing a solution. In the proposed project, three products are extracted from the rice hulls and straw in the process making it very attractive: low quality silica, ethanol, and lignin. Ethanol and silica can be sold. The high Btu value of lignin makes it a favorable fuel for power

generation. An on-site generator powers the extraction process, and excess power is sold to the grid. The greatest drawback to the project is the unproved technology in cellulose removal.

Corn for many years has been used to produce ethanol. Now biodiesel fuel is being produced from soybeans to replace fuel oil in electric generators, without modifying the machinery. The flashpoint for biodiesel is 300° versus 125° for regular #2 diesel fuel. Biodiesel is nontoxic and biodegradable, and because of its higher carbon content, it combusts more efficiently, significantly reducing harmful emissions. In 2000, more than 100 million gallons of fuel oil was burned in cooperative-owned power plants, much of which could be replaced with biodiesel.

At the USDA's National Agricultural Center (Agricultural Research Service) in Beltsville, Maryland, a good deal of research has been done on biodiesel fuels. Currently a fleet of 17 buses used at the Center is powered by biodiesel made from soybeans. The Center has also researched anaerobic digesters and has recently installed a small turbine running off the gases from the digester at its dairy farm.

WOOD AND TIMBER

Wood waste from the timber industry creates environmental problems which can be alleviated or eliminated if the potential for electric generation is realized. A study by the Energy and Resources Group of the Renewable and Appropriate Energy Laboratory at Berkeley concentrates on Zimbabwe. Zimbabwe is a very small rural economy of 120,000 hectares of timber plantations facing escalating costs of electricity. The amount of waste products currently produced from the industry is about 500,000 cubic meters annually with a potential yield of about 20-25 MW. Factors which might lower the value or yield of the wood waste include variation in residue quantity available, moisture content of the residue, transportation distance and general recoverability. Current disposal methods including dumping at the sawmill, plantation or municipal dumpsites or open air burning, have serious environmental effects, such as runoff in streams and smoke affecting air quality. A typical large sawmill produces about 70 metric tons per day of sawdust, chips and off cuttings. With 20% conversion efficiency, each dry ton can produce 1 MWH. A sawmill producing 70 tons per day will be able to generate 70 MWH per day or 3MW and could supply its own energy and steam requirements.

The U. S. Forest Service has two programs for the removal of undergrowth in the National Forests. Controlled burns are performed periodically in the National Forests to clear out undergrowth which, if left alone, can fuel and spread forest fires. With rapidly changing weather conditions a controlled burn can quickly turn into a massive forest fire, as we have seen in the recent past with thousands of acres of precious forests going up in smoke. Instead of burning the undergrowth in the forest, another program removes it to the nearest road. Currently RUS is working with the Forest Service and the Department of Energy to solve the problem of controlled burns. The Forest Service collects the undergrowth and delivers it to a gasifier plant

where it is converted to syngas for co-firing in a coal-fired generator. The project expects yields of about 100 tons per day which is sufficient to produce just over 2 MW of generating capacity or 1.9 tons per MWH for 24 hours. The consortium will be looking for partners in this project.

RUS COMMITMENT -- NATIONAL COMMITMENT

Many of the processes of converting biomass into biofuel are still in developmental stages. In fact, the entire electric industry is continually evolving. RUS and the current Administration are totally committed to the promotion of renewable energy sources. As a part of that commitment, RUS will finance commercially available technology and viable projects to cooperatives or other entities with cooperative structures and goals.

Many States are also committed to developing and using renewable energy sources and have developed renewable portfolios for their electric utilities. At http://www.dsire.org, you can evaluate your own State's requirements.

The Internet provides a wealth of information on bioenergy resources, but a greater source of information are the numerous interest groups and conferences where users and researchers exchange experiences and ideas. RUS has added a Renewables Page to its website http://www.usda.rus.gov/electric/renewables where you will find links to many research and governmental organizations. Special interest meetings will be posted, and many others can be found through the links. I urge you to explore our page and the links you find there. Additionally, RUS has initiated a brown bag seminar series to highlight renewable energy resources, with guest speakers from various disciplines.

CONFERENCES

Last January, I attended the Harvesting Clean Energy conference in Spokane, WA. All forms of renewable energy were showcased, where farmers, utilities and developers from various parts of the United States presented their success stories. Except for technology, wind and photovoltaic systems have changed very little. However, new biofuels are being discovered all the time and processing methods are also evolving.

In late September, the 5th Biomass Conference of the Americas was scheduled in Orlando, Florida. With speakers invited from all over the world, the conference was necessarily cancelled due to the tragic events of September 11. However, I recently received abstracts of nearly 400 papers that were to be presented. Some of those presentations have been

highlighted here. If you are interested in a particular technology, contact me and I will be happy to provide additional information and assistance.

CONCLUSION

While our energy needs continue to grow, our fossil and water resources dwindle and become more dear. Renewable power resources should be fully examined for their economic and environmental benefits along with preservation and wiser use of our resources.

Remember: One man's trash is another man's treasure. A nearby landfill, farm, or forest contains a powerful treasure -- maybe even a pot of gold.

BIOMASS

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Definitions

BIOMASS -- A VARIETY OF SOURCES

BIOFUELS -- A VARIETY OF FORMS

BIOENERGY ==

- ENVIRONMENTALLY FRIENDLY
- GREEN POWER

Renewables Not So New

Hyrdo power -- run of the river

Solar -- hot rocks & adobe baking

Wind -- windmills for grain milling

Geothermal -- geysers and spas

Biomass -- burning peat & manure

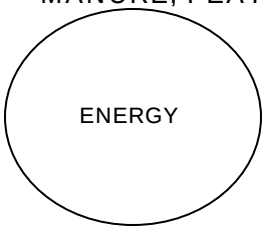
Industrialization

Industry -- increased need for power and power sources

- Coal
- Oil
- Natural Gas

Coming Full Circle

HYRDO, WIND, SOLAR
MANURE, PEAT



COAL, OIL
NATURAL GAS

Trash to Treasure

Biomass ----------> Biofuels

Digesters

Pelletizers

Gasifiers

Projects

- Anaerobic digesters at dairy & swine farms
- Landfill methane capture
- Agricultural waste
- Food processing waste
- Chicken litter
- Wood waste
- Short rotation crops
- Grains

Challenges or Problems It's All Relative

- Btu value
- Moisture
- Cellulose
- Odor
- Emissions
- Transportation
- Availability of product

Economic Benefits

- By-products Offset Collection & Transportation Costs
  - Fertilizer, Feedstocks, Gases
- Alleviates Environmental Problems
  - Emissions Reduced
  - Water Quality Improved
- Fosters Community Development
  - New Farmers' Cooperatives
  - Waste Product Removal & Utilization

Animal Waste

- Dairy Cows
  - Digesters
  - Gasification
- Swine
  - Digester
- Chicken Litter
  - Pelletization

Land Fill Methane and Municipal Solid Waste

Effects of Methane Released in Atmosphere or Flared

U.S. Environmental Protection Agency - Land Fill Methane Outreach Program

Grasses and Trees

Switchgrass

Fast Growing Willows

Other Hybrids

Grains ....

Corn Stover & Wheat

Effects of leaving stalks and leaves in the field versus removal and use for power production

More Grains

Rice Hulls and Rice Straw

- Cellulose
- Silica
- Lignin

Corn and Soybeans

Ethanol

Biodiesel

Corn Stover

Other

Walnut and Pecan Shells

Peach Pits

Anything Else You Can Imagine

Wood & Timber Industry Waste

Timber Waste

Sawdust

Wood Chips

RUS/USDOE/Forest Service

National Forests

- Controlled Burns
- Undergrowth Removal

100 tons per day == 2 MW

- 1.9 ton per MWH

Looking for partners

RUS & National Commitments

- Promote renewable energy sources
- RUS will finance
  - Commercially available technology
  - Viable projects
  - Entities with cooperative structure and goals
- Asked for: Priority to Biomass Projects
  - 4% financing

State Regulation

- State Portfolios for renewable energy production
- Green credits

- Website for information on State Portfolios
  - http://www.dsire.org

RUS Renewables WebPage

Renewables Page added to RUS Website

http://www.usda.rus.gov/electric/renewables

Conferences

Special Interest Meetings

News You Can Use

Conferences and Networking

Harvesting Clean Energy

2001 - Spokane, WA

2002 - Pasco, WA

Biomass Interest Group

with EPRI

Biomass of the Americas

5th Annual Conference of the Americas scheduled for September in Orlando canceled.

A wealth of information from around the world

Watch our webpage for information on the next conference

Conclusion

Energy requirements continue to grow...

Our fossil and water resources dwindle...

Renewable power resources as alternatives to fossil fuels provide economic and environmental benefits.

In Parting.....

Remember:

One man's trash is another man's treasure.

A nearby landfill, farm, or forest contains a powerful treasure -- maybe even a pot of gold.