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PRESIDENT CLINTON AND VICE PRESIDENT GORE: GROWING CLEAN ENERGY FOR THE 21ST CENTURY

August 12, 1999

Today, President Clinton will announce new steps to spur bio-based technologies that can help grow the economy, enhance U.S. energy security, and meet environmental challenges like global warming. The President will issue an Executive Order coordinating Federal efforts to accelerate these 21st century technologies – which can convert crops, trees, and other “biomass” into a vast array of fuels and materials – and set a goal of tripling U.S. use of bioenergy and bioproducts by 2010. Meeting this goal could create \$15 billion to \$20 billion in new income for farmers and rural America, and reduce annual greenhouse gas emissions by up to 100 million tons – the equivalent of taking more than 70 million cars off the road. In addition, the President will call on Congress to approve his proposed research funding and tax credits to promote energy efficiency, bioenergy, and other clean energy sources.

New Economic Opportunities for a New Century. Advances in farm, forestry, and other biological sciences are fueling a revolution in the use of biomass (trees, crops, and agricultural and forestry wastes) to make low polluting products, such as:

- **transportation fuels**, like cellulosic ethanol from agricultural waste;
- **electricity**, by burning willows and switchgrass along with coal in existing plants and by converting paper industry by-products into fuel gases; and,
- **commercial products**, such as chemicals, glues, paints – even furniture and textiles.

By creating high-tech jobs and new economic opportunities, meeting the President’s goal of tripling U.S. use of bioenergy and bioproducts could add \$15 billion to \$20 billion in new income for farmers and many rural communities.

Cleaner Energy, Cleaner Environment. Bioenergy and bioproducts can dramatically reduce greenhouse gas emissions that contribute to global warming. Since crops absorb carbon during growth, their use for energy and other applications results in near zero net carbon release.

- Tripling our use of bioenergy and bioproducts by 2010 will reduce annual greenhouse gas emissions by up to 100 million tons – the equivalent of taking over 70 million cars off the road.
- In addition, the deep-rooted plants commonly used for biomass are helpful in controlling erosion, filtering chemicals from water runoff, and slowing floodwaters.

Energy Security. Meeting the President’s goal of tripling our use of bioproducts and bioenergy will allow us to cut back on the almost 4 billion barrels of oil we are projected to import in 2010.

Federal Leadership. Leading scientific and industry groups are calling for a stronger Federal role to help move these promising technologies from the laboratory to the marketplace. Today’s Executive Order creates a powerful new research management team focused on an ambitious set of goals. It:

- Establishes a permanent council consisting of the Secretaries of Energy and Agriculture, the EPA Administrator, the Director of the National Science Foundation, and other agency heads to develop a detailed biomass research program to be presented annually as part of the Federal budget.
- Directs the council to review major agency regulations, incentives and programs to ensure that they effectively promote the use of bioproducts and bioenergy.
- Creates an outside advisory group with representatives from bio-based industries, farm and forestry sectors, universities, and environmental groups.

In a separate Executive Memorandum, the President instructed the Secretaries of Energy and Agriculture to prepare a report within the next 120 days on options for modifying existing DOE and USDA programs with a goal of tripling U.S. use of bio-based products and bioenergy by 2010.

**THE PRESIDENT'S NEW EXECUTIVE ORDER ON
BIO-BASED PRODUCTS AND BIOENERGY
AUGUST 12, 1999**

The Executive Order issued by President Clinton today will coordinate Federal efforts to accelerate the development of 21st century bio-based industries that use trees, crops, and agricultural and forestry wastes to make fuels, chemicals, and electricity. Owing to recent scientific advances, bioenergy and bioproducts have enormous potential to create new economic opportunities for rural America, enhance U.S. energy security, and help meet environmental challenges like global warming. In a separate Executive Memorandum, the President set a goal of tripling U.S. use of bio-based products and bioenergy by 2010. Meeting this goal could create \$15 billion to \$20 billion in new income for farmers and rural America, and reduce annual greenhouse gas emissions by an amount equal to as much as 100 million metric tons of carbon (MMTCE) – the equivalent of taking over 70 million cars off the road.

BIOMASS

Biomass is trees, crops, and agricultural and forestry wastes that can be used to make fuels, chemicals, and electricity. Biomass is a clean, domestic, and renewable source of energy. It can be used to fuel cars, power factories, and create a host of chemicals and other everyday products.

EXECUTIVE ORDER

Recent scientific advances in farm, forestry, and other biological sciences are making bioenergy and bioproducts more technically feasible and more economically viable. Recent reports and studies – including the just-released National Research Council report, “Biobased Industrial Products” – have concluded that Federal support for research is essential to realizing the economic and environmental potential of bio-based industries. Today’s Executive Order acts on this advice to create a powerful new research management team to focus Federal efforts with a goal of tripling U.S. use of bioenergy and bioproducts by 2010. Energy from biomass sources currently accounts for about 3 percent of the total U.S. energy supply – mostly from wood and wood waste.

This Executive Order :

- Establishes a permanent council consisting of the Secretaries of Energy and Agriculture, the Environmental Protection Agency Administrator, and the Director of the National Science Foundation, and other agency heads to develop a detailed research program to be presented annually as part of the annual Federal budget.
- Instructs the council to review major agency regulations, incentives and programs to ensure that they are being used effectively to promote the use of bioproducts and bioenergy. The council’s plan will be reviewed by an outside advisory group with representatives from bio-based industries, farm and forestry sectors, universities, and environmental groups.

- Directs DOE and USDA to establish a National Biobased Products and Bioenergy Coordination Office to manage the preparation of interagency budgets and provide an easy point of entry for anyone interested in Federal work in biobased products and bioenergy.

Today's Executive Order also builds on the Administration's record of strong and consistent support for bio-based industries. This includes the Administration's electricity restructuring bill introduced earlier this year requiring that 7.5 percent of all U.S. electricity come from renewable resources by 2010; Executive Order 13101, signed in September 1998, instructing Federal agencies to make use of biobased products; new proposed tax credits for bio-based electricity production; and increased research funding for the Department of Energy (DOE), the Department of Agriculture (USDA), and the National Science Foundation.

In a separate Executive Memorandum, the President instructed the Secretaries of Energy and Agriculture to prepare a report within 120 days outlining and assessing options for modifying existing DOE and USDA programs with a goal of tripling U.S. use of bio-based products and bioenergy by 2010.

WHAT IS BEING DONE RIGHT NOW IN BIOENERGY AND BIOPRODUCTS

Clean bioenergy and bioproducts are very much here and now. Already DOE and USDA are participating in partnerships on a number of major, breakthrough bioenergy and bioproducts projects, including:

- **Biomass to Ethanol Demonstration Projects.** Last fall BC International broke ground in Jennings, Louisiana on the first commercial plant to produce ethanol from the cellulose in agricultural waste – in this case sugar cane bagasse. A number of other demonstration projects are under development to convert municipal solid waste to ethanol.
- **Biorefinery for Chemicals.** Cargill Corporation, one of the largest privately held company in the United States, has built a prototype biorefinery in Blair, Nebraska. This new facility will use corn to produce a stream of chemical products and also a biodegradable polymer, polylactic acid, used in making films, fibers, rigid materials and coatings.
- **Co-Firing Technologies.** A number of projects are exploring ways to use biomass such as switchgrass and short-rotation wood crops like willows to make electricity by cofiring them with coal. Two of the most prominent projects – the Iowa Chariton Valley project and the New York Salix project – will also investigate the technical and business aspects of biomass gasification, where biomass is made into a fuel gas that can be used for heat or power production.

ECONOMIC POTENTIAL OF USING BIOMASS FOR ENERGY AND PRODUCTS

A robust bioenergy and bioproducts industry in the United States promises tremendous economic benefits for biomass producers – including farmers and the forest products industry – energy producers, chemical manufacturers, and the U.S. economy as a whole.

For rural America, a fast-growing bioenergy market will greatly increase the demand for energy crops and for agricultural and forest residues, or wastes, of all types. Since the cost of transporting the raw materials is high, most of the value-added work would occur in rural communities, providing new revenue streams for farmers and cash-flow for rural economic development. This means that good, high-technology jobs associated with producing biofuels and chemicals can be added in rural communities helping ensure that they will be an integral part of a prosperous 21st century American economy. By creating high-tech jobs and new economic opportunities, meeting the President's goal of tripling U.S. use of bioenergy and bioproducts could add \$15 billion to \$20 billion in new income for farmers and many rural communities.

Finally, as the President's Committee of Advisors on Science and Technology highlight in their new report – "Powerful Partnerships: The Federal Role in International Cooperation on Energy Innovation" – investments in bioenergy technologies, infrastructures, and markets could increase profitability for U.S. firms competing in global markets, while simultaneously providing for the world's future energy needs in an environmentally sustainable way.

BIO-BASED TECHNOLOGIES HELP MEET ENVIRONMENTAL CHALLENGES

Substituting biomass for fossil fuels can dramatically reduce greenhouse gas emissions that contribute to global warming. Since biomass crops absorb carbon during growth, their use for energy and other applications results in near zero net carbon release.

Meeting the President's goal of tripling our use of bioenergy and bioproducts by 2010 will reduce greenhouse gas emissions by up to 100 MMCTE – the equivalent of taking more than 70 million cars off the road. Substituting for fossil fuels, bioenergy will also reduce emissions of nitrogen oxides (NO_x), sulfur oxides (SO_x), and other pollutants.

Additionally, the deep-rooted plants commonly used for biomass – such as poplar, willow, and switch grass – are helpful in controlling erosion, filtering chemicals from water runoff, and slowing floodwaters.

PRESIDENT CLINTON'S FY2000 BUDGET ON BIOMASS

The President's FY 2000 budget request contains \$242 million for investments in biomass research, development and deployment, including:

- **Advanced Biomass Power and Fuels.** Funding for DOE and USDA to continue developing, testing, and demonstrating high-yield, low-cost biomass feedstocks; cofiring biomass with coal to produce electricity; advanced technologies for biomass gasification using paper industry by-products; and continued work on producing alternative fuels, such as ethanol, from biomass.
- **National Biomass Partnership.** Funding for DOE, USDA and other Federal agencies and private partners to launch a national partnership to develop advanced integrated biomass technologies.

The President has also proposed a package of **biomass tax credits**. The President proposes to extend for 5 years the current 1.5 cent per kilowatt hour tax credit for electricity produced from biomass. The proposal also expands the types of biomass eligible for the credit to include certain forest-related, agricultural and other resources. Finally, the package includes a 1.0 cent per kilowatt hour tax credit for electricity produced by cofiring biomass in coal plants.

To date, Congress has not only failed to enact these proposed new tax credits, but has terminated the current 1.5 cent per kilowatt credit and cut the President's budget request by 14 percent.

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PRESIDENT CLINTON: GROWING CLEAN ENERGY FOR THE 21st CENTURY
Department of Agriculture
August 12, 1999

Today, President Clinton, joined by Secretary Glickman, Secretary Richardson, and Administrator Browner, will make remarks on the potential of bio-technologies to help in the fight against climate change by producing clean energy and products, while building stronger agricultural and technology sectors and strengthening the economy. The President will announce steps that the Federal government will be taking to promote the development of this industry, including the signing of an Executive Order establishing a high-level government council to focus and expand federal leadership in this promising area.

The President's remarks will precede a roundtable discussion to be led by Secretary Glickman, Secretary Richardson, Administrator Browner, and Senator Lugar, and including key representatives of academia, industry, the farm sector and the environmental community. President Clinton will depart before the roundtable discussion begins.

Participants in the roundtable include: Dr. Joseph Miller, Chief Technology Officer at Dupont Corp.; Ms. Amal Mansour, CEO at Manufacturing Technology & Conversion, Inc.; Mr. Edan Prabhu, President of Reflective Energies, Mr. Michael Yost, President of American Soybean Assoc.; Mr. Roger Pine, National Corn Growers Assoc.; Mr. Stephen Gatto, CEO of BC International; Mr. Tom Mitchell, President and CEO of Genencor International, Inc.; Lanny Jass, CEO of Phoenix Biocomposites Inc.; Dr. Bruce Dale, Chair of Department of Chemical Engineering at Michigan State University and Chair of the National Research Council study on biobased products; and Ms. Carol Werner, Executive Director of Environmental and Energy Study Institute.

Speaking Program

Secretary Glickman

Dr. Bruce Dale, Michigan State University

Ms. Amal Mansour, CEO, Manufacturing Technology and Conversion, Inc.

President Clinton

A fact sheet is attached.

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else |

Senator Dick Lugar

U.S. Senator for Indiana

Contact: Andy Fisher 202-224-2079 or Tiffany Steele 202-224-7435

Date: 8-12-99

Lugar statement at bio-fuels announcement

The following is the text of the statement made by Sen. Dick Lugar at today's ceremony where President Clinton announced an administration bio-energy initiative to work in coordination with Lugar's bill. The ceremony was at the U.S. Department of Agriculture.

I join in applause for the President's announcement. Implementation of the Executive Order will have an immediate and positive impact on Federal efforts to develop cost-competitive technologies for the production of biofuels and biochemicals from nature's own sustainable supply of biomass.

The commitment of the administration to develop renewable and environmentally superior forms of energy is reflected in the presence of Secretary Glickman, Secretary Richardson and Administrator Browner. Research activities carried out by the Department of Agriculture, Department of Energy and other Federal agencies are a principal reason for much of the progress witnessed in biomass processing - as evidenced by today's exhibits. Impressive as these advances are, I believe we are only at the beginning of a revolution in biotechnology that will lead to more efficient use of the world's resources, enabling ecologically sustainable growth and development.

The President highlighted the potential of biobased fuels to dramatically reduce greenhouse gas emissions that threaten climate stability. A shift to biomass fuels is an excellent way to introduce an environmentally friendly energy technology that has a chance of both enjoying widespread political and economic support and having a decisive impact on the risk of climate change.

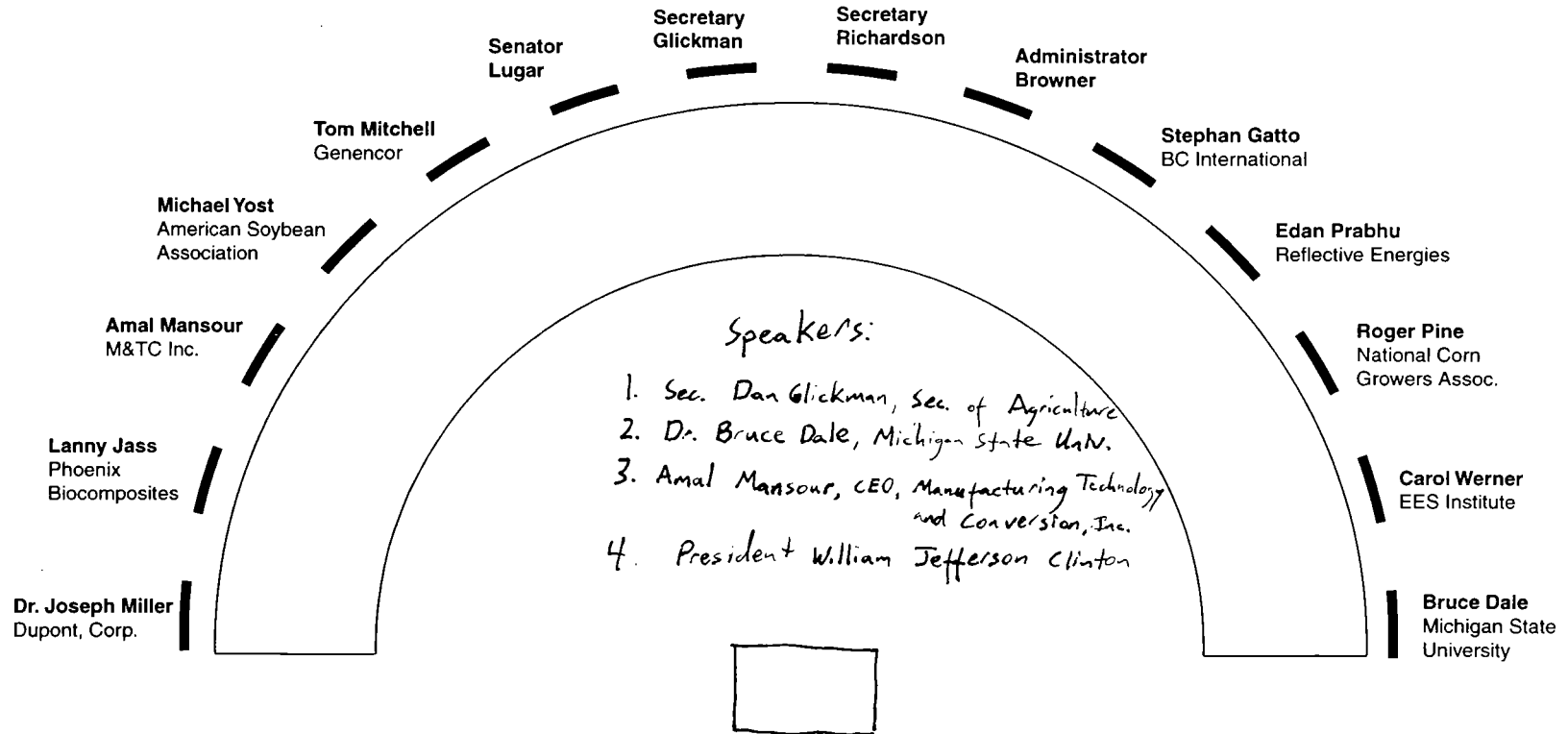
Equally compelling is the potential of advanced biomass processing to help American farmers. At a time when farmers are struggling, technologies for producing fuels and chemicals from biomass offer new sources of income and a diversification of agricultural markets.

Our national security will increase by diversifying energy options. The ability to use biomass as a vast and sustainable raw material for fuels and chemicals will reduce our dependence on unstable foreign sources.

I want to underline, again, the importance of Federal efforts to develop and promote biobased products and energy. The Executive Order is an important first step, but we should not stop here. Legislation which I introduced in April will make permanent various provisions in the Executive Order and authorize nearly \$300 million for focused research over the next six years. Supported by 15 Senators of both parties, the National Sustainable Fuels and Chemicals Act was unanimously approved recently by the Senate Agriculture Committee for consideration by the full Senate. A companion bill in the House is being drafted by Congressman Mark Udall. Given the opportunity for significant benefits in the national interest, we should all strive to promote biomass research that will improve our national security and balance of payments, reduce greenhouse gas emissions and strengthen rural economies in America and around the world.

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SEATING CHART



UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

January 21, 1999

SECRETARY'S MEMORANDUM _____

Use of Ethanol Blended Fuels and Bio-diesel Fuel in USDA Motor Vehicles

The Department of Agriculture (USDA) is committed to improving environmental air quality and reducing our nation's dependence on imported oil by choosing to use replacement and alternative fuels made from domestic renewable resources in our vehicles. Use of these ethanol-blended fuels in our fleet and off-road vehicles will reduce pollutant emissions and increase the demand for agricultural crops. President Clinton's Executive Orders 13031, "Federal Alternative Fueled Vehicle Leadership," December 13, 1996 (61 FR 66529), and 13101, "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition," September 14, 1998 (63 FR 49643), address the need for Federal agencies to take the lead in buying and using bio-based products made from renewable agricultural crops and waste materials and vehicles using these products.

USDA has actively encouraged the use of ethanol-blended fuels in its vehicles since 1990. In the past decade, these fuels, which contain at least 10 percent domestically produced ethanol or other alcohol, have become price competitive and more widely available across the country. Therefore, effective immediately, all USDA agencies with bulk fuel facilities shall buy and use these fuels to the extent practicable when the price of the fuel is competitive with the price of unleaded gasoline. Further, all USDA agencies with vehicles that use commercial fueling stations shall encourage the use of these fuels where practicable and cost competitive.

Our nationwide motor vehicle fleet also includes an estimated 500 flex-fuel vehicles that can use E-85 ethanol fuel instead of gasoline. Where those vehicles operate in geographic areas that offer E-85 fueling stations, USDA agencies shall strive to fuel the vehicles routinely with E-85. USDA agencies shall also strive to meet the alternative fuel vehicle acquisition mandates of Title III of the Energy Policy Act of 1992 (EPACT), as amended, 42 U.S.C. 13211-13220, and Executive Order 13031 through the purchase or lease of E-85 fuel vehicles where these vehicles meet mission requirements.

Our efforts to gain recognition for bio-diesel fuel made from renewable non-petroleum feedstocks such as soybeans, canola seed, and recycled restaurant grease have contributed significantly to an amendment to EPACT and recent Department of

DISTRIBUTION:

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Energy amendment of the Alternative Fuel Transportation Program regulations, 10 CFR part 490, implementing alternative fuel guidance on use of bio-diesel. These new regulations allow Federal fleets to use set quantities of blends of 20 percent (B-20) or higher bio-diesel fuel in certain vehicles to meet EPACT mandates. Bio-diesel can be used in any conventional diesel engine without major modifications to achieve reductions in the most harmful polluting emissions. Therefore, I encourage all USDA agencies that maintain diesel fuel tanks for their fleet vehicles, off-road vehicles, and other diesel motorized equipment to buy and use B-20 or higher bio-diesel fuel.

I additionally am directing the Assistant Secretary for Administration to take the necessary regulatory actions to carry out these policy objectives.

I strongly support the use of domestically renewable alternative fuels as a commitment to both our nation's farmers and to better air quality for all Americans, and I ask each USDA employee to join with me in this commitment.

A handwritten signature in black ink, appearing to read "Dan Glickman". The signature is written in a cursive, flowing style with a large initial "D".

DAN GLICKMAN
Secretary



EFFECTS OF BIOMASS AND NEW CROPS/USES ON FARM INCOME AND RURAL DEVELOPMENT

August 4, 1999

May, 1999--**The Economic Impacts of Bioenergy Crop Production in U.S. Agriculture.** Study results indicate that at \$40 per dry ton of energy crops at the farm gate, about 42 million acres could be planted to energy crops by the year 2008, with annual production of 188 million dry tons of biomass feedstock and no significant increase in major commodity prices. Net farm income is estimated to increase by \$5.5 billion over the baseline projection from 2000 to 2008.

April, 1999--**Ethanol and Its Implications for Fuel Supply** presented to the EPA Blue Ribbon Panel On Oxygenates. An OEPNU analysis indicates that increasing ethanol production from 1.6 billion gallons per year in 2004 to 3.4 billion gallons that year, and every year thereafter, will increase farm income by \$19.3 billion over the baseline projection (1999-2010).

April, 1997--**USDA Analysis of Withdrawing Ethanol Tax Incentives.** Compared with the FY 1998 President's budget baseline, which retains the Federal ethanol tax exemption, elimination of the Federal tax benefit will lower net farm income by \$5.9 to \$10.2 billion during crop year 1998-2005. Net farm income in nine major corn producing states declined by \$2.6 to \$4.4 billion.

Potential Biodiesel Markets and Their Economic Effect on the Agricultural Sector of the United States, A. Ranese, et. al., *Industrial Crops and Products*, 9(1999) 151-162. The study finds increased demand for soybean oil for biodiesel increases annual average (1996-2000) soybean oil price by up to 14.1 percent. As a result, U.S. soybean prices rise 2.0 percent and soybean meal prices fall by 3.3 percent. Net farm income increases by up to 0.3 percent.

Assessment of Biodiesel Production Potential in the Southeast, D. La Torre Ugarte, et. al., Prepared for the Southeast Regional Biomass Energy Program, Contract 97RKW-219278. Assuming biodiesel demand increased to 100 million gallons from 1998 to 2007, the U.S. average price of soybean oil increased 7 percent, soybean prices increased by 0.5 percent and soybean meal price dropped 2.3 percent. Net farm income increased by 0.2 percent.

Economic Analyses of New Crops and New Uses. *Industrial Uses of Agricultural Materials, Situation and Outlook Report*, Economic Research Service, USDA, Washington, DC, published from 1993 to 1997. Profitability of crambe, an annual oilseed crop grown in North Dakota, was evaluated. Net returns to land, labor, and management amounted to \$83.04 per acre, nearly twice the next highest returns of \$44.21 per acre from Canola production. Direct and indirect and induced effects of the crambe production resulted in an addition of \$1.8 million dollars, \$900 million in value added, and 24 additional jobs in the 15 county central North Dakota study region.

Lesquerella is a new oilseed crop being developed for production in Arizona, New Mexico, and Texas. At production cost of \$250 per acre and yields of 1,800 pounds per acre, net returns at seed prices of 21 cents per pound would total \$128 per acre.



BACKGROUND ON BIOBASED PRODUCTS LIST

- Section 504 of Executive Order (EO) 13101, September 14, 1998, titled Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition, assigned the USDA Biobased Products Coordination Council the responsibility to create, publish, and maintain a "Biobased Products List"(BPL).
- Biobased products are defined in EO 13101 as a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials.
- The purpose of the list is to provide a "yellow pages" of biobased and environmentally preferable products for Federal buyers. Although the use of the list is voluntary, we anticipate that states and local governments, businesses and private citizens will use the BPL as a guide.
- Examples are — vegetable or seed oils for lubricants and greases, low value wool for absorbents, straw as a construction material, corn starch as a packing material, or new (meaning not traditional) crops like kenaf for paper and absorbents.
- USDA will publish this week in the *Federal Register* for public comment its methodology for the creation of a Federal Biobased Products List (BPL). The methodology is patterned after the Environmental Protection Agency's (EPA) "Comprehensive Procurement Guidelines" for products with recycled content.
- We believe biobased products and recycled products as complementary concepts in "buying green" or as indicated in the EO, buying "environmentally preferable products."
- The BPL establishes 13 categories of commercial and industrial products and the method that USDA will use, in cooperation with the Federal Environmental Executive, the EPA, and others, to seek out commercial products within one or more categories, explore the products environmental preferability following the EPA guidelines on Environmentally Preferable Products, and then list the products and sources for the products in "Biobased Products Advisory Notices" (BPAN). These notices will also be offered for public comment.
- The categories are Absorbents/Adsorbents, Adhesives/Inks/Coatings, Alternative Fuels and Fuel Additives, Construction Materials/Composites, Lubricants/Functional Fluids, Renewable Alternative Fiber Papers/Packaging, Solvents/Cleaners/Surfactants, Plant Based Plastics/Degradable Polymers/Films, Landscaping Products, Bioremediation Products, New Fibers/Filler/Yarn/Insulation, Enzymes/Intermediate Chemicals, and Other such as cosmetics, pharmaceuticals/nutraceuticals.



Actions – Accomplishments – Outreach Efforts of the Biobased Products Coordination Council (BPCC) and Member Agencies:

- **Strategic plan:** This five year plan was prepared as the work product of the Strategic Retreat in October 1998. Several hundred partners in biobased products and the environment were invited and worked together to build the plan. Released June 1999.
- The November 1997, National Marketplace for the Environment in Washington D.C. was a successful three day environmental conference sponsored by USDA. Most of the products on display were biobased. We participated in the 1998 National Marketplace in Los Angeles, CA.
- USDA through the BPCC sponsored the “**AgriTechnology Venture Capital Forum**” both financially and by providing speakers. An agricultural products Venture Capital Conference in November 1999 is sponsored by a BPCC member agency.
- The BPCC is working with the Defense Logistics Agency (DLA) and others on a Joint Environmental Attributes Task Force to place environmental icons within the DOD Federal Logistics Information System. This inventory ordering system is one of the largest in the Federal government and is used to locate sources for products and services. Also, the BPCC is working with DLA to begin pilot projects using biobased products in a variety of DOD environments.
- USDA has funded a **representative to the Office of the Federal Environmental Executive** to provide leadership in outreach and coordination.
- The BPCC has sponsored proposals to exhibit and speak at the **National Recycling Coalition, September 26-29, 1999**. In 1998, the BPCC coordinated USDA’s offerings in the National Recycling Challenge in 1998.
- The BPCC will speak and have a booth at the Department of Energy’s Pollution Prevention Conference in November 1999.
- The BPCC member agency will sponsor two workshops for stakeholders in November 1999 on New Uses, Fibers and Oils.
- **Technology Transfer Trade Shows** are scheduled for the following conferences: Produce Marketing Association; Technology 2008; Minority-Owned Business Technology Transfer Consortium; and Celebration of America’s Bounty.



BIOBASED INDUSTRIAL PRODUCTS

Biobased products from agricultural and forestry resources provide renewable raw materials for the processing and manufacturing of a broad range of nonfood and nonfeed products, such as chemicals, fibers, construction materials, and energy sources. Development and commercialization of such products provide new and expanded markets, accelerate successful market penetration, and diversify agriculture while fostering rural and sustainable development.

The Biobased Products Coordination Council, established by the Secretary of Agriculture, is chaired by the USDA Under Secretary for Research, Education, and Economics. The Council promotes biobased industrial product research, development, and commercialization through information sharing, implementation of strategic planning, and provision of policy advice to the Secretary. Ten USDA agencies are members of the Council. The activities of these agencies in the area of biobased industrial products are described below.

FOREST SERVICE

The Forest Service (FS) has Federal responsibility for national leadership in forestry and forestry-related issues. Through its research arm, the Forest Service develops and communicates scientific and technological information to protect, manage, and use the Nation's 1.6 billion acres of forest and related rangeland.

The FS Resource Valuation and Use Research program and Cooperative Forestry program develop and provide scientific and technological information to support the harvesting, production, and use of wood products in ways that are efficient, safe, and environmentally beneficial. Specific areas of development include improved wooden transportation systems; fiber-reinforced cement products; uses for waste wood and plastics (ranging from very inexpensive, low-performance composites to expensive, high-performance building

materials); housing components and systems made from recycled wood waste and wastepaper; and novel enzymes used to treat virgin and recycled wood fibers in the production of a variety of chemicals.

Contact: Howard Rosen (202/205-1565)

AGRICULTURAL RESEARCH SERVICE

As the in-house research arm of USDA, the Agricultural Research Service (ARS) develops new knowledge and technology needed to solve a broad range of technical and agricultural problems of high national priority. ARS aims to ensure adequate production of high-quality food and agricultural products to meet the nutritional needs of the American consumer, to sustain a viable food and agricultural economy, and to maintain a quality environment and natural resource base.

Biobased industrial product research and development focuses on areas such as chemicals and industrial products from crops, cattle, and animal fats; starch-based biodegradable plastics; polysaccharide encapsulating agents; and new products from soybean oil, which are useful as additives to lubricants, fuels, and plastics; as surface coatings; and as inks for the printing industry. Additional areas include development of ion exchange resins based on agricultural residues, cotton-based fabrics with versatile new and improved properties, and fiber crops for specialized uses.

Contact: Michael Ruff (301/504-6905)

COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

The Cooperative State Research, Education, and Extension Service (CSREES), USDA's principal link to academia, participates in a nationwide agricultural research planning and coordination system that includes State land-grant universities and the agricultural industry. CSREES advances research and development in

new uses for industrial crops and products through its Agricultural Materials program, National Research Initiative, Small Business Innovation Research program, and other activities.

Areas of interest include paints and coatings from new crops such as vernonia, euphorbia, and lesquerella; fuels and lubricants from soybeans, crambe, rapeseed, and canola; fiber products from kenaf and hesperaloe; natural rubber from guayule; and biobased polymers from vegetable oils and starches.

Contact: Daniel Kugler (202/401-4640)

OFFICE OF ENERGY POLICY AND NEW USES

The Office of Energy Policy and New Uses provides leadership, oversight, coordination, and evaluation for all USDA energy and energy-related activities with the exception of those delegated to the USDA Assistant Secretary for Administration. The Office analyzes existing and proposed energy policies, strategies, and regulations concerning or potentially affecting agriculture or rural America. It also evaluates the feasibility of new uses for agricultural products.

In collaboration with the U.S. Department of Energy and the U.S. Environmental Protection Agency, projects have focused on technologies that convert plant cellulose and hemicellulose into ethanol and electricity production using direct combustion or gasification technologies.

Contact: Roger Conway (202/694-5020)

ALTERNATIVE AGRICULTURAL RESEARCH AND COMMERCIALIZATION CORPORATION

Created by Congress as part of the Farm Bill in 1990, the Alternative Agricultural Research and Commercialization Corporation (AARC) is a USDA agency that makes equity investments to commercialize industrial products from agricultural and forestry materials and animal byproducts. This activity complements the work of USDA's research agencies. AARC policy and

program direction is provided by a nine-person Board of Directors—eight of whom are non-Federal—representing processing, financial, producer, and scientific interests.

Development and commercialization projects include vegetable oil lubricants for engines and transmissions; building materials made from wheat straw; cleaners and biodiesel fuel made from vegetable oil; a lightweight, high-strength molded fiber panel made from waste wood and kenaf; windshield washer solvent using ethanol made from corn; oil spill adsorbents made from natural fibers; and a nontoxic biodegradable concrete release agent.

Contact: Robert Armstrong (202/690-1633)

FOREIGN AGRICULTURAL SERVICE

The Foreign Agricultural Service (FAS) maintains 75 overseas posts with the overall goal of supporting expanded U.S. exports of agricultural, forest, and fish products. This is accomplished by reducing trade barriers; collecting and disseminating global trade and market information; and developing markets through the use of promotion, loan guarantees, food aid, and economic development activities.

FAS works through private industry to identify overseas markets for new products, promote exports of such products, and research and develop new products. FAS supports these activities through the Market Access Program, the Foreign Market Development Program, and scientific exchanges sponsored by the International Cooperation and Development program.

Contact: Linda Wheeler (202/720-5387)

NATURAL RESOURCES CONSERVATION SERVICE

The Natural Resources Conservation Service (NRCS) has national responsibility for helping farmers, ranchers, and other pri-

vate landowners develop and implement voluntary efforts to conserve and protect our Nation's natural resources. Key NRCS programs provide technical assistance to land users and local government to sustain agricultural productivity while protecting and enhancing the natural resource base.

Activities emphasize reduction of soil erosion; improvements in soil and water quantity and quality; wetland conservation and improvement; enhancement of fish and wildlife habitat; improvements in air quality; improvements in the conditions of pastures and rangelands; reduction in upstream flooding; and improved woodlands.

Contact: Peter Smith (202/720-2307)

AGRICULTURAL MARKETING SERVICE

The mission of the Agricultural Marketing Service (AMS) is to facilitate the strategic marketing of agricultural products in domestic and international markets while ensuring fair trading practices and promoting a competitive, efficient marketing system. Working with other government agencies, industry, and the public, AMS establishes grades and standards for a wide array of agricultural commodities and products and provides grading and classing services to certify the quality or condition of products in marketing channels.

AMS provides oversight of federally sanctioned marketing orders and agreements and industrywide market research and promotion programs. In addition, the agency administers certain pesticide reporting requirements, compiles data concerning pesticide residues on certain products, and conducts or administers research and technical assistance programs to improve the efficiency of the marketing and transportation system and to identify new or expanding market opportunities for U.S. farmers and agribusiness.

Contact: Larry Summers (202/720-8043)

RURAL BUSINESS-COOPERATIVE SERVICE

The Rural Business-Cooperative Service promotes economic development in rural communities by financing needed facilities, assisting business development and rural cooperatives, and planning national strategies for rural economic development.

Contact: Anthony Crooks (202/205-9322)

OFFICE OF THE ASSISTANT SECRETARY FOR ADMINISTRATION

The USDA Assistant Secretary for Administration provides leadership and oversight in acquisition, asset management, civil rights, internal energy conservation, and recycling. As the USDA Environmental and Energy Management Executive, the Deputy Assistant Secretary has responsibility for coordinating environmentally preferable and energy-efficient initiatives and serves as an advocate for coordination of these initiatives in USDA facilities and programs across the country.

Contact: Richard Holcombe (202/720-8484)

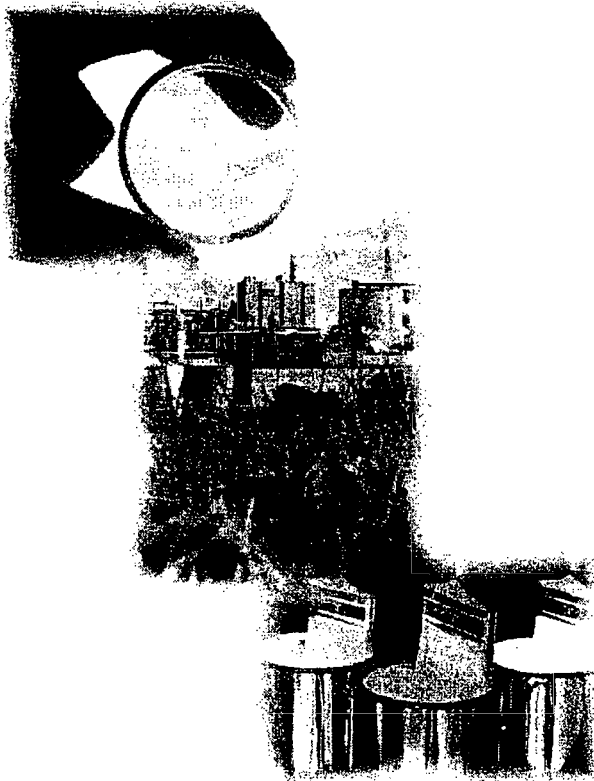
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NOVEMBER 1997

SLIGHTLY REVISED OCTOBER 1998

BIOENERGY



Plant/Crop-based Renewables Resources

Goals

- Achieve 10 percent of basic chemical building blocks from plant-derived renewable sources (a 5-fold increase from the level today).
- Establish environmentally sensitive manufacturing platforms for renewable plant-based products.
- Build partnerships among industry, growers, academia, and government to develop commercial applications.

Accomplishments

- A strategic vision, “Plant/Crop-Based Renewable Resources 2020,” for using crops, trees, and agricultural wastes to manufacture industrial chemicals and a huge range of everyday consumer goods was developed by the U.S. agricultural, forestry and chemical communities.
- Industry has identified the significant barriers that exist in the overall system for conversion of renewable resources into industrial chemicals and everyday consumer goods.

Background

The U.S. Department of Energy (DOE) through its Office of Industrial Technologies (OIT) supports industries in their efforts to increase energy efficiency, reduce waste and increase productivity. The goal of OIT is to accelerate the development and use of advanced energy efficient, renewable, and pollution prevention technologies that benefit the industry, the environment, and U.S. energy security. The core of OIT is its Industries of the Future program which focuses on basic materials and processing industries such as the Agriculture Industry.

Benefits

- Expand/open new markets to farmers and increase their sales/profits.
- Lessen reliance on imported fossil fuels/improve energy efficiency of products.
- Reduce carbon emissions.

- Establish alternative pathways of making similar or superior products that consumers demand.
- Revitalize the economy in rural regions by co-locating facilities/farm gate.
- Reduce waste generated in the production of chemicals and products.
- Create new opportunities for recycling.

Future Activities

Research and development is being solicited in the high priority areas identified in industry's technology roadmap. Selected high-priority research needs from the technology roadmap include:

Plant Science—Develop understanding of gene regulation and control of plant metabolic pathways, and functional genomics to improve gene manipulation.

Production—Improve production methods (higher plant productivity, more desirable plant components) for an adequate supply of plants for industrial use.

Processing—Improve methods of product separation and develop new, more effective catalysts for creating chemicals and other products from plants rather than hydrocarbons.

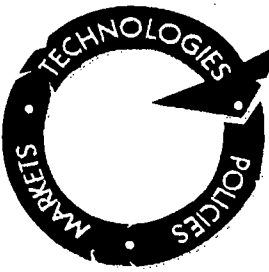
Utilization—Develop understanding of the relationships between the structure and functionality of different plant constituents (e.g., proteins, starch) and sound infrastructure and distribution systems to ensure adequate raw materials supply.

Partners in Success

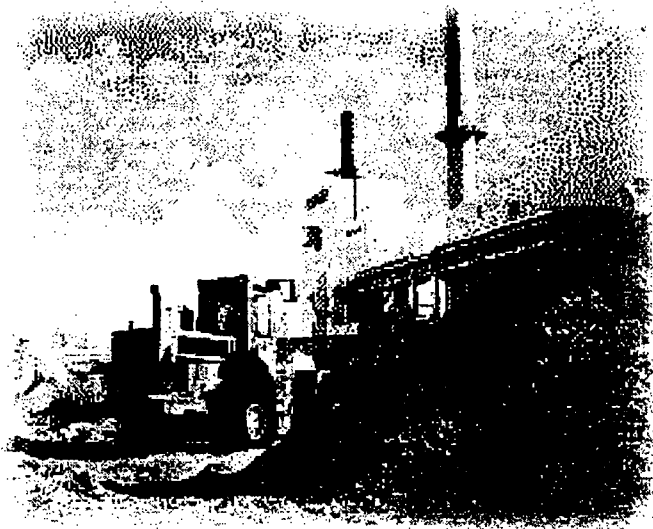
AIChE, Center for Waste Reduction Technology
 Agriculture Research Institute
 American Soybean Association
 Archer Daniels Midland Company
 CA Institute of Food and Ag Research
 Center for Crops Utilization Research
 Corn Refiners Association
 Genencor International, Inc.
 Grain Processing Corporation
 Institute for Physical Research and Technology
 National Association of State Energy Offices
 National Association of Wheat Growers
 National Corn Growers Association
 New Uses Council, Inc.
 U.S. Department of Agriculture



BIOENERGY



Biomass Gasifiers: Kindling Biopower Potential



Background

The world's first demonstration of an efficient, low-pressure biomass gasifier capable of producing a high-quality fuel gas is now operating at the Burlington Electric Department's McNeil wood-fired generating station in Burlington, Vermont. The gasifier, developed by Battelle Columbus Laboratories (BCL) and licensed by Future Energy Resources Co. (FERCO) of Atlanta, GA, converts 200 tons of wood chips per day into a gaseous fuel, enough to generate 8 megawatts (MW) of power. The gasifier heats the wood by mixing it with hot sand, causing it to break into its basic chemical components. The resulting fuel gas (with about half of the heat content of natural gas) is separated from the remaining solids—sand and char—and cleaned prior to burning in the McNeil boiler. This very clean fuel gas is also suitable for use in modern power systems, such as combined-

cycle gas turbines. In the near future, a gas turbine will be tested with the gasifier to verify operability and efficiency.

Benefits

The gasifier will significantly improve biomass-to-electricity generating efficiency in stand-alone power generation and in cogeneration. The existing biopower industry is based on conventional combustion/steam turbine technology and has an average plant capacity of 20MW at 20 percent efficiency. This gasifier will allow biomass to be used with standard gas turbines and combined cycles producing advanced power systems with efficiencies that can exceed 35 percent, nearly double that of today's biopower industry. That means twice as much electricity for each pound of biomass converted; or half as much fuel required for each kilowatt of electricity generated.

Because the gas is cleaned before combustion and wood has low nitrogen and sulfur content, controlled emissions (such as SO_x and NO_x) are extremely low. Furthermore, emissions of greenhouse gases (CO_2) are greatly reduced because, when biomass is grown and harvested in a sustainable way, virtually all of the CO_2 that is produced by the power plant is absorbed by the trees and crops when they grow again. In some cases, systems like this can even result in a net removal of CO_2 from the atmosphere.

Future Activities

Commercial development of this gasifier will increase the number and types of biomass fuels suitable for electric generating systems. These fuels could include residues from agriculture, from bioprocessing industries, or eventually energy crops grown specifically for power production. Some of these fuels are difficult to use in existing plants because of their tendency to form deposits in the boilers. One very promising market for the gasifier is in combined heat and power systems in the forest products industry, which already generates a substantial amount of electricity from biomass.

Partners in Success

Battelle Memorial Institute

Bechtel

Burlington Electric Department

Future Energy Resources Corporation

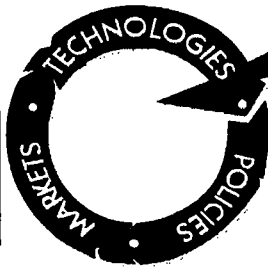
IEA Zurn

National Renewable Energy Laboratory

OEC/Enron

Zurn Industries

BIOENERGY



Integrated Waste-to-Ethanol Facility



Background

Masada Resource Group, based in Birmingham, Alabama, is developing a \$130 million waste disposal and recycling facility in Middletown, New York. On the front end, the plant will recycle plastics, glass, metal, and waste paper. Technology developed in partnership with the Tennessee Valley Authority and the U.S. Department of Energy will also be used to convert the remaining cellulosic refuse into 8 million gallons of ethanol annually. Start-up of the facility is planned in 2000.

Accomplishments

- First proposed biomass ethanol plant to use municipal solid waste (MSW) as a feedstock.
- Contracts negotiated with the surrounding municipalities to accept their MSW.

Benefits

- Use waste that would otherwise be burned or landfilled.
- Eliminate 12,800 metric tons of carbon, equivalent to the carbon emissions of approximately 12,000 cars.
- Displace almost 200,000 barrels of imported oil annually.

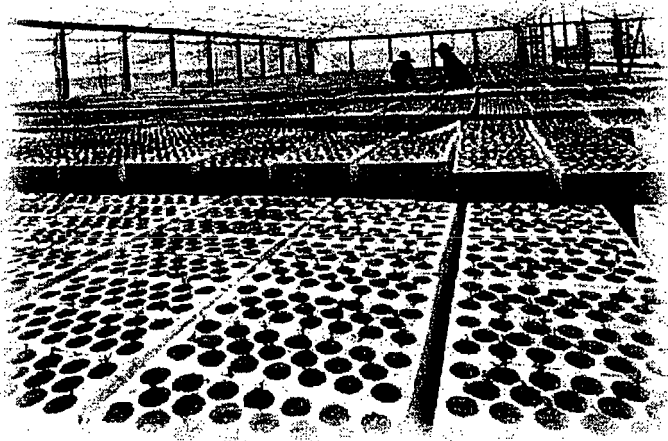
Future Activities

- Demonstrate commercial ethanol production from MSW.
- Demonstrate the benefits of co-locating Masada's MSW-to-ethanol technology with coal power plants.
- Complete engineering and permitting activities needed to obtain project financing.
- Improve the performance and robustness of genetically engineered microorganisms used to ferment sugars from biomass to ethanol and chemicals to increase efficiency and yield.

Partners in Success

Harris Group (Seattle)
Masada Resource Group
Tennessee Valley Authority
Stone & Webster Canada, Ltd.
Mississippi State University

BIOENERGY



Background

In November 1994, DOE's Secretary of Energy and the Chairman of the American Forest & Paper Association® signed a compact, establishing a research partnership involving the forest products industry and DOE. A key feature of this partnership was a strategic technology plan—Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood and Paper Industry. Agenda 2020

Forest Products and Agenda 2020

includes goals for the research partnership and a plan to address the industry's needs in six critical areas:

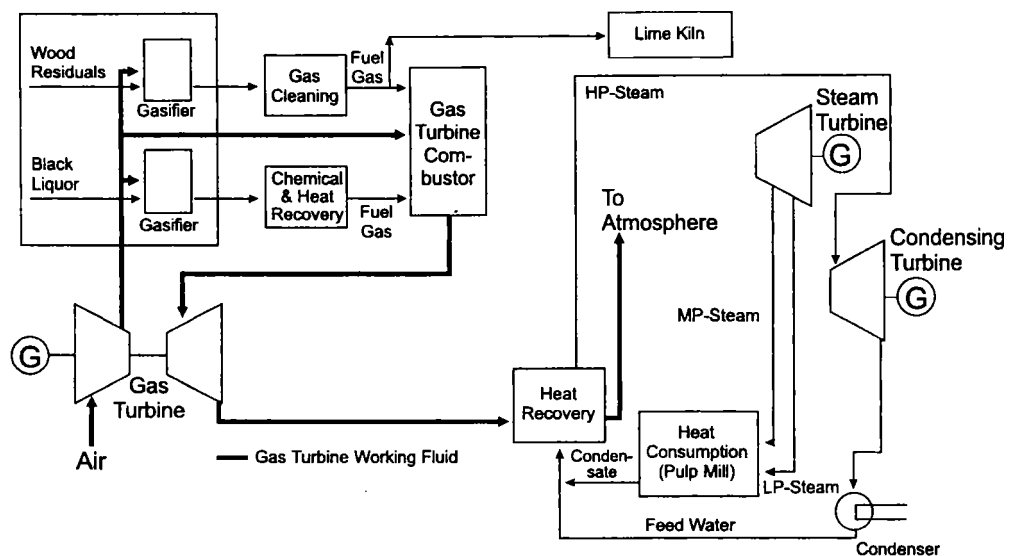
- Energy performance
- Capital effectiveness
- Recycling
- Environmental performance
- Sensors and controls
- Sustainable forestry

For each area, task groups, including industry, university and government representatives, have developed technology roadmaps—called research pathways—consistent with Agenda 2020's goals.

Black Liquor and Biomass Gasification

Among the highest priority projects identified by the Agenda 2020 process are those related to demonstrating gasification of biomass and black liquor, a by-product of the Kraft chemical pulping process. A large

Power Recovery Island of 2010
One of the many potential configurations generated from Agenda 2020



Source: Adapted from data provided by the Swedish National Board for Industrial and Technical Development

fleet of recovery furnaces and conventional power boilers in pulp and paper plants will need to be replaced or upgraded in the next five to fifteen years. This creates an opportunity for installing new gasification technology in these facilities during the normal capital replacement cycle.

Benefits

- Substantially improve environmental performance: widespread industrial adoption will potentially reduce carbon emissions by more than 30 million metric tons.
- Significantly increase energy efficiency and increased electrical generation from renewables by nearly 30 GW.
- A dramatic shift to increase use of indigenous renewable energy.
- Significant gains in technological leadership.
- The establishment of technologies with crosscutting potential for other industries.

Future Activities

In order to achieve significant energy and environmental benefits, the industry urgently needs to advance gasification technologies which are ready for large-scale demonstration. However, these demonstrations will cost significantly more (40-50%) than subsequent installations, and the industry cannot bear the entire cost alone. DOE participation will not only make the demonstrations possible, it will also accelerate deployment of the technologies in the pulp and paper industry and ensure that results will be shared with other industries and the public.

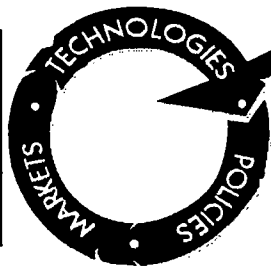
Related Bioenergy Areas

- Sustainable Forest Management—Advances in sustainable forest management will enable the industry to enhance its existing systems and methods for bolstering productivity while maintaining the biodiversity of intensively managed forests.
- Sensors and Controls—Improved process measurement and control systems hold the key to improving efficiency and cost effectiveness in the forest products industry. With real-time feedback on internal and external environments, process conditions, and product quality, manufacturing systems can optimize energy and materials use.

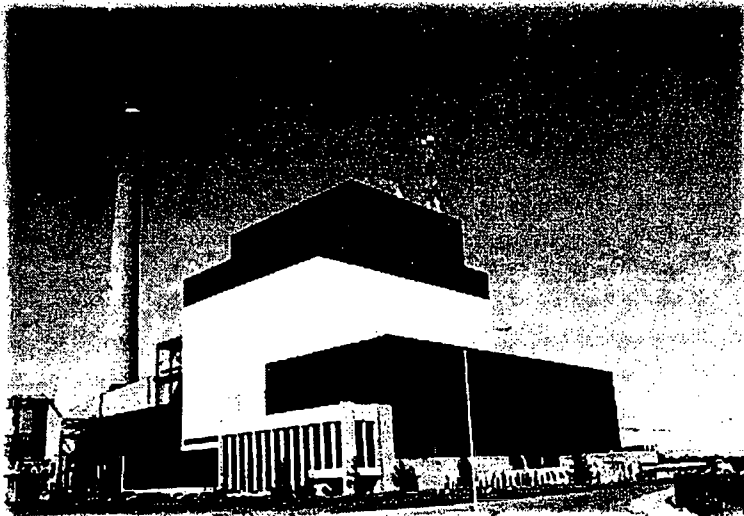
Partners in Success

American Forest & Paper Association®

BIOENERGY



Biomass Cofiring – A Renewable Alternative for Utilities



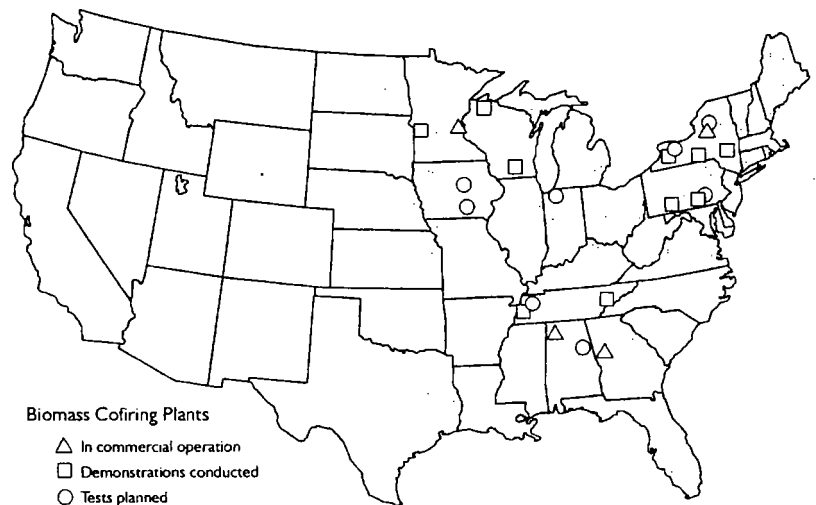
and trials have shown that effective substitutions of biomass energy can be made up to about 15 percent of the total energy input with little more than burner and feed intake system modifications to existing stations. In addition to CO₂ emission benefits, biomass in general contains significantly less sulfur than coal, so there is an SO₂ benefit as well. Early test results also suggest that there is a NO_x reduction potential of up to 30 percent with woody biomass.

Background

Biomass cofiring refers to the practice of introducing biomass as a partial substitute fuel in high efficiency coal boilers. This is the nearest term low-cost option for the efficient conversion of biomass to electricity. Cofiring has been practiced, tested, or evaluated for a variety of boiler technologies. After “tuning” the boiler’s combustion output, there is little or no loss in total efficiency, implying that the biomass combustion efficiency to electricity would be close to the 33-37 percent range. Since large-scale coal power boilers represent 310 GW of generating capacity, there is a substantial opportunity for power generation using biomass cofiring. Extensive demonstrations

Economic Requirements

The economics of cofiring are highly site-specific and depend on power plant layout and type and availability of low-cost biomass fuels. A typical cofire installation includes modification to the fuel-handling and storage system to accommodate biomass. Costs can increase significantly if facilities for wood



drying or size reduction are required, or if a separate feed to the boiler is required. For pulverized-coal boilers, retrofit costs range from \$150 to \$300 per kilowatt (kW) of biomass generation. The lowest cost opportunities are with cyclone boilers, for which costs may be as low as \$50 per kW.

The more important cost factor, however, is fuel supply. Costs for biomass fuels depend on a number of factors such as climate, proximity to population centers, and the presence of industries that handle and dispose of wood. Usually the cost of biomass fuels must be equal to or less than the cost of coal (per MBtu) for cofiring to be economically successful. Some utilities reduce fuel costs by cofiring with biomass; the Tennessee Valley Authority, for example, estimates that it will save \$1.5 million per year in fuel costs by using cofiring at its Colbert plant.

Technical Challenges

Several technical questions having to do with fuel feed, boiler chemistry, and ash deposition and disposal have been defined and are approaching resolution. Losses in boiler efficiency due to cofiring are small and are usually due to higher moisture content in the biomass fuels. A consensus is emerging that cofiring is feasible at the majority of coal-fired power plants. However, many power companies sell fly ash for use in making cement; currently the standard set by the American Society for Testing and Materials requires that only “coal ash” be used in the mixture. Until this standard is changed, cofiring biomass may hinder plant managers from selling ash for use in cement. Several utilities are currently working with the U.S. Department of Energy (DOE) to resolve this issue.

Partners in Success

Alliant Power
Auburn University
CharitonValley RC&D
Cornell
EPRI
General Public Utilities
New York Gas
New York State Gas and Electric
Niagara Mohawk Power Corporation
NIPSCO
NYSERDA
Southern Companies
Southern Research Institute
SUNY
Tennessee Valley Authority
University of Toronto
U.S. Department of Agriculture

BIOENERGY



Agricultural Waste to Ethanol: BC International



Background

In October 1998, BC International Corporation (BCI) dedicated a former molasses-to-ethanol plant in Jennings, Louisiana, to a new use: it will soon become the world's first facility to produce ethanol from sugar cane wastes and rice hulls. DOE has invested \$11 million toward the renovation cost of approximately \$90 million. The facility will produce 20 million gallons of ethanol per year at first and then expand production to 25 million gallons per year in the future. The ethanol will be used to fuel cars and provide raw materials for the chemical industry.

This facility is a giant step toward alternative fuels that are domestically produced and based on renewable, low-polluting energy sources. We can look forward to a day when a ton of biomass will be traded like a barrel of oil is today.

Bill Richardson
U.S. Secretary of Energy

Accomplishments

- Groundbreaking ceremony on October 20, 1998.
- First facility in the world to produce ethanol from sugar cane wastes and rice hulls instead of more costly feedstocks, such as corn or wheat.
- Uses process based on new genetically engineered bacteria that will allow biofuels to become more cost competitive with fossil fuels.

Benefits

- Create 350 construction jobs and 50 permanent jobs.
- Will displace almost 500,000 barrels of imported oil annually.
- Will reduce carbon emissions by 30,000 metric tons, equivalent to the carbon emissions of approximately 30,000 cars.

Future Activities

- Demonstrate commercial production of ethanol from agricultural residues to lower risk and cost of future facilities.
- Reduce cost of cellulase enzymes to achieve lower cost and higher efficiency.

Partners in Success

BC International
University of Florida
The Industrial Company

BIOENERGY



Project Update: Salix Consortium

This project demonstrates cofiring fast growing willow trees with coal in utility power plants.



Daniel Peck/PIX05084

Willows such as these planted by the State University of New York will soon be providing clean, renewable energy from utility power plants throughout the Northeast region.

Energy crops for electricity production are becoming a reality. Led by Niagara Mohawk Power Corporation, the Salix Consortium, formed in 1994, is an association of twenty corporations and industrial, government agency, farming, and research organizations supporting commercial development of willows for generating electricity. These fast-growing trees, developed through genetic engineering specifically for maximizing growth and pest resistance, are grown for utilities across the Northeast region for cofiring with coal in existing power plants.

Long-Term Goals

The Salix Consortium's objectives are twofold. First, it aims to establish willows as a commercial biomass energy crop in the Northeast and upper Midwest regions. To do this, it will attempt to develop a reliable market for willow at a cost of less than \$2 per

million Btu by 2001. Second, it will demonstrate and quantify the environmental and economic benefits of cofiring willow with coal in existing electric power plants. Several power companies have already announced tentative plans for participation. New York State Electric and Gas Company's (NYSEG) Greenidge Station may cofire 5,000 tons of willows per year grown on 400 acres near the plant. NYSEG is already cofiring wood obtained from other (i.e., non-willow) sources at the Greenidge Station since the winter of 1997. (In summer 1998, AES Corporation of Arlington, Virginia, won a bid to acquire Greenidge Station and five other NYSEG power plants; subject to approval of several governmental agencies, completion of the sale is expected in early 1999.) Further north on the shores of Lake Erie, Niagara Mohawk will cofire willow grown on 400 acres near its 600-MW Dunkirk Station. For cofiring with coal, the

-more-

energy input from biomass is expected to be between 10% and 20% of the total. In addition to these plans, Salix Consortium will plant willow at additional trial sites at various locations throughout the Northeast to lay the basis for eventual scale-up to commercial operation.

Recent Accomplishments

During 1998, Salix participants made a number of advances, including:

- Planted 105 acres of willow near the Dunkirk Station and an additional 34 acres in four areas of central New York
- Completed preliminary design for retrofitting the Dunkirk Station and fuel supply plan
- Installed biomass cofiring systems retrofit and conducted test burns of willow at NYSEG's Greenidge Station
- Produced more than 850,000 willow cuttings at State University New York at Syracuse-College of Environmental Science and Forestry (SUNY-ESF) and Saratoga Tree Nursery
- Modified and tested a willow planter (Cornell University) on 17 acres.

Near-Term Plans

Work will continue in 1999, including:

- Plant additional 200 acres of willow near the Dunkirk Station scheduled for the spring of 1999; harvesting is scheduled for the winters of 2001 and 2002
- Test the cofiring retrofit of Dunkirk Station
- Study environmental benefits, avian biodiversity, root dynamics, soil sustainability, and productivity of willow plantings at SUNY-ESF

- Analyze ash samples from cofiring at the Greenidge, Dunkirk, and Seward stations at GPU, Inc., and test the ash for suitability for use in Portland cement.

Project Participants

Antares Group, Inc.
Burlington Electric Department
Cornell University
Electric Power Research Institute
FORECON, Inc.
GPU, Inc. (formerly General Public Utilities)
Montreal Botanical Gardens
National Renewable Energy Laboratory
New York State Electric & Gas Company
New York State Energy Research and Development Authority
Niagara Mohawk Power Corporation
Oak Ridge National Laboratory
Ontario Hydro
South Central New York Resource Conservation and Development
State University of New York at Syracuse
U.S. Department of Agriculture
U.S. Department of Energy
University of Toronto

BIOENERGY

Agricultural Waste to Ethanol: Sacramento Ethanol Partners



Background

In 1999, Arkenol, a technology and project development company based in Mission Viejo, California, and its partners will build a new biomass-to-ethanol plant near Sacramento. The \$100 million facility will produce 8 million gallons of fuel ethanol and 40 million tons of citric acid from rice straw per year. Key engineering, permitting, and financing activities are under way through a partnership with the U.S. Department of Energy.

Accomplishments

- First facility to use rice straw to produce ethanol and citric acid on a commercial scale.
- Produce precipitated silica and lignin as by-products of the process.
- Obtained process guarantees from Bateman Engineering.

Benefits

- Reduce air pollution and particulate emissions due to rice straw burning, which is being phased out in California.
- Create about 2,000 construction jobs and 105 permanent jobs.
- Ethanol fuel produced will reduce carbon emissions by 12,800 metric tons, equivalent to the carbon emissions from 12,000 cars.

Future Activities

- Demonstrate commercial ethanol production from rice straw.
- Obtain project financing and complete engineering and permitting activities.
- Improve performance and robustness of genetically engineered microorganisms.

Partners in Success

Arkenol, Inc.
Bateman Engineering
University of California-Davis

BIOENERGY



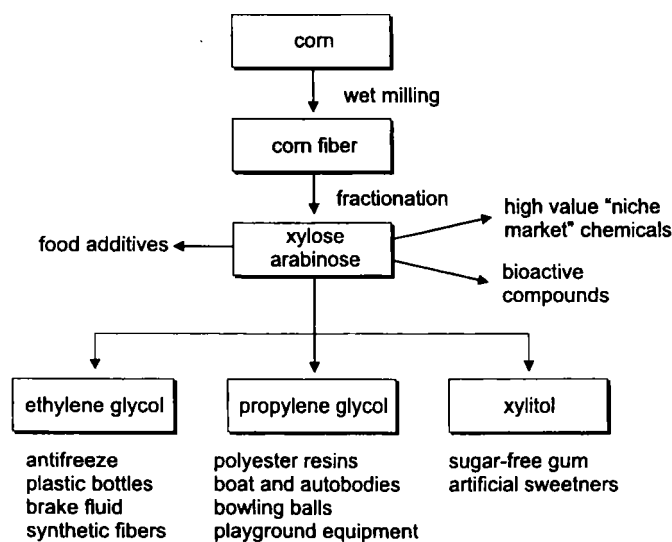
Biobased Chemicals – A Renewable Replacement for Petroleum Products

Background

Petroleum-based products are an integral part of our everyday lives — from the bumpers on our cars to the pens we write with, plastics, polymers, and other chemicals derived from oil make our lives safer and easier. But with the world's oil reserves depleting at a steady pace, we are forced to seek alternatives. Government, university, and private sector researchers are striving toward the development of cost-effective petroleum alternatives derived from renewable resources, such as corn and other plant matter. Consider these three examples.

Fractionation of Corn Fiber for Production of Polyols

Corn fiber, a by-product of the corn milling industry, is an inexpensive and abundant biomass feedstock that is drawing the

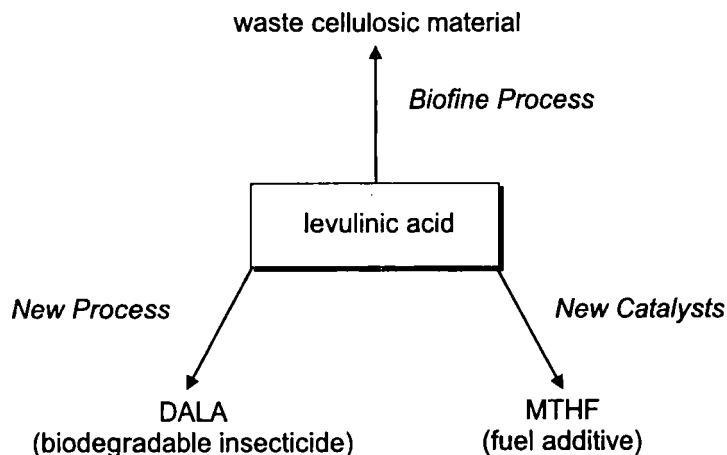


Corn fiber fractionation process produces low-cost feedstock for chemical industries

attention of industrial and Government researchers. More than 10 billion pounds of this material is presently sold as animal feed at a cost of around \$0.04 per pound. Innovative new catalytic conversion technology is now under development in the laboratory to cleanly and selectively remove hemicellulose from the corn fiber and to subsequently separate and isolate the xylose and arabinose fractions. Catalytic conversion of these fractions into ethylene and propylene glycol will provide important basic chemicals used in the production of antifreeze, plastics, and personal care items. Commercialization of this technology will add value to farmers' corn crops while reducing production costs, conserving energy, and reducing the Nation's dependence on imported oil.

Levulinic Acid: A New Feedstock for the Chemicals Industry

A new, waste-minimizing method for producing levulinic acid (LA) from renewable biomass resources has significantly improved the cost-effectiveness of supplying this versatile chemical "building block" to industry. The flexibility of this method allows the use of cellulose-containing waste materials from papermaking operations, recycled waste paper, and agricultural residues. A 1-ton per day pilot plant is now in operation, allowing researchers to turn their attention to developing new products from inexpensive LA. Researchers are developing new catalysts to produce a



Cost-effective supply of levulinic acid recovered from biomass provides chemical building blocks to industry.

renewable fuel additive, and investigating new processes to produce a completely biodegradeable herbicide/pesticide. These products offer the benefits of being produced from renewable sources, reducing the Nation's demand for imported oil, and protecting our environment. Developing a chain of value-added, bio-based products from intermediate "building blocks" is an important step in establishing the economics of the Nation's emerging bioindustry.

Novel Membrane-Based Process for Producing Lactate Acid – Nontoxic Replacements for Halogenated and Toxic Solvents

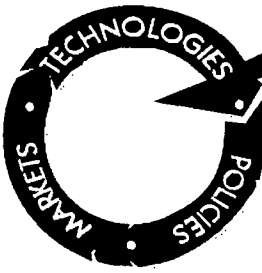
Lactate esters are versatile solvents that are biodegradeable, nontoxic, and applicable to a wide range of industrial and consumer uses. They can replace many chemical products used to produce paints, cleansers, and adhesives, among others, and are important "building blocks" for the production of polymers and commodity chemicals. Until recently, it was not cost-effective to produce

lactate esters in the volumes necessary for widespread industrial use. Government and private sector researchers have now developed a cost-effective, membrane-base process for producing these esters. The process, proven at the pilot scale, won a Presidential Green Chemistry Challenge Award in 1998. The process will provide an important bio-based chemical product for use by industry in a cost- and energy-efficient manner that is also less polluting than using traditional petroleum-based products.

Partners in Success

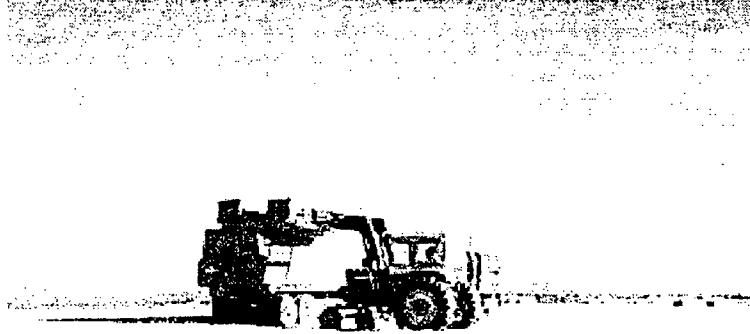
Argonne National Laboratory
 Biofine Corporation
 Chemical Industry Services
 National Corn Growers Association
 National Renewable Energy Laboratory
 New York State Energy Research and Development Authority
 NTEC, Incorporated
 Pacific Northwest National Laboratory

BIOENERGY



Project Update: Chariton Valley

This project demonstrates cofiring energy crops with coal for renewable power production on the Great Plains.



Tom Satchewill/PIX06530

Farmers in Southern Iowa are developing the best methods for harvesting switchgrass for cofiring with coal to produce electricity in a local utility power plant.

Switchgrass, a grass native to the U.S. Great Plains, may soon become an important cash crop for producing energy. In late 1996, the U.S. Department of Energy entered into a cooperative agreement with the Chariton Valley Resource Conservation and Development (RC&D), Inc., in Centerville, Iowa to establish markets for energy crops (an effort begun by Southern Iowa farmers in the winter of 1995). The Chariton Valley RC&D is a rural development organization representing a diverse consortium of public and private partners (see the list of project partners on back page). This organization will transform switchgrass, now used primarily for erosion control, into a cash energy crop with a value of up to \$200 per acre.

Long-Term Goals

Chariton Valley RC&D proposes producing enough switchgrass to generate 35 MW of

power by cofiring with coal at the Alliant Power Company's Ottumwa Generating Station. This represents 5% of the total capacity for the power plant, rated at 650 MW, and will require 200,000 tons of biomass harvested from 40,000 to 50,000 acres of switchgrass. Eventually, as many as 500 local farmers will have the opportunity to raise and sell the energy crop for power production.

The main highlights of this project are:

- Development of 35 megawatts (MW) of generating capacity from biomass by cofiring switchgrass with coal at the Ottumwa Generating Station
- Investigation of switchgrass gasification for long-term efficiency and use in fuel cells
- Erosion control and minimizing pesticide applications in the Rathbun Watershed

in Southern Iowa, which supplies water to 13 counties and 21 cities by growing switchgrass on 40,000-50,000 acres on Conservation Reserve Program (CRP) lands. CRP is run by the U.S. Department of Agriculture to reduce soil erosion.

Recent Accomplishments

Substantial progress has been made in this project in 1997 and 1998, including the establishment of a growers' cooperative and the commitment of 4,000 acres of CRP lands to grow switchgrass.

Near-Term Plans

In 1999, project participants will:

- Quantify the value and extent of environmental benefits by raising switchgrass as an energy crop, such as the improvement of water Quality—less fertilizers are needed for switchgrass and it can filter some contaminants out of surface runoff
 - Measure the amount of decreased emissions of CO₂, a climate change gas
 - Develop methods to maximize the yield and conversion of switchgrass to renewable energy
 - Develop switchgrass gasification processes at the Iowa State University with the Energy Research Corporation
 - Complete detailed design and site plans for boiler modifications and switchgrass handling facilities at the Ottumwa Generating Station. On-site modifications to accommodate cofiring are scheduled for late 1999 through early 2000
 - Carry out 100-hour test of cofiring switchgrass with coal at the Ottumwa Station at a level of 5% switchgrass by energy content
- Investigate using gas produced from switchgrass to power fuel cells.

Project Partners

ABB Combustion Engineering
Alliant Power Company
R.W. Beck
Chariton Valley RC&D, Inc.
John Deere Company
Energy Research Corporation
Iowa Department of Natural Resources
Iowa Division of Soil Conservation
Iowa Energy Center
Iowa Farm Bureau Federation
Iowa State University
Leopold Center for Sustainable Agriculture
Local Farmers and Landowners
National Renewable Energy Laboratory
Oak Ridge National Laboratory
Prairie Lands Bio-Products
Soil and Water Conservation Districts
U.S. Department of Agriculture
U.S. Department of Energy



BIOENERGY



Industrial Webs – The Future of the Bioenergy Industry in Action

The compelling aspects of bio-based fuels, chemicals, and energy are their environmentally conscious nature and sustainability. Using renewable products as feedstocks, the bio-based products of the future will allow the Nation to transition from dependence on diminishing oil supplies. The logical evolution of bio-based industries is the creation of industrial webs, where waste products from one process are used as the feedstock for another, where industrial by-products, such as heat and process streams, are shared, reducing initial feedstock demands and recycling wastes into desirable, value-added products.

The forest products industry has long adhered to these principles, evolving their processes over time to make the best use of internally produced wastes. This industry recycles products to produce energy and recapture chemicals used within the plant, all with the goal of reducing costs and increasing productivity. These technological advances continue today, rapidly gaining on the ideal “closed-loop” system. The following examples provide some insight into the technological and engineering advances that may be utilized in future bio-based industrial webs.

Pulse-Enhanced Steam Reforming Process

Kraft pulping accounts for more than half the pulp produced in the United States. A by-product of this process is an organic/inor-

ganic mixture called black liquor. This fluid contains high levels of inorganic compounds that are used in the pulping process. Pulp mills attempt to recycle the greatest volume of these inorganics as possible. Using a newly developed black liquor steam reforming treatment process, mills can reduce their capital costs while improving plant safety, energy efficiency, and environmental performance. This new process produces a synthetic gas that is used within the plant, replacing natural gas currently bought from outside suppliers, while also enabling efficient chemical recovery. The product gas is scrubbed to produce sodium sulfide, which is recycled for use in the kraft pulping process. The total efficiency of the system is 70 percent, 5 percent greater than conventional recovery boilers, and results in significantly lower emissions of NO_x , CO, VOCs, and particulates. The process possesses the additional benefit of being energy self-sufficient. By more efficiently treating black liquor, pulp mills can lower their chemical costs and displace a portion of their external energy requirement.

High-Pressure Oxygen-Blown Black Liquor Gasification Technology

This soon-to-be-demonstrated black liquor treatment technology promises to produce a clean gas for use in powering the mill while also delivering impressive chemical recovery rates. Using advanced technologies, this process will gasify black liquor at a tempera-

ture of about 1800°F at a pressure of 400 psi. The organic compounds in the black liquor will be partially oxidized, producing a medium-Btu gas, while the inorganic components will be reduced and dissolved in water to produce green liquor, which can then be processed into the white liquor used in the kraft pulping process. Cooling and scrubbing the product gas will produce process steam for use in the plant and hydrogen sulfide, which will be processed into sulfur and injected into the white liquor, increasing the productivity of the kraft process. Installing this cost-effective gasifier can double the amount of power produced per unit of black liquor, provide substantial reductions in environmental emissions, and increase the efficiency of the kraft pulping process.

Low Inlet Velocity Gasification

Using dried and chopped waste wood residuals and pulp mill wastes as fuel, this flexible new approach to gasification operates at atmospheric pressure and displays a high tolerance for feed quality variation, demanding less attention to fuel drying than other systems. Fuel is fed into the gasifier where it is contacted with hot sand in a conveying stream of steam. The wood reacts in this environment, producing product gas and char. The gas and char are separated in cyclones.

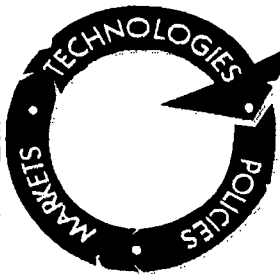
The char is used to reheat the process sand, while the product gas is fed through heat recovery units and scrubbed. The clean synthesis gas can then be used to produce additional steam or can power a conventional gas turbine to produce heat and power. Using this process gas to generate power within the plant can reduce the need for external sources of energy, increasing the energy self-sufficiency of the plant while making productive use of waste products.

These three new technologies will enhance the self-sufficiency of the forest products industry by making productive use of wastes. Such systems will be the basis of the bio-based industrial webs of the future.

Partners in Success

Air Products & Chemicals
Bechtel National, Inc.
Champion International
FERCO
Georgia-Pacific Corporation
Kværner Chemrec
HTCI/StoneChem Inc.
Weyerhaeuser Company

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Biomass Power for Rural Development



Background

Using biomass to generate heat or to drive steam engines is nothing new. Historical methods of burning wood, field residues, or waste were not environmentally sound because they emitted polluting carbons and volatile organic compounds into the air. Today, scientists and engineers are developing several new methods to cleanly and efficiently convert biomass to electricity.

Accomplishments

Coproducts from the Heartland: In Southern Minnesota, alfalfa markets weren't strong enough to justify hauling the crop off the farm—until now. A partnership of the Minnesota Valley Alfalfa Producers cooperative, ENRON Capital and Trade, Carbona, Great River Energy, Westinghouse Electric Corporation, the University of Minnesota and DOE are about to get that alfalfa moving. When they build a planned biomass gasification and power generation

facility in Granite Falls, between 50,000 and 75,000 homes and farms will be served with electricity, and companion products like high-protein feed pellets will be produced. These coproducts will bring new revenues to local farmers. The farmers will get more local control and stability in their business, and there will be beneficial side effects, like an economic cushion against the devastating effects of rain damage to crops.

Switchgrass Binds Prairie: Underutilized, marginal land will be put to work through a public/private partnership to grow switchgrass for energy generation in Iowa. Currently, switchgrass is grown to reduce soil erosion or for feed. By cofiring the switchgrass in existing coal boilers, this native crop can generate about 36 megawatts of electrical power, enough to light some 40,000 homes.

Fourteen organizations, representing a broad cross section of business, community, utility and governmental interests, will work with hundreds of farmers and landowners to develop a biomass power system that will reduce acid rain. The partners plan a 4,000-acre demonstration project that will help farmers achieve a sustainable income as a lasting alternative to traditional Federal farm subsidies. In addition, increased use of homegrown renewable energy will keep more energy dollars in Iowa, concentrating the benefits.

Farmed Trees Grow Energy: In Upper Minnesota, 1,870 acres of hybrid poplar have been established on Conservation Reserve Program land by a consortium led by the WesMin Resource conservation and Development District. These four-year-old trees are being managed and studied extensively by scientists to learn how to grow dedicated crops for future energy uses.



Farmers Dedicate Crops to Energy in New York:

The first dedicated crop for energy production in the United States is growing near Syracuse, New York. Under the care of the Salix Consortium, with 25 university, association, corporate utility and government partners, willow trees are grown on land set aside by 26 farmers and landowners. These trees produce a crop every three years that can be efficiently harvested using existing machinery. Several power plants will participate in this project, cofiring the harvested feedstock with other fuels to produce electricity and reduce emissions. Projections indicate that willow crops like this one could be competitive with coal for producing energy without government subsidies.

Benefits

The U.S. Departments of Energy and Agriculture are partnering to further the development of electricity generation systems that use biomass instead of fossil fuels.

Using biomass, such as energy crops, processing waste, and agricultural residues for energy production is beneficial to the nation, and especially to rural areas. The national benefits include lower acid rain-producing emissions, reductions in greenhouse gas emissions, and less dependence on fossil fuels. Rural

benefits start with new sources of income for farmers, more jobs, and economic development, all achieved while preserving the high quality of life, local control, and lack of pollution that help make rural America a good place to live.

When economic development happens without harming the environment or jeopardizing our children's future well-being, we call it sustainable development. In the four projects established throughout the nation to demonstrate and validate biomass power production, we hope to embody the principles of sustainable development at its best.

Partners in Success

Iowa

Chariton Valley RC&D
Alliant Power
Local Farmers/Landowners
Iowa Farm Bureau
Iowa State University
Iowa Department of Natural Resources
Iowa Division of Soil Conservation
R.W. Beck
NBB/CES
Soil and Water Conservation Districts
U.S. Department of Agriculture

Minnesota

Minnesota Valley Alfalfa Producers
Enron Capital and Trade
Carbona Corporation
Kvaerner Pulping
Siemens Westinghouse
Great River Energy
City of Granite Falls
University of Minnesota
U.S. Department of Agriculture

New York

Niagara Mohawk/SUNY
Cornell
New York State Gas and Electric
New York Gas
U.S. Department of Agriculture
NYSERDA
EPRI



BIOENERGY



Small Modular Biopower Systems

Objective: To develop small modular biopower systems:

- fuel flexible
- efficient
- simple to operate
- minimum negative impacts on the environment
- power range: 5 kW - 5 MW

Individual Households to Institutions (hospitals, schools) under 100 kW

Developer	Location	Technology
Sunpower	OH	Combustion/Stirling Engine
CPC	CO	Gasification/IC Engine
STM	MI	Gasification/Stirling Engine
Reflective Energies	CA	Gasification/Gas Turbine

Multiphase Project:

- Phase 1: Feasibility Studies
- Phase 2: Prototype Development and Testing
- Phase 3: Integrated Systems Demonstration

Small Villages and Industries 100-300 kW

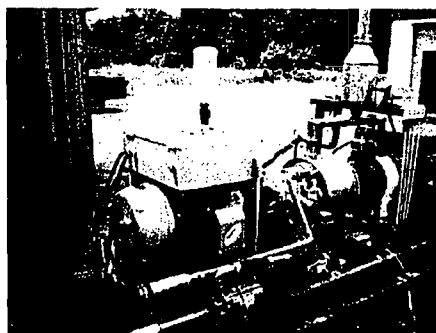
Developer	Location	Technology
Reflective Energies	CA	Gasification/Gas Turbine
Bechtel	VA	Gasifier/Engines/Gas Turbine

Phase I Feasibility Studies:

RFQ Issued	Feb 1998
RFQ Closed	Mar 1998
Technical Review	Apr 1998
Awards	May-Jun 1998

Industries, Mini-grids, Grid Support > 500 kW

Developer	Location	Technology
Agrielectric	LA	Fluid-Bed Combustor/ Steam Turbine
Bioten	TN	Direct-Fired Comb. Turbine
Carbana Corp.	GA	Gasification/Steam Turbine
EERE	ND	Fluid-Bed Combustor/ Steam Turbine
Niagara Mohawk	NY	Gasification/IC Engine/ Gas Turbine



STM's BioStirling™ system is one example of the modular power units being developed under this initiative.