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Biomass energy: A New choice for America

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BIOMASS ENERGY

a new choice for America

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Agribusiness has reacted in a number of ways to the soaring cost of energy, including belt tightening, reshuffling its energy priorities, and, predictably, raising its prices—a move that only compounds the problem. All of these actions, in fact, only forestall the realities of energy depletion. But there is a bright idea growing in the Farm Belt that could in time produce a harvest of energy for America.

In spite of the inherent risk in any new idea, agribusiness is putting more than a little of its money and its hopes on biomass conversion. Briefly, this is the production of energy from organic matter, such as the field crops heretofore destined for human consumption or livestock feed. The industry, in particular its farmers, sees in the early stages the promise of a major contribution to the nation's search for energy self-sufficiency.

At this point in its development, biomass conversion is accomplished in three ways:

- *Direct conversion:* the burning of feedstocks, wood, crops wastes, nut shells, or fruit pits to produce heat for space heating and steam for processing.
- *Physical/chemical conversion:* the decomposition of dry biomass material—such as rice straw, wood chips, tree trimmings, and cannery waste—into low- or medium-BTU (British thermal unit) gases.
- *Biochemical conversion:* the fermentation of animal waste into methane gas, and starch- and sugar-based crops—such as corn, wheat, and potatoes—into ethyl alcohol, also commonly known as ethanol.

Energy resources like these have two apparent advantages: one, they don't have to be dug or pumped from the ground, and two, the supply is nearly inexhaustible. A third advantage, of course, is that the raw materials do not have to be imported.

One reason there has been no rush to melt down the nation's crops is that such conversion does not begin to supply our energy needs. In fact, the nation will be lucky to displace 10 percent of its gasoline in this way by 1990. Like it or not, fossil fuel and its synthetics are still the best, albeit most expensive, energy source. Also, they are still necessary to any conversion process.

The situation is brighter than it seems, however. Biomass conversion is a positive energy source because it can yield more energy than it takes to produce it. In the future, some way will certainly be found to increase the energy balance of other processes and a real obstacle to commercial production will be hurdled. In the meantime, it is the agribusiness industry that will probably benefit most from this revolutionary process. And properly so, since the nation's food growers and processors have been the driving force behind it. Besides, they're closer to the source.

Of the various techniques for biomass conversion, the one most attractive to the farmer is biochemical conversion, a variation of old-fashioned fermentation. It is also attractive because one plant can be built to serve the needs of many. And fortunately, the raw material is growing everywhere. Any starch- or sugar-based crop—including wheat, potatoes, sugarcane and beets, and sorghum—can be used, as well as such food processing wastes and by-products as cheese whey, molasses slurry, cannery wastes, potato scraps, low-grade starch, pulp plant waste, and other flotsam and jetsam of our throw-away society. But the feed-

stock of choice—because of its availability and stable price—is corn.

Biochemical conversion is a relatively simple process. The first step is to convert the feedstock into a liquid, sugar base by heating it, mashing it, adding enzymes, and finally separating the usable elements. Next, yeast is added which converts the sugar molecules into alcohol (fermentation). It is not pure, 200-proof alcohol, however, but a watered-down (hydrous) liquid known as primary or farmer's alcohol. The third step—distillation—removes the water and other by-products, including distillers grain and carbon dioxide gas. The final base product is ethanol, which can be added to unleaded gasoline, at nine parts to one, to produce Gasohol—a trademark registered by the state of Nebraska.

Obviously, a nine-to-one ratio will not solve America's fuel crisis, but the agribusiness industry is confident that eventually the technology will develop to displace more and more fossil fuel. Thus, many within the industry believe, large-scale production of ethanol will not only improve the farmers' lot and income, bu in time will drastically reduce the degree of their dependency on outside energy sources.

The most obvious beneficiary of the new technology is the farmer, who faces the delightful prospect of being able to extract consumer crops, livestock feed, and fuel from the same acreage. One such agribusinessman is Howard Norman, owner of Norman Land & Livestock Company, a feedlot operation in Fort Collins, Colo. Plagued by the wildly fluctuating beef prices and rising energy and feed crop costs, Norman began a year ago to explore the possibility of building his own conversion plant. Norman stores about 100,000 bushels of corn to feed his 9,000 head of cattle; but he decided that there was no reason why his storage couldn't serve two purposes—food for the livestock and fuel for himself and others—and thus reduce his investment in the feed corn. He quickly enrolled in a conversion seminar at Colorado University, and later traveled to northwest Germany, where farm alcohol plants are common and where the alcohol produced is purchased by the West German government.

> "The continuation of our rather modest biomass fuels program, particularly the loan guarantees portion of the program, which has no budget impact and does not contribute to inflation, seems like a reasonable investment in our future energy security."
>
> BERKLEY BEDELL
> congressman, Iowa

Upon his return, Norman discovered there was somewhat less than universal applause for farm fuel. For example, the U.S. Energy Advisory Board concluded in its report that the energy return from ethanol production was about zero, considering the technology available. That is, the process required as much energy as it yielded.

Norman, however, had done his own research. He knew that as a straight commercial venture, the project was risky for the reasons mentioned; but, combined with a feedlot operation, he believed it was possible to come out ahead.

"What's really happening," he claims, "is that because the plant is linked to a feedlot, we get something for almost nothing. Because after we convert our feed corn to alcohol, we feed the wet mash that is the by-product of the process to our cattle. In other words, we get twice the benefit from the same amount of corn."

"The flaw in the energy board's reasoning is its failure to see that I can feed wet mash to my cattle," he explains. "If I had to dry the mash first, the critics would be right, because it can't be dried economically. But wet mash is an excellent livestock feed. The real nutritive value is still intact; only the starch is removed, and this doesn't affect the length of time required to fatten cattle or the quality of the meat."

In fact, Norman says he has been assured by the company building his plant "that the BTUs required to produce a gallon of ethanol will be no more than 29,700 if the by-product is not dried, and if you don't count the energy used to grow and harvest the corn. Assuming that anhydrous ethanol has a heat value of 84,000 BTUs, there will be a net energy gain of 54,300 BTUs per gallon."

Norman's plant will produce 8,000 gallons of ethanol a day, or about one truckload of ethanol from three to four truckloads of corn. In addition, he plans to buy and distill primary alcohol that is being produced by neighboring farmers who can manage the first two processing steps without expensive equipment. This and the ethanol that he himself produces will be sold to a local gasohol distributor.

Energy in a Nutshell

Gasohol is only part of the biomass energy story, however. Processes are

available to convert organic material to gaseous fuel, and also to use the raw material as a direct source of heat. The latter process, known as direct conversion, is being used to its fullest extent by Brazil, which is not only distilling sugarcane, but is burning cane waste to fuel the distilleries.

Closer to home, Diamond Walnut Growers, Inc. and Tri/Valley Growers, Inc., both located in California, are converting walnut shells and fruit pits into direct-fire boiler fuel and solving a solid-waste disposal problem at the same time. Diamond has spent $3.5 million to build a non-polluting electricity plant fueled by walnut shells. The co-generating plant will not only recycle waste heat to heat, cool, and power the plant and administrative offices in Stockton, but will also refrigerate six million cubic feet of storage at the world's largest walnut processing facility.

The project also excites California utilities, who will reap unexpected dividends in surplus electricity. Fired by tons of once useless shells, the new plant will generate all the electricity needed by Diamond, which in turn will reduce its demands on Pacific Gas & Electric Company by enough electricity to supply 5,500 homes and enough natural gas to heat another 950 homes. Total energy savings are expected to be the equivalent of 66,000 barrels of oil yearly, with up to 20 million kilowatts of excess electricity being sold to the utility in addition.

Direct firing of agricultural waste is also being practiced by Tri/Valley Growers in Modesto. In 1978, their "supercannery" Plant 7 was the first in the food processing industry to burn peach pits as boiler fuel, and the company has now built another Modesto plant that is fully powered by biomass energy. Tri/Valley installed two grinders to pulverize the pits, convey them to a storage tank, then feed them to a burner system on the plant's steamboiler. The system also can run on cherry and olive pits, and on walnut shells.

Burning biomass fuels directly has saved the pioneer plant the annual energy equivalent of 160,000 barrels of oil or 100 million cubic feet of natural gas. The California Almond Growers Exchange is building a plant with potentially an even greater capacity.

The third method of biomass conversion has been the least popular because of the costs involved. Gasifying by means of physical or chemical conversion involves the decomposition of dry material—such as rice straw, wood chips, fruit pits, and even cotton waste—in an air-tight thermochemical reactor or downdraft gasifier. Of all the biomass conversion systems, gasification may have the greatest potential, since the low- to medium-BTU gas it produces has many uses in industry.

As natural gas increases in price, the investment in this type of gasification technology will become more attractive. One leader in this field is Biomass Corporation of Yuba City, California, a manufacturer of downdraft gasifiers. According to its chief engineer, Robert Williams, the converted gas can be used to fuel either a stationary or transport engine which puts out shaft horsepower; or, if the engine is coupled to a generator, it will produce electricity. The clean-burning gas can also replace natural gas, propane, or oil in boilers, dryers, or kilns.

Because fuel availability is seasonal, the Yuba company is also looking ahead to the logistics of gathering enough agricultural field waste and other raw materials at biomass receiving centers, where the material would be chopped, cubed, and stored until needed. This would eliminate haphazard bulk transportation of material from scattered sources and would even out availability. One of the most lasting benefits of gasification—as with other biomass conversions—is low emissions. Biomass Corporation reports that boiler stack emissions will meet the most stringent federal, state, and local standards.

Unfortunately for America, alternative energy in the near future will be just that: alternative. But there is definite cause for optimism that such solutions as fermentation, direct firing, and gasification will no longer lack a sustained commitment from government. Certainly the farmer, the processor, the retailer, and the consumer are ready to try any means as inexpensive energy vanishes further down the well of history.

Support is growing, albeit none too rapidly, in response to the Energy Security Act of 1980. The act sets up a Synthetic Fuels Corporation with the authority to commit about $88 billion to that industry. It also sets aside about $1.27 billion for biomass conversion, and last October the Department of Agriculture approved more than $340 million in federal loan guarantees for construction of 15 distilleries that will ultimately produce 246 million gallons of fuel alcohol a year. It is also anticipated that private enterprise will see the inherent possibilities in biomass energy and cast its lot in that direction.

Perhaps the brightest and most intriguing aspect of this new technology is the re-discovery of something that nature has always known—that everything has a useful purpose. It may take time, energy, and money to determine what that purpose is, but it helps to remember that nature never throws anything away. △