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AMERICA'S ALTERNATIVE ENERGY SOURCES

Animal Power: Turning Animal Waste Into Energy

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Current State of this Energy Source

Just a smattering of farms and communities turn the copious amounts of waste generated by animals, such as cows, cattle, poultry, and swine, into gas and then into power. The gas from animal waste, called biogas, contains about 60 to 70 percent methane and 30 to 40 percent carbon dioxide and has a heat value that is approximately half that of natural gas. Farmers, utilities, and communities use anaerobic digesters, also known as manure or methane digesters, to break down the bacteria in animal waste and produce this biogas for powering generators and creating electricity.

Like other alternative energies, this technology is not new. The first digester was built in 1859 at a leper colony in India. Since then, digesters have been turning animal waste into energy in scattered locations in Europe, Asia, and North America. But animal waste as an energy source has yet to take off in a big way, anywhere. Now, spurred by the rising costs of fossil fuels and growing environmental concerns about where to go with agricultural organic wastes, our society is expressing renewed interest in the conversion of animal wastes into energy to both cope with the pollution problems and to capitalize on a homegrown power source. That's why more digester plants are on the drawing boards.

How Does It Work?

To no one's surprise, animal waste is loaded with bacteria. Anaerobic digesters compost or "digest" organic waste in a tank that limits access to oxygen (hence the "anaerobic"); maintains a constant temperature of 101 degrees, which is the same temperature as a cow's stomach, and pH; and encourages the generation of biogas. Producing biogas from

manure take two steps and each requires a specific group of organisms. In the first step, the manure, a complex organic matter, is broken into simple organic compounds by acid-forming bacteria. Next, microorganisms, the methane-formers, break down the acids into the biogas. The two groups of bacteria must balance so that the methane-formers use just the acids produced by the acid-formers. When correctly balanced, an abundance of biogas forms and this gas is pumped into an engine where it is converted into electricity to power a farm or a community, and, if there is a surplus, to sell to the utility company.

Where?

A shining example of what is being done with animal waste, right here in southcentral Pennsylvania, is the Mason Dixon Farm near Gettysburg, Pa. The farm, which also extends into Maryland, is often called a "living laboratory" for its innovations including milking cows with robots and turning the waste from its 2400 milking cows into energy. Over the last 40 years, Richard Waybright, who is the 8th-generation to farm its 375 acres, has turned the old family farm into a cutting-edge operation. Each day his dairy herd produces 52,000 gallons of manure and urine. Instead of polluting the water supply, the atmosphere, and the land, the farm's on-site biogas digestion system turns the animal waste into methane gas. In turn, the methane gas drives generators that produce 320 kilowatts of power daily. That is more than enough electricity to operate the farm. In fact, each month, since 1978, the farm has sold electricity to the utility company, receiving a monthly check rather than a bill, and the farm has done all this innovation without any particular government support.

If the Cove Area Regional Digester in Pennsylvania's Blair and Bedford Counties secures the funding, the 6800 dairy cows in Blair and Bedford counties could soon be producing 2.5 megawatts of electricity a day, enough to power over 1,700 homes. The proposed Cove Area Regional Digester expects to produce over 1 million cubic feet of biogas daily from digested cow manure, enough to fuel an on-site electrical generator and to make soil treatment products. Not only would this plant provide power, but it will also help manage the more than 380,000 gallons of manure produced every day by the cows. According to an article in the *PA Environmental Digest*, agricultural runoff has steadily increased nitrate levels in groundwater in the region, and now two of the four wells supplying Martinsburg Borough exceed the drinking water standard for nitrates. Faced with these concerns, the Cove Area Regional Digester Project formed as a non-profit group to develop a proposal for managing animal waste in the area with a digester plant.

In Wisconsin, Lee Jensen says the manure from his dairy farm powers almost as many homes as he has cows. The gas generated from the manure from his 875 cows produces about 775 kilowatts of electricity, enough for about 600 homes. The Jensen farm is one of three in Wisconsin that has partnered with New Hampshire-based Environmental Power Corp. Their digesters heat the manure after the biogas has been removed to create pathogen-free bedding for the cows and fertilizer for the farm's fields. Because more of the waste gets used, the farm needs smaller manure lagoons, making them less likely to leach into local water supplies.

In Bridport, Vermont, 1,500 cows at Blue Spruce Farm are producing milk and methane gas. The gas is generating electricity for Vermont's largest utility, Central Vermont Public Service Corp. Similar digester systems are being used on dairy farms in Iowa and California, and this month, in the tiny town of Reynolds, Indiana, the community has begun building a digester plant using hog and cow manure to generate electricity for its 450 citizens. But biogas can generate more than electricity. In Kansas, Panda Energy plans to use one billion pounds of cattle manure per year to produce biogas to power an ethanol production plant.

In Canada, the North Middlesex community in southwestern Ontario hopes to become the first municipality to be electrically powered by cow manure. The fuel for the electricity is coming from the digested waste produced by 5,500 head of beef cattle at the 2,800-acre Lynn cattle farm. After going through the digester, the waste will be further processed into biologically stable, odorless and pathogen-free fertilizer/soil amendment and water. Experts say enough power will be generated to supply the North Middlesex municipal infrastructure requirements and to sell a surplus to the Ontario electrical grid.

In Europe, The Netherlands leads in anaerobic digestion with its numerous digestion plants. Great Britain and Germany are also developing digestion plants. In New South Wales, Australia, Energy Australia is building a methane-powered plant to harvest the gas from five large lagoons filled with pig manure. The company says the plant will produce enough power to power the piggery as well as 1,500 homes, and it will also curb the release of methane, which is a powerful greenhouse gas, from being released into the atmosphere and reduce odors. India already has several large-scale digestion as well as small-scale digesters for small villages and farms to produce gas for cooking.

Cost?

The cost of a farm-site manure digester depends on local site conditions and the number of animals on the farm. For example, a plug-flow digester, designed to process the manure of 500 dairy cows, costs in the range of \$230,000 to \$260,000. According to the US EPA AgSTAR Program, the cost for a manure digester is approximately \$550 per cow. On the plus side, the electricity and heat generated from digester gas can reduce the farm's energy costs, and the residue from the digester can have value as a fertilizer and a soil amendment.

The proposed Cove Area Regional Digester project in Pennsylvania is expected to cost about \$23 million with anticipated annual revenue of \$ 1.7M from the sale of electricity, from tipping fees for accepting bio-solids disposal, and from selling soil amendment products.

Cost per KWH

The estimated cost of producing electric power from anaerobic digestion of animal manure is 3.7 to 5.4 cents per kilowatt-hour.

Environmental Plus

A digester can produce electricity, while managing some of the disposal and odor problems with manure and while protecting the waterways from agricultural runoff and the atmosphere from methane.

Outlook for Animal Power

Pros and Cons

Turning an environment problem, such as the safe storage of animal waste, into an environmental boon that provides power and pathogen-free fertilizer seems like a dream come true. In addition, when you use manure for your energy source, you have access to a steady and reliable supply. But digesting animal waste is not perfect.

While digesters have improved a lot in recent years, many farmers remember experimenting with them during the fuel shortages of the 1970s. These farmers recall how many digesters failed and how expensive they are. Another negative is the waste that remains after the manure spends its week or two in the digester. At the end of the time in the digester, the solids have become smaller, the odor far less pronounced, and much of the waste has become water. But the waste is not completely gone nor is it pollution free. The waste still contains most of its original nitrogen, phosphorus, and potassium and cannot enter a stream from the digester. It is, however, cleaner than it was, and it is free of the pathogens found in raw manure, such as fecal coliform. Besides, technological breakthroughs are being developed to further refine and purify the remaining waste. Meanwhile, the processed waste, while not perfect, does reduce the risk of groundwater contamination. To cope with what remains, farmers commonly store the waste in lagoons until the digested waste can be either hauled away or spread on the land as fertilizer.

Barriers

A digestion system can be expensive and difficult to keep in operation, so a back-up source of electricity should be in place. Even digested manure doesn't disappear. It still must go somewhere. Finally, the electricity a digester generates can cost more than purchasing electricity from the grid but it does offer a way to handle the disposal of animal waste, the odor problems, and to protect the environment.

Incentives

Energy subsidies are available in a form of a tax credit for electricity generated from renewable sources including manure. To be eligible for the credit, the methane digester systems need to be capable of generating 150 kilowatts.

Recommendations

Digestion technology offers a lot of promise as way to power farms and small rural communities with a renewable and fossil-free energy, while also helping to manage the animal waste problems on farms. Farm runoff is an enormous environmental problem. Anaerobic digestion protects surface streams from contamination because the process destroys some of harmful microorganisms that are carried in manure. In addition, digesters reduce the odor in manure, reduce the emission of greenhouses gases, and reduce dependence on fossil fuels. While the outlay for a digester system is high, it does

reduce fuel costs for a farm and even provides a small revenue source from selling electricity to the grid and selling the clean and digested manure.

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