Energy Conservation, Energy Production— THE NDSU ENERGY—INTEGRATED FARM SYSTEM

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Since the beginnings of agriculture in this country, the American farm has supplied some (or all) of its energy needs.

Prior to the industrial revolution's impact on farming methods, about one-third of the average farm was used to produce the feed for the animals producing the energy for the farm. Combining human and animal labor, 40 percent of the farm was devoted to energy production.

Now, with fuel and heating prices on a continual upward spiral, experiments are underway across the country to update the earlier "energy-integrated" farming methods.

One of eight such projects in the United States, North Dakota State University is now in its second year of a combined experiment and demonstration in which energy-efficient cropping practices, solar energy and the production and use of methane for generating electricity are being tried.

A joint project of the U.S. Department of Energy and NDSU, about 110 acres of cropland, 100 milk cows, plus calves and bulls, and housing for that herd are being used to demonstrate energy-efficient equipment and techniques designed to minimize the farmer's dependence on scarce energy sources.

According to Dr. Harvey Hirning, project co-chairman, the three segments of the project are in varying stages of development. While some segments are in the demonstration phase, others remain in the final stages of construction.

The energy-efficient crop production demonstration, under the direction of Dr. J.F. Giles, crop committee chairman, is in the demonstration phase.

In this part of the project, cropping practices designed to conserve fuel are being put to the test. Sugar beets, soybeans, barley, wheat and silage corn are being grown, using both energy-conserving and conventional cropping practices. The goal of the demonstration is to produce crops most efficiently, not necessarily to use the least amount of fuel.

The cropping system consists of 40-acre demonstration plots, with each of the four cash crops allotted approximately 10 acres. Each 10-acre plot is subdivided into smaller strip plots, in which each crop is farmed both conventionally and with energy-minimizing technology.

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So far in the tests, very little difference has been noted in the amounts of fuel conserved between the two types of cropping for the small grains, according to Hirning.

Fall tillage included a discing operation, primarily because soybeans had been grown on the land the year before, and an application of anhydrous ammonia and herbicide. Next year, says Hirning, the discing may not be necessary, and fuel efficiency will be enhanced.

And, although the results have yet to be fully analyzed, differences appear much greater between the two types of practice in the soybean, corn and sugar beet fields.

Energy-efficient tillage operations on silage corn. Using only a buffalo till planter and applying herbicide only once resulted in a 1.02 gallons per acre fuel use. Conventionally farmed corn plots were plowed, cultivated, harrowed and planted at a cost of 4.32 gallons per acre.

By eliminating fall plowing, fuel used on the sugar beets was reduced from a conventional practices 5.22 gallons per acre to 2.86 gallons. By eliminating plowing, the conventionally cropped soybean cost of 4.89 gallons per acre was reduced to 2.83 gallons.

Conventionally cropped corn fields were plowed, cultivated, harrowed and planted at a cost of 4.32 gallons per acre. With the use of a buffalo till planter and a one-time herbicide application, the use of fuel on the energy-efficient fields remained at 1.02 gallons per acre.

While the initial results fall short of the originally predicted 25 percent reduction in energy input (fuels) with the newer methods, project personnel still feel the demonstration will show farmers they can combine primary tillage with fertilizer application and herbicide incorporation in one autumn field operation, return in the spring with minimal secondary tillage and then plant, saving both time and fuel without sacrificing yield.

According to project co-chairman and dairy committee chairman Dr. James Lindley, the methane production portion of the farm system will shortly complete its construction phase.

As one of a number of interelated energy projects at the NDSU dairy barn, the methane generator will involve the use of livestock waste as a multiple source of energy.

According to Lindley, waste will be separated into liquid and solid portions — solids to used for animal bedding and liquid to be used as a feedstock for an anaerobic digester, which will produce methane gas.

The methane will be used to power a modified gasoline engine generator to provide heat, and possibly power, for the dairy barn's free stall loafing area.

The waste material for the anaerobic digester will be applied to the station's cropland as fertilizer, along with bedding, straw and other manure products.

According to Lindley, the final construction details for the digester system should be completed within the next month. The estimated gas production from the system will be the equivalent of 3 million BTUs per day, about the number of BTUs needed to heat a home for 30 days.

While construction lags slightly on the methane production system, other portions of the dairy segment of the project are in the demonstration phase.

According to Hirning, the use of a covered plate solar collector to preheat ventilation air in the calf housing area saved 100 gallons of fuel last year.

Despite some difficulties in hooking up the 200-square foot collector to the barn's ventilation system, Hirning says the fuel saved by its use amounted to about $125 during its 6-month operating period.

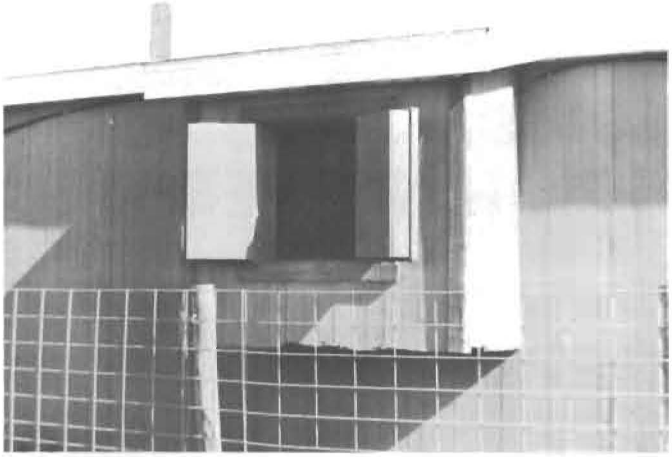
Preparation of the solar collector began with the nailing of 2 x 4's (on edge) to the south wall of the calf housing area of the dairy barn to create air passages.

Once air passages on the south wall of the dairy barn's calf housing area were created, the entire wall was painted black. Glazed panels were attached over the painted area, with air entries at the bottom of the collector, and exit ports to the facility's ventilation system at the top. Once the unit was completed and began operating, it saved 100 gallons of fuel in six months.

In addition to methane generation and solar heating, two additional energy-conserving devices are currently being monitored as part of the dairy barn segment of the project.

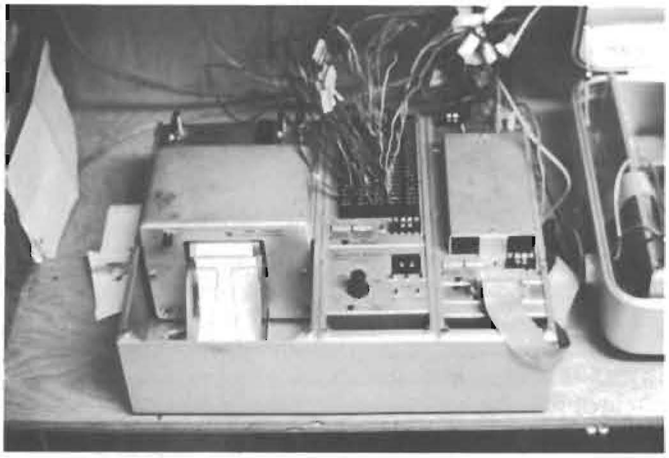
A rock-to-air heat exchanger and a milk heat exchanger, both in place previous to the project, are being closely monitored to assess their effectiveness.

The rock-to-air heat exchanger is being used to reduce the need for heat in the barn's free stall loafing area, while the milk heat exchanger unit is being used to heat water.



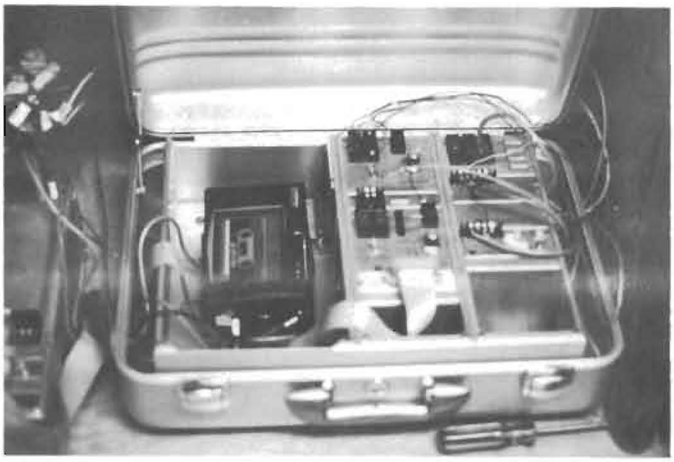
One of the eight rock-to-air heat exchanger units on the NDSU dairy barn. Designed to preheat ventilation air for the free stall area, the units are being monitored as part of the energy-integrated farm project.

As part of the dairy segment, the two devices have been attached to monitoring equipment to determine their effctiveness.



Part of the temperature measuring equipment used to monitor and record temperatures in the dairy barn's solar collector, free stall housing area and water system.

The third part of the project, headed by Dr. Roger Johnson, is the economic committee. Presently collecting the crop and dairy demonstration data, Johnson's committee is turning the collected figures into economic



Part of the monitoring equipment used in the energy-integrated farm project. When hooked to another unit measuring various temperatures in the dairy facility, the equipment shown measures wind velocity and direction and water use, and records all the data on a magnetic tape for later use with a computer.

terms, which can be translated into real-world costs for a typical farmer.

Johnson says his committee's work will be pivotal to the project's success as a demonstration of energy-efficient farming practices.

Project leaders and committee chairmen agree with Johnson's perception. They see his committee's work as providing the program with a window into the "real world."

Both co-chairmen say a careful analysis of their work on the project will be necessary to make it beneficial to the largest number of farmers. The correct evaluation of what practices, equipment, payback periods can be used by what size farming operations will be an important factor in determining the adoption of many of the demonstrations.

In league with the interpretation of the demonstration findings, says Hirning, is the presentation to the public of a good understanding of its potential use. Information on all segments of the project, he says, will be available to the public via publications, mass media and extension program presentations and scheduled on-site inspections.