



# PROJECT FOCUS # 11

Small Farm Energy Project

## Energy Conservation on the Farm

July, 1980

"Project Focus" is part of a primer on energy alternatives that would help lower the high costs of energy inputs on small farms. The examples are drawn from innovations built by north-east Nebraska farmers who are participants in the Small Farm Energy Project, a special 3-year research effort sponsored by the Center for Rural Affairs of Walthill, Nebraska and based in Hartington, Nebraska. The aim of Project Focus is to help small farmers discover and develop viable alternatives for their own farms.

Conservation of energy for the farm and home has been a major factor for the success of Energy Project cooperating farmers in lowering energy costs. "Innovative" farmers cooperating in the Small Farm Energy Project for over three years have made a variety of energy use changes. Results indicate an average savings of \$1100 per year per farm when compared to a comparable group of farms making no changes in energy use patterns.

Although the more elaborate solar projects may have received the greatest publicity, energy conservation has proved to be the most effective step in saving energy. Energy conservation is an important primary step before more sophisticated solar, wind, or alcohol projects are utilized for producing energy. It is normally less costly to save a portion of energy consumed than to produce an alternative energy.

This Project Focus concentrates on a variety of conservation techniques used by Energy Project cooperators in dry land farming operations.

### Farm Yard Energy Savings

#### Saving Energy At Fuel Tanks

##### WHITE OR SHADED TANKS

Fuel tanks can be a source of a number of energy losses during the year. Leaking hoses or valves should be repaired. During summer months, fuel tanks should have a white color, or be shaded. Researchers indicate that a white fuel tank will have one-third less loss of fuel due to evaporation during warm weather than red tanks, particularly with volatile gasoline. A white tank in the shade will save even more fuel.

##### PRESSURE-VACUUM RELIEF FILLER CAPS

A pressure-vacuum relief filler cap will also lower evaporation losses. It reportedly will lower evaporation losses as much as one-half during warm weather. They are available for about \$10 from many hardware stores and fuel suppliers.

Research indicates that a conventional sized farm fuel storage tank, especially in the case of gasoline, can lose as high as \$75 or more worth of fuel per year, when not protected from warm weather. It is quite obvious that a can of paint and a pressure-vacuum relief filler cap can pay for themselves in a year or less.

#### EVAPORATION LOSSES FROM COMMON—300 GAL. GASOLINE TANKS

(Information from the University of Nebr.)

Tank Configuration	Representative Losses Gallons/month
Red tank in sun	9 to 10
White tank in sun	6
Red tank in sun with pressure-vacuum relief valve	5.5
White tank in sun with pressure vacuum relief valve	3.2
Tank in shade	2.4
Tank in shade with pressure-vacuum relief valve	1.3
Underground tank	less than 1

#### Stock Tanks and Waterers

A major energy consumer on the livestock farm during the winter months is the livestock waterer, resulting in high electric bills. Thermostats should be in good working order to SFEP Primer, 7/80

—A pressure, vacuum-relief filler cap used to lower evaporation losses on farm fuel tanks. The inexpensive device should pay for itself during one summer of warm weather. Fuel tanks should also be painted white or located in shade to save additional energy.



avoid excess electrical use. Stock tank waterers should be reinsulated where possible using a rigid board insulation. On large tanks, rigid styrofoam insulation can be floated on water surfaces that are not used.

There are several energy saving waterers and tanks available on the market, and farmers should shop around to find good efficient systems when purchasing new units. Some have a floating cover. Others are animal regulated, as in the "nipple" hog waterers which contain no reservoirs. This requires considerably less heat. Other ideas include making better use of ground heat, by making a hole beneath the waterer in the ground. Or the reservoir itself may extend into the ground.

Ed Lange of Cedar County, Nebr. uses a simple method to keep his round cow tank providing water to cows without heating the tank. He allows ice to build up over the water and, in addition, runs water over the ice to make the ice cover quite thick. Then he chops a hole in the ice for access to water by the cows. Next the float is lowered to keep a lower water level. And the system is basically maintenance free. The concept works best in the shade so the ice doesn't melt in warmer weather, and a fair number of cows are required so continual water flow is maintained.

#### Shelterbelts Save Energy

Researchers indicate that tree shelterbelts around the farmstead can save eight to thirteen percent of heating cost in the home. Other studies indicated higher savings. Many other benefits can be realized with shelterbelts, including shade and fire wood.

# Saving Energy in the Home

## Home Heating INSULATION

Heat loss from a home is determined by several factors including the insulating value of walls, windows and ceilings; and the amount of air infiltration present.

Older homes can usually be upgraded in insulating value by the addition of insulation to walls and ceilings. Usually the "blow in" type insulation is used. **Basement masonry walls can also be insulated** on the exterior to a depth of four feet or to the frost line. A "closed cell" rigid board insulation should be used to avoid water penetration. The insulation should be covered at the top to prevent damage to it. Insulating the exterior side of the wall allows the wall to act as a "heat sink", thereby stabilizing the temperature of the home, especially when solar systems are utilized, when all of the solar heat is provided during the day. Basement walls can also be insulated on the interior of masonry walls by "studding" the wall out and adding batt insulation.

For new wall construction, a vapor barrier is recommended. A polyethylene sheet is placed over the wall on the inside of the insulation to protect the insulation from moisture condensation.

### AIR INFILTRATION

Air infiltration into the home during cold weather is a major factor in heat loss. This takes place at cracks around doors, windows, and other openings. **Caulking and weather-stripping** are two methods of tightening up a house to prevent infiltration of cold air. A candle can be used to check for points of potential air leaks.

### HEATING SYSTEMS

Furnaces used for space heating should be well tuned prior to each heating season. This includes replacing furnace filters, replacing jets on fuel oil systems, and other steps. Chimneys used for wood heating should be cleaned to remove creosote as a step to prevent dangerous fires.

**Heat Pumps usually operate effectively only above a certain outside temperature.** When it gets very cold the system will use electric resistance heating within the system, which is more costly. If one is aware of this, operation might be avoided during very cold nights, substituting wood or other heat. The newest innovation in the heat pump area is to use the "water to air" type systems where well water is used to improve the efficiency. This may require two wells, one to receive cooled water from the system, unless there is other use for the water.

## Summer Home Cooling

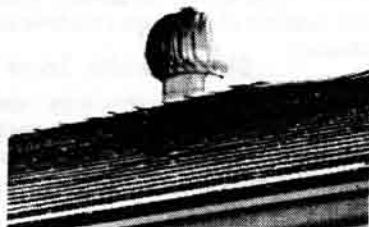
### AIR CONDITIONERS

**Air conditioning systems should be kept clean and properly maintained.** Condenser units are best located in the shade of the house or trees. Thermostat should be maintained between 78 to 80 degrees. Stoves should be vented to the outside. Windows should be shaded to lower heat load.

### VENTILATION FOR COOLING

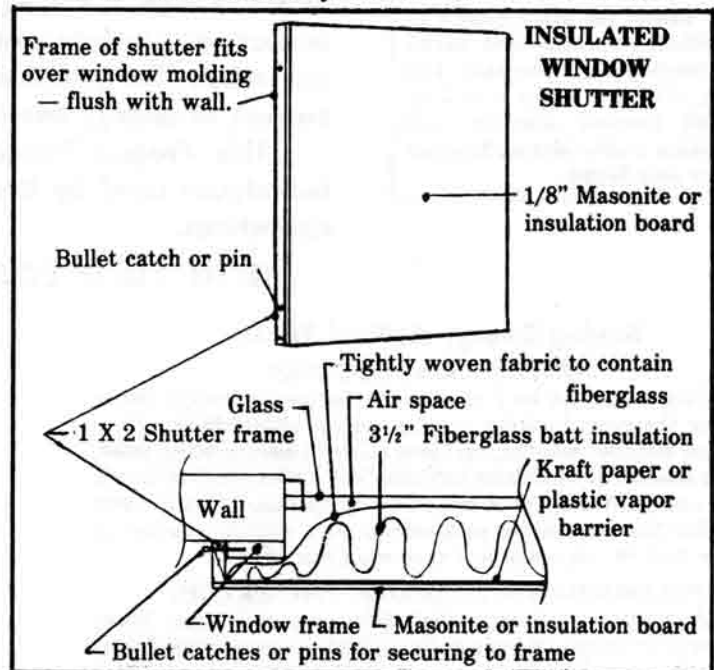
**Wind turbine vents** help to draw heat out of home attics during hot summer days, bringing in outside cooler air. The turbine vents operate in very low wind speeds. Such winds are usually always available. The turbines can eliminate the need for power vents in the attic, and they will also lower the air

—Wind turbines can be quite effective in keeping attic temperatures cool during summer months. Homes can be kept cooler with such devices, lowering electrical demands when air conditioning is used.



## INSULATED WINDOW SHUTTERS

**Paul and Wilma Phelps of rural Hartington have built several insulated window shutters,** in addition to their vertical wall solar collector. The two shutters are used to cut down on heat loss through north windows. They are made of wood framing with a masonite cover facing the interior of the house. Fiberglass batt insulation is used inside of the shutter. The shutter is made to fit over the window frame and is pinned with brads to the sides of the window frame. Paul Phelps built the shutters with the intention of leaving them attached to the windows most of the winter. A decorative covering will be used over the interior of the shutter. Phelps used a set of plans from Wisconsin to construct the shutters. **There are a variety of methods of constructing shutters, all of which can be quite valuable, since windows are a major source of heat loss in homes. Insulated drapes can also be helpful, but should extend to the floor and be covered with a valance or other device at the top of the drapes to lower air flow between drapes and the window, since air cooled by the wind can "fall" to the floor.**



conditioning loads in homes where power vents are not used.

Vent tubes can also be used with wind turbines to move warm air directly from room ceilings. Dampers at room ceilings and at the tube opening can be opened during cool nights and closed during the day.

**Other vents** are available, including the continuous ridge vent, for venting attics. Such vents should be combined with soffit vents in the eaves, to allow for cooler air to enter the base of the attic. These vents will also lower moisture and condensation problems in the winter, which lower the effectiveness of insulation.

## Water Heating

**Water heaters should be reinsulated;** kits are available from hardware stores. In some cases timers may be effective on the heater. **Water pipes should be insulated,** especially the warm water pipe above the heater. Water heaters should be located near use, and should be drained and flushed every 6 months. Water leaks should be repaired. Choose the lowest water temperature setting possible. Lowering the temperature setting 10 degrees can save over a kwh per day when 40 gallons of hot water are used each day.

## Livestock Buildings

Many of the same considerations for home weatherization apply to heated shops and livestock buildings, particularly with insulation and prevention of air infiltration. Heating systems should also be properly maintained.

### Farrowing Barns HEAT EXCHANGERS

For the livestock building that uses considerable ventilation during the winter heating season, various heat exchangers are now on the market to lower energy demands. "Air to air" heat exchangers are designed to utilize the heat of moist exhaust ventilation air to heat incoming fresh air. Corrosion and dust are difficulties with the heat exchanger, but some designs have addressed these areas. The systems can be quite expensive, but home-built, low cost systems seem possible.

### FARROWING OPERATIONS

Livestock operations, such as hog farrowing enterprises may be more feasible if timed to avoid the worst of cold winter weather.

Russell Perkinson of Illinois uses a "hover" of plywood over new-born pigs in his farrowing stalls. The hovers are located at the ends of the pens and are 1 ft. wide and 1 ft. above the floor. The pigs congregate under the hover where it is warm. The idea is to conserve the heat of the pigs for better pig health and to also conserve energy.

The "straw bale hover" concept has also been used by LaVern Truby, an Energy Project cooperator, for pigs of the "nursery" size. The technique improves the conversion of feed to weight gain rather than to hog "maintenance" energy requirements.

### Energy Conservation in the Dairy

#### WATER HEATING

Water heating requires a high energy demand in the dairy. A relatively new concept in heating water in the dairy is the use of the commercially available heat exchanger. Refrigeration coolant is used to transfer heat from the milk at the bulk tank to heat water which is used for cleaning equipment and udders. Energy Project cooperator Gary Young uses such a system and is quite pleased with its performance.

## Field and Farmstead Operations

### Pumping Water With Wind

Pumping farm water may seem to require little energy when electricity is used. However, wind pumping can add to energy savings. Many farms have wind water pumping equipment available, which, with a little repair work, can be put back into service.

### Transportation

Transportation can be reduced by planning and combining trips from farm to field or to town. Keeping a record of trips and energy use may help to better manage them.

### Machinery Maintenance

University researchers make the following energy saving suggestions for farm machinery:

- Read and understand operator's manuals
- Check machinery adjustment; keep lubricated
- Keep engines tuned up; check air filters
- Keep cutting edges sharp
- Don't overfuel an engine

—Minimize engine block heating during winter with a timer to avoid heating around the clock.

### Grain Drying

"Natural air drying" methods can often be used to lower energy inputs into drying of corn. Harvesting corn in the ear is still a very good method of reducing energy during harvest and many farmers are returning to the method. This method eliminates the need for electrical fan energy for drying and aeration.

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—Rob Aiken, left, assists Edgar Wuebben with insulation of his dairy barn. A vapor barrier was placed over the concrete block wall before mounting double 2 X 2's using concrete nails. Then fiberglass batt insulation and galvanized metal were installed. Fuel use for heating was cut in half.

### MILK COOLING SYSTEMS

In the dairy barn, one of the big consumers is the electric bulk tank cooling compressor. The compressor should be well serviced. Fan and condenser coils should be kept clean in order to maintain peak efficiency. In the winter, heat can be recycled in the building; in summer, the system should be well ventilated for best efficiency and lowest electrical use.

### NEW DAIRY FACILITIES

Edgar Wuebben, Energy Project cooperator, has some suggestions for the farmer designing a new dairy barn:

- build walls low and use a "pit design (cows remain on ground level) to reduce building exposure to wind and cold
- place water heater in center of building to minimize plumbing expenses and heat losses from hot water lines.
- insulate walls and foundation
- use compressor heat for pre-heating water
- install a low-cost vertical wall solar collector on the south wall
- run the roof-peak east and west for a south-facing roof for future solar collectors
- locate cow entrance and exit to the south and east to minimize winter drafts.

### Field Operations

Here are suggestions for field operations:

- Use a smaller tractor for light loads or throttle back with large tractor
- Limit engine idling. A medium size tractor uses 1/4-1/2 gallon per hour when idling.
- Plan machine movement between fields and farmstead for minimum travel.
- Plan fields for long rows; limit turning
- Plan fields to reduce bottlenecks or unnecessary operations.
- Utilize "minimum tillage" methods where practical
- Use proper ballast for tillage

### Using Horses

Some farmers have continued over the years to maintain a team of horses for light farm work. They foresee the potential of horses being used more in the future as energy prices rise.

### Irrigation

Irrigation is the largest farm energy consumer in Nebraska. The University of Nebraska has done considerable work in the area of improving irrigation pump efficiency. Extension Service offices have energy saving tips for irrigators.

As the cost of energy rises, the feasibility of irrigation of farms in Eastern Nebraska and related areas becomes more questionable. Small farmers may be wiser in practicing better soil and water conservation practices, like terracing, mulch tillage and manure composting to assist in water conservation in soils.

# Soil Conservation and Fertility

## Fertility Practices

### SOIL FERTILITY

Soil fertility requirements account for a major share of energy use on Nebraska farms. **Nitrogen fertilizer requires considerable amounts of energy during its manufacture. Crop rotations with legumes can provide a large amount of the nitrogen needs.** Energy Project cooperators have also adapted **manure composting techniques** in an attempt to conserve nutrients of livestock manures for soil fertility purposes.

Cooperators of the Energy Project have utilized **soil testing** as a valuable tool for gauging soil management, but they prefer to consider results of the tests with a "grain of salt" rather than following them as an absolute rule.

### NUTRIENT LOSS WITH SOIL EROSION

Until recently, researchers were only concerned with soil losses due to soil erosion. A 7-year study done in southwest Iowa indicates that nutrient losses can be substantial when there are soil losses. A comparison was made with contour farming and terraced land, both in corn production. The major portion of N and P lost was in sediment when compared to water run-off. In addition, **over 10 times more nitrogen was lost throughout the year on the contoured fields compared to the terraced land.** The results of the study show that **a major reduction in the loss of plant nutrients is another primary benefit for using conservation practices.**

## Value of Trees in Fields

**Trees not only can provide shelter and wood fuel, they can be used as "field belts" in single or double rows across fields.** Such belts can help to control wind erosion, hold snow on fields during winter months, and provide a wildlife habitat. In addition, various research efforts have indicated that such **tree belts across fields can greatly reduce evaporation losses** in conventional crops by hot dry winds **during the summer.** This helps to provide good crop yields during dry years, or to lower the demand on irrigation water and energy, where irrigation is used. Research also indicates that the value of the trees to field crops is more than offset by the land required by the trees. Of course, recommended varieties of trees should be used. Trees with primarily vertical root systems will be better than those with horizontal systems which will rob moisture from the field crops.

—Trees in rows across fields, called "field belts", can provide a variety of advantages. Soil erosion is reduced as well as evaporation losses caused by summer winds. Benefits can add up in the form of indirect energy savings.



## Home Energy [continued from page 50]

### Lighting and Appliances

Correct lighting levels should be used for the task. Dimmer switches may be helpful. Remember to turn off lights when not in use. Fluorescent lights are the most efficient.

**Heat from electric clothes dryers** can provide both heat and humidity to the home in the winter. A lint collector can be placed over the exhaust. Appliances with the best EER, Energy Efficiency Ratings, should be purchased.

For **refrigerators and freezers**, avoid placing warm dishes into these appliances, and keep containers covered. Maintain gaskets of doors in good condition. Defrosting should be done often; "frost-free" units consume more energy. "Multi-door" refrigerator-freezer combinations should be used rather than single door units. Condenser coils should be kept clean to allow efficient operation; and if heat released from the coils could be vented easily to the outside during the summer, it would lower heat build up inside the house. Chest freezers are less energy consumptive than upright types. Door opening, of course, should be minimized.

**Ovens can be turned off early in the baking cycle** to make use of "residual" heat. Combine baking tasks, perhaps the total meal. Pressure cookers can use as little as one-fourth the energy as other methods of cooking. Use lids on pans and minimize water. Use lowest possible heat settings. Avoid baking and cooking when air conditioner is used.



—Pumping farm water with wind can add to energy savings, even though pumping with electricity may seem to require little energy. Many farms have wind water pumping equipment available, which can be put back into service.

## More Information

### From the Energy Project

"**Home Energy Conservation Checklist**" is a 5-page list of suggestions covering such items as insulation, appliance use, lighting, windows, heating and more. Available for 50 cents.

"**Farm Energy Conservation Checklist**" is a 2-page checklist of conservation ideas for fuel handling, dairies, tractors, equipment, harvesting and more. Available for 25 cents.

"**Energy Conservation Bibliography**" is a 3-page annotated listing of books and various periodicals on saving energy in the home and on the farm. Price is 25 cents.

"**Project Focus**" includes #6 on heating with wood, #7 on heating water in the dairy, and #8 on composting farm manures. These three are especially useful for farm energy conservation. Available for 50 cents each.

"**Heat Exchangers for Livestock Barns**," SFEP Newsletter, March, 1979, page 10. A description of heat exchangers used in Minn. for various livestock barns to extract heat from exhaust ventilation air to pre-heat incoming cold air. 25 cents.

"**The Return to Ear Corn Harvest**," SFEP Newsletter, Sept., 1979, page 5. Floyd L. Herum, Ohio ag. engineer, indicates the reasons why he thinks harvesting corn in the ear is in the future. Available for 25 cents.

### Other Good References

"**What About Windows: A Report on Thermal Window Coverings With Six Design Options**", Center for Community Technology, 2909 Stevens St., Madison, Wis., \$1.25. Includes several designs for insulated shutters and shades. Used by Paul Phelps, Energy Project cooperator.

"**Small Farmer's Journal**", P.O. Box 197, Junction City, OR 97448, \$10/year for four issues. This publication features practical horse farming and a variety of other energy saving topics. Excellent.

"**Nebraska Energy Saving Manual**", Nebraska Energy Office, Box 95085, Lincoln, NE 68509. This publication is designed specifically for the home owner, covering such topics as insulation, water heating, furnace maintenance, and also some solar energy concepts. Other states have a similar publication. Available for 50 cents.

**Local Extension Service** offices also have fliers on various energy conservation topics.

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