ENERGY FACTS

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Energy Management for the Livestock Producer[1]

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Livestock production in Michigan uses over 430 billion British thermal units (Btu) of direct energy each year, equivalent to nearly 3.5 million gallons of gasoline. This figure does not include indirect energy inputs such as the energy required to make fertilizers and pesticides used in feed production. When the indirect energy inputs are added to the direct energy requirements, the energy input to output ratio of livestock production can be as high as 12 : 1 (useable calories of livestock products counted as output) (3). Though not a net energy producer, as are some agricultural crops such as corn, livestock production will continue to play an important role in Michigan agriculture as long as consumers demand meat products.

Average energy use for all Michigan livestock operations, including dairy, appears in Figure 1. Waste disposal requires the largest energy inputs, followed by feed handling and farm travel, which includes the farm automobile as well as trucks. However, this breakdown can vary widely depending on the type of livestock operation. For example, feed processing and distribution can account for almost 50% of the energy requirements for a beef cow-calf operation and as little as 10% for a hog-farrow to finish operation.

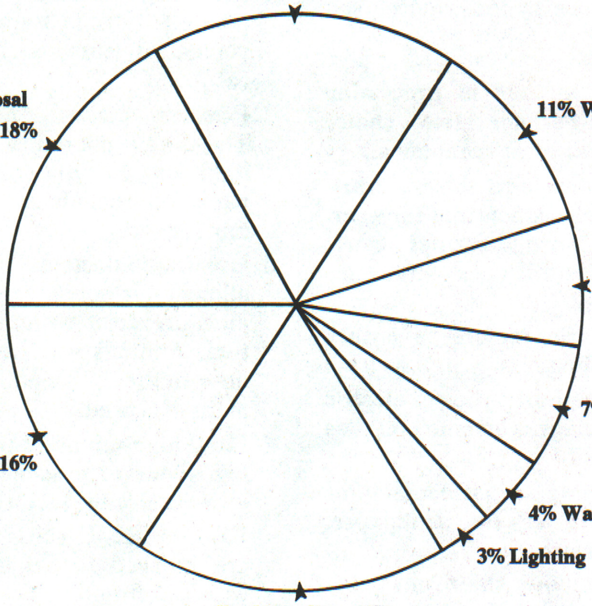

Fig. 1. Average Energy Use in Michigan Livestock Operations(2).

Table 1 illustrates the form in which the energy was used for all livestock operations. Gasoline is the most used energy source followed by electricity, diesel fuel and LP gas. Since it takes almost three units of primary energy (all energy sources in Table 1 except electricity) to make one unit of electricity, electrical equipment is ultimately the largest energy user.

Table 1. Percent of Total Energy Consumption of Various Energy Sources for Michigan Livestock Production

Energy Source	% of Total Supplied
Gasoline	40.3
Electricity	28.6
Diesel Fuel	17.6
LP gas	13.2
Natural gas	<1
Fuel oil	<1
Coal	<1

Source: (2)

Since energy prices are increasing rapidly, reducing energy waste and eliminating energy inefficient practices can make sound economic sense. Proper management techniques may reduce the energy requirements for livestock production by 20 percent. Some energy conser-

[1]Adapted from "A Guide to Energy Savings for the Livestock producer," (1977). (1) Federal Energy Administration and USDA, Washington D.C.

vation measures need little investment; others require major changes in management and considerable dollars.

Grinding and Preparing Feed

Grinding and preparing feed may require substantial electrical energy. An electric-powered hammer mill equipped with a 5 horsepower motor requires 3.75 horsepower-hours (2.8 KWH) per ton of corn processed. A roller with a 5 horsepower motor requires 1.5 horsepower-hours (1.1 KWH) per ton of corn processed. Grinding dry shelled corn at a high rate with a tractor-powered hammer requires 350 gallons of diesel fuel for every 20,000 bushels of corn (6.7 KWH/T).

To reduce energy for grinding you can:

1 **Select the method of processing carefully. Perhaps free choice feeding is the most economical.**

2 **Keep grinders and mixers lubricated and check bearings for wear.** Dry and worn bearings cause operating inefficiencies and use more energy.

3 **Clean electric motors to ensure proper cooling.**

4 **Avoid overlubricating electric motor bearings.** Too much oil is as bad as too little.

5 **Clean starting switch contacts or brushes with very fine sandpaper, not emery cloth.**

6 **Be sure the motor shaft runs freely to prevent overheating.**

7 **Keep belts properly tightened and aligned.**

8 **Use three-phase service when possible.** When expanding or purchasing new equipment, talk to the power supplier about obtaining three-phase current for part of the farm's operation. Three-phase electric motors are more efficient and inexpensive than single-phase electric motors.

9 **Consider not grinding at all.** If corn is a major portion of the ration, grinding shelled dry corn does not increase its efficiency as a cattle feed over whole grain. There may be a 5-8 percent efficiency loss for swine, however.

Grain Drying

Corn harvest usually begins when grain moisture is 28 to 30 percent. By the end of the harvest season, the moisture of corn in the field is usually around 18 percent. Harvested corn usually averages 23 percent moisture content. Corn to be sold at harvest must be dried to 15.5 percent moisture or sold at a discount. To be stored on the farm, it is normally dried to 13 to 15.5 percent moisture depending on how long it will be stored. Usually, 8 to 10 percentage points of moisture are removed from corn during the drying process.

To save grain drying energy you can:

1 **Feed high moisture corn when possible.** Corn containing 24 to 30 percent moisture is good for beef cattle.

2 **Preserve through fermentation.** The storage container must be airtight or the material must be packed to exclude air, as done in a bunker silo.

3 **Use propionic acid.** Propionic acid allows preservation of high moisture corn without fermentation. Animals will gain the same no matter which preserving method is used.

4 **Limit high-temperature batch drying whenever possible.** Place feed into wet storage facilities.

EXAMPLE: If 110 steer calves are finished to slaughter weight with 6,300 bu. of No. 2 dry corn, equivalent to 7,194 bu. of 26% moisture corn, then about 1,300 gal. of LP gas and 1,000 KWH of electricity are needed to dry this corn to 15.5% moisture using a medium capacity high-temperature batch or continuous dryer. By not drying the 7,194 bu. of corn, the savings at $.50 gal. of LP is $650/yr. and at 5 cents/KWH, the savings is $50/yr., for a total savings of $700/yr.

5 **Consider a delayed harvest.** The longer a crop stands in the field, the greater the loss to bad weather, but by delaying harvest for a week or 10 days, you could harvest 25 instead of 30 percent moisture corn.

6 **Consider partial grain drying.** This takes longer, but using partially heated air followed by natural air drying cuts fuel needs in half.

7 **Use dryeration.** Dryeration is a combination of partial drying in a high-temperature dryer followed by slow cooling in a separate bin. Dryeration can increase dryer capacity, reduce energy use, and improve grain quality.

Ventilation and Supplemental Heat

Naturally ventilated cold barns are recommended for beef housing and fattening hogs since you can completely eliminate the energy requirements for ventilation and supplemental heat. Animals will require additional food energy to offset the greater body heat losses, but studies show that livestock not only survive, but produce as well in cold housing as in warm housing. Proper construction and management techniques are extremely important. Consult your local Cooperative Extension agent for the latest information.

Swine farrowing buildings do require mechanical ventilation and supplemental heat but proper planning and management can keep this energy requirement at a minimum.

1 **If ventilation is used in the barn, insulate where possible.** Heat helps remove moisture from the barn. In the winter, excessive heat loss through the walls and roof can cause moisture condensation. Check with your Extension agent to determine the break-even point between the costs of additional insulation and a lower energy bill.

Example: A 40-crate (26 x 120 ft) uninsulated farrowing house requires nearly twice as much heating and cooling as a properly insulated one. Heating an uninsulated farrowing house consumes about 2,400 gal. of LP gas during a typical winter plus 5,800 KWH of electricity for electrical heaters. Adequate ventilation could take as much as 34,000 KWH. Adding insulation to cut gas and electricity costs in half will save 19,900 KWH and 1,200 gal. of LP gas. At 5 cents/KWH and $0.50/gal for LP gas, the savings for electricity and gas are about $1,000 and $600, respectively, for each year.

2 **Consider a three-step fan control system.** Fans with a single thermostatic control system can result in large energy waste. Ideally, the fans should be humidistatically controlled to keep the relative humidity between 50-80%, but unfortunately, a reliable and practical humidistat fan control for livestock housing does not exist. A three-step fan control system can approach a humidistatic control, however. One small fan designed to provide minimum wintertime ventilation is operated continuously. A second somewhat larger fan provides additional ventilation for intermediate temperatures. A third larger fan is used for summer ventilation when the inside air must be exchanged nearly every minute. Consult your county agent for further details.

3 **Select ventilation fans on their AMCA certified ability to deliver air against the house resistance and accessory equipment to be installed.** Generally, they should be rated at 1/10 or 1/8 inch static pressure with free air delivery. Never buy on the basis of fan diameter or motor size alone. Two fans with the same diameter, and even made by the same company, may have entirely different rates of air delivery because of internal design.

4 **Choose direct fan motors of the split-phase or capacitor type.** Direct drive motors generally need less maintenance and have less power transmission loss than belt-driven units.

5 **Operate fans only when necessary, not continually.**

6 **Operate fan switches manually in the summer if animals are pastured or fed outside.** Turn off ventilation fans when animals are outside. Continuous summer operation wastes energy and draws air from outside into the barn. You may want to keep one fan on for young stock or a sick animal in the barn.

7 **Check and oil fan motors regularly.**

8 **Do not use resistance element multispeed fan motors.** They draw the same current operating at low or high speed.

9 **Check and clean all heating systems.**

10 **Turn off the heating system in the summer by shutting off the gas line valve leading to the space heater.**

Table 2. Lighting Chart

Type of lamp	Size by watts	Average output in lumens	Approximate lumens per watt[1]	Average hours of life[2]
Standard incandescent	25	225	9	
	40	480	11	
	60	810	14	750
	100	1,600	16	to
	150	2,500	17	1,000
	200	3,500	18	
	300	5,490	18	
Standard florescent	15	660	34	
	20	1,000	40	
	40	3,200	66	18,000
	60	4,080	68	
	75	5,475	78	
Mercury vapor	75	2,800	40	
	100	3,800	40	
	175	7,500	40	24,000
	250	11,600	45	
	400	21,000	50	
	700	39,000	50	
Metal halide	175	12,000	65	
	400	34,000	80	18,000
	1,000	95,000	90	
High pressure sodium	250	25,000	80	
	400	47,000	160	20,000
	1,000	130,000	110	

[1]Includes the power requirements for the ballast when appropriate.

[2]These hours vary; check the specifications on the package. "Long-life" incandescent bulbs are available in the range of 3,500 hours, but they deliver fewer lumens per watt.

Lighting

Lighting accounts for about 2 percent of a typical livestock operation's total energy requirement. However, expensive electrical usage can sometimes be cut in half with proper conservation methods. For example, one 110-watt bulb left on overnight (12 hr.) consumes 1.3 KWH. This could add $20 a year to the average bill. Also, a 16 percent energy savings is possible using a 100-watt incandescent bulb for two 60-watt bulbs.

Sometimes, extended-life lamps are more economical, though the lumen output is 10 to 15 percent less. Before changing lighting, however, walk around facilities, both indoors and outdoors, noting over or underlighted areas. An individual evaluation of the light needed may be adequate. To be more accurate, use a light meter to match the amount of light provided to tasks performed in a particular area. Hold the light meter 30 inches from the wall and 30 inches from the floor to obtain the correct reading. Light from old bulbs will be weak, giving an inaccurate indication of the light level when new bulbs are installed.

To reduce energy for lighting:

1 **Use florescent, rather than incandescent, bulbs where possible indoors.** They provide about 4 times more light per unit of energy as incandescent bulbs (Table 2).

EXAMPLE: Six 100-watt incandescent bulbs put out the same light (9,600 lumens) as three 40-watt florescent bulbs. The electricity to power the incandescent bulbs for 6 hr/day costs about $52/yr, compared with $13/yr for the florescent. In this case, changing from incandescent to florescent bulbs leads to an electric savings of $39/yr.

2 **Consider mercury vapor, metal halide or high pressure sodium lamps for large outdoor areas.** A mercury vapor lamp provides more than twice as much light per watt as do standard incandescents; a metal halide lamp provides 4 times as much and a high pressure sodium lamp, 5 times as much light (Table 1). However, these lights require 3 to 10 minutes start-up time.

3 **Clean light fixtures.** A clean 25-watt bulb with a clean reflector has the same light intensity as a clean 40-watt bulb with no reflector or a dirty 60-watt bulb with no reflector!

4 **Eliminate unnecessary lights.**

5 **When removing a florescent lamp, disconnect the primary side of the ballast.** The ballast draws energy even after the bulb is removed.

6 **Replace dim or fading florescent bulbs.** Their efficiency is decreasing rapidly.

Additional Information

The following selected publications (free) offer helpful suggestions for energy conservation in livestock production. Consult your local extension agent for a complete publications list.

Reducing Energy Requirements for Harvesting, Drying, and Storing Grain. Extension Bulletin E-1168, Michigan State University, East Lansing. 1974.

Grain Drying Methods. AEIS 393. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Operating a Low Temperature Drying System. AEIS 404. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Operating a Dryeration System. AEIS 405, Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Combination Drying Systems. AEIS 406. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

What Type of Grian Storage? AEIS 417. Agricultural Engineering Department, Michigan State University, East Lansing. 1980.

Principles of Grain Storage. AEIS 418. Agricultural Engineering Department, Michigan State University, East Lansing. 1980.

Grain Center Safety. AEIS 425. Agricultural Engineering Department, Michigan State University, East Lansing. 1980.

Energy Utilization in Grain Drying —Crop Residues. AEIS 436. Agricultural Engineering Department, East Lansing. 1980.

Crop Residue Availability for Fuel. AEIS 440. Agricultural Engineering Department, Michigan State University, East Lansing. 1980.

Swine Waste Handling Systems. AEIS 412. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Milk Heat Recovery. AEIS 490. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Ventilation of Warm Housing for Calves. AEIS 367. Agricultural Engineering Department, Michigan State University, East Lansing. 1977.

Anaerobic Digestion of Livestock Wastes into Methane Gas. AEIS 403. Agricultural Engineering Department, Michigan State University, East Lansing. 1979.

Energy Management for Field Crop Production. Extension Bulletin E-1407. Michigan State University, East Lansing. 1980.

Energy Management for Dairy Operators. Extension Bulletin E-1273. Michigan State University, East Lansing. 1979.

References

1. "A Guide to Energy Savings for the Livestock Producer," Federal Energy Administration and USDA, 1977.
2. "Energy and U.S. Agriculture: 1974 and 1978," USDA, 1980. Statistical Bulletin No. 632.
3. Lockeretz, W., 1977. Agriculture and Energy. Academic Press, Inc. 111 Fifth Ave., New York, New York.

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