ENERGY FACTS

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Energy Management for Egg Production

The fuel energy consumption for egg production consists mainly of electrical energy for mechanical ventilation, lighting, egg cooling and materials handling. Egg laying houses in Michigan traditionally do not use supplemental heat, therefore no fossil fuel energy is used for house heating. Egg production houses (5,000 or more caged layers), that are well-insulated, windowless and have properly designed and controlled ventilation systems can be maintained at from 55 to 60°F throughout the winter without supplemental heat. Additional feed efficiency is possible with higher house temperatures, but so far the cost of fuel has not justified supplemental heating.

Mechanical ventilation annually accounts for nearly two-thirds of the electrical energy requirement for egg production (see Fig. 1). Most of the energy for fan operation is needed during the summer months. A 10,000-bird laying house used a total of 35,168 kw hours of electricity during one year in Michigan. At a charge of 5 cents per kwh, each bird had an energy cost of $3.62 \times .05 = \$0.18$ per year.

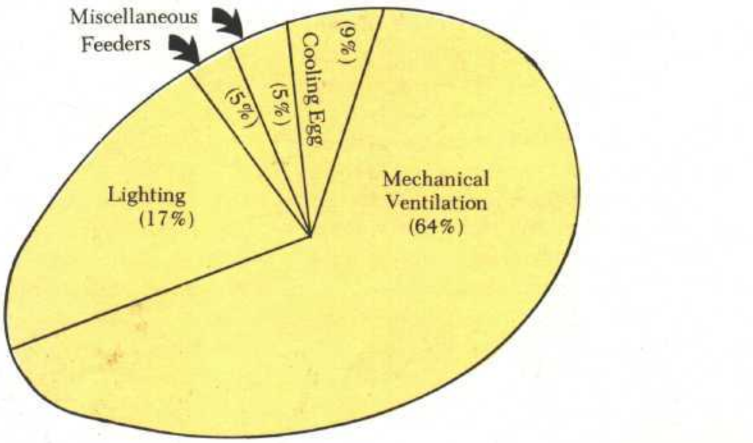

Fig. 1. Egg Production Energy Use

Natural Summer Ventilation

Three quarters of the electrical energy required for mechanical fan ventilation is used during the warmest six months of the year. This is nearly half of the total electrical requirement for the total operation of the poultry laying house. Eliminating summer mechanical fan ventilation with a satisfactory natural ventilation system could cut energy consumption in half. That represents a savings of \$900 per year for the example 10,000-bird house. This significant savings justifies opening the building during the summer months for natural ventilation. This can be done by installing 4 ft x 8 ft insulated panel openings 8 ft apart, along both side walls. The panel openings should be pivoted on the horizontal axis, easily adjusted as to amount of opening and screened to keep out wild birds. They should also be well-insulated and tight-fitting for winter.

Pullet Growing Energy Management

The total amount of energy required to grow a 20-week-old pullet is considerably more than the amount required to maintain a laying hen for a year. For pullet growing, 71 percent of the energy used is for brooding (Fig. 2), and the type of energy used is different. A few houses are electrically heated but most use fuel oil, LP or natural gas.

Brooding Management

Because heat used during brooding consumes over 71 percent of the energy

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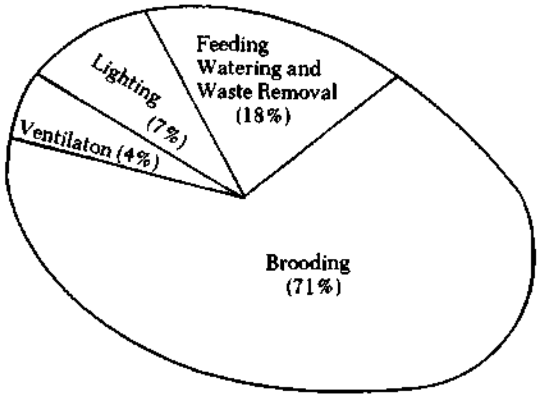

Fig. 2. Energy use by function for pullet growing.

used for pullet production, brooding management and maintenance demands close attention. The reduction of brooding energy costs will have a significant payoff.

1. Brood the maximum number of chicks feasible per brooder. Brooder capacity can be increased 10 to 20 percent by clustering the brooders in groups of three or four and using a single brooder guard per cluster.

2. Start and maintain chicks on dry litter (20 to 30 percent moisture content). Dry litter absorbs moisture and thereby reduces evaporation which requires energy.

3. Set up solid brooder guards. Guards made of materials such as sheet metal or corrugated paper help hold in the heat as well as the chicks.

4. Brood at the lowest temperature consistent with bird comfort. A starting temperature of 85° is acceptable for most conditions. Reducing the brooding temperature by 2 to 3°F every 3 to 4 days instead of 5°F every week can save money. Remember that during the first week the chick's ability to regulate body temperature has not yet been developed. During this early stage, proper environmental temperature is critical for survival.

5. Start layer replacement chicks in the top deck in cage houses. The room temperature is higher near the ceiling.

6. Examine brooder gas lines and hoses for leaks before each brood.

7. Maintain gas line pressure at an 11-in column of water equivalent.

8. Be sure pilot lights are adjusted according to the manufacturer's specifications.

9. Keep the burner orifice on the brooder clean. Use a reaming needle of proper size so as not to alter the size of the orifice.

10. Check brooder thermostats frequently for accuracy to avoid wasting fuel and causing chick stress.

11. Use partial house brooding if possible. This system provides a more uniform brooding temperature, minimizes drafts, and gives growers more time between flocks to set up other house sections. Use 4-mil polyethylene curtains to partition off the middle of the house when brooding begins. Place day-old chicks in the center of the building at twice the normal number per brooder. Maintain the full number of feeder lids and waterers. Position equipment before chicks arrive since equipment changes will be difficult later. Remove curtains after three weeks to distribute chicks throughout the house and to eliminate litter caking and feeding problems. Caution: water may freeze during cold weather unless one brooder in each end of the house remains on at a low setting.

Laying House Ventilation Management

1. Design and control the ventilation system to use a minimum of air exchange both summer and winter. Excess air exchange wastes heat from the house during cold weather and wastes electrical energy for fans during hot weather.

2. Select poultry-house fans on their AMCA certified ability to deliver air against the house air flow resistance and accessory fan equipment. Generally, the fans should be selected to deliver the specified amount of ventilation against 1/10-in static pressure. Never buy fans on the basis of diameter or motor size alone. Two fans with the same diameter, and made by the same company, may have entirely different air delivery characteristics because of blade design and other performance characteristics.

3. Choose direct drive fans with split phase or capacitor type motors. Direct drive fans generally require less maintenance and involve less power transmission loss than belt driven units.

4. Motors should be totally enclosed (dust tight), have built in overload protection, low starting current, and a high power factor. If a fan is to be used in a vertical location, both it and the motor should have permanently lubricated ball bearings. Both should be made of heavy-gauge metal with tough weather and corrosion-resistant finish. The ease of maintaining and cleaning blades and shutters should be considered; and fans should have guards for protection.

5. Check with the manufacturer before purchasing an electronic speed controller for an existing ventilation system. This device is recommended only on direct drive fans because excessive slippage can occur on belt driven units at low speeds.

6. Plan the ventilation system for an outside design temperature of 20°F. This is approximately the average temperature for the coldest month of the year in Michigan.

7. Select a fan system with the capability of a minimum of ¼ cfm (cubic feet per minute) per bird (0.06 cfm per lb.) for extreme cold weather (0°F or below); and a maximum of 6 cfm per bird (1.50 per lb.) for hot weather (85°F and above).

8. When comparing initial costs of fans, be sure the units are comparable. Check air delivery rates (cfm) at similar static pressures. Cost of operation should be compared in cfm per watt or per 100 watts. *Example:* Two different fans both have a capacity of 3,000 cfm at 1/10-in static pressure. Fan A has an output of 5.84 cfm/watt and costs $133 while fan B costs $169 but has an output of 9.45 cfm/watt. If the fans are operated at their rated capacity one half of the time for 3 months, (360 hr/month) then fan A requires 555 kwh (360 hr/month × 3 months/5.84 cfm × 3,000 cfm/1,000 watt = 555 kwh) while fan B requires 343 kwh (360

hr/month × 3 months/9.45 cfm × 3,000 cfm/1,000 watt = 343 kwh). At 5 cents/kwh, fan A costs $28 to operate while fan B costs $17, a difference of $11 ($28-$17). Over 10 years, the approximate life of the fans, fan B costs at least $110 less to operate than fan A. So, even though fan A appeared to be the better buy at first, costing $36 less than fan B, it turns out to be more expensive in the long run.

9. The single-speed, constant output fan is the least expensive and, more importantly, delivers the maximum amount of air at the highest efficiency. The cost of air delivery is greater at all speeds (particularly lower speeds) other than the optimum performance speed. Egg production houses with 1,000 laying hens or more do not normally need variable output nor two-speed fans. However, brooder houses in which temperature control is more critical and the amount of air needed is very low at times must have some variable output on two-speed fans.

10. Clean fan blades and shutters regularly (at least weekly).

11. The slot inlet openings must be carefully designed and controlled. If the slot openings are too narrow at any time they choke the ventilation system down and cause the fans to operate needlessly against high resistances and pressure differences. This is particularly true during hot weather when all fans may be operating and a maximum amount of air exchange is necessary. Design slot openings to allow the required volume of ventilation air exchange at a velocity of 600 ft/min. During cold weather, the prescribed operating ventilation rate is ½ cfm per bird and during hot weather, 6 cfm per bird. For example, for summer operation a 200 ft long slot for a 10,000 bird house should have 10,000 × 6 cfm divided by 600 ft/min = 100 sq ft of slot opening. This would then be a 6 inch wide slot for the 200 ft house. During cold weather, only 1/12th the amount of air is needed which would be a ½-in slot opening. Automatically operated slot ventilators are available which are activated by the pressure differential in the house. The activated systems eliminate the necessity of manually adjusting the slot openings, and assure that they are adjusted at the right time.

House Insulation

Layer or brooder houses should have insulation equivalent to an R-value = 24 in the ceilings and an R = 16 in the side walls. Adequate insulation makes it possible to maintain a higher environmental house temperature during cold weather with heat from the birds, thus providing a better feed conversion efficiency. (Research indicates that every 2°F warmer house temperature, between 54° and 80°F, provides about 1 percent better feed conversion.) Ample insulation, particularly in the ceiling, during hot weather reduces the influx of solar heat from the attic and cuts down on the amount of fan operation needed. Installation and operation of a fan in the gable end of the attic (above the ceiling) to exhaust the hot air during hot clear days, will more than pay for its cost in helping maintain a lower in-house temperature (see Table 1 for R-value ratings of insulation materials).

Lighting

Lighting accounts for 17 percent of the electrical use in a typical egg production house, and 7 percent in a pullet growing house (Fig. 1 and 2). Electrical requirements can be reduced by turning off unnecessary lights, using the right bulbs and keeping bulbs and reflecters clean. For example, four additional 60-watt bulbs—needed only for the caretaker to adequately care for the birds—will consume 3.6 kwh/day during the lighting period (14 hr/day). This can add $66 a year to the electricity bill. Sometimes, extended life lamps are more economical even though the lumen output is 10 to 15 percent less. Before changing lighting, get a light meter and check the amount of light projected at the level of the birds' eyes.

Recommendations for reducing energy consumption for lighting include:

1. Use soft white fluorescent bulbs instead of incandescent. Fluorescent lamps have a higher light output per unit of energy than incandescent bulbs. *Example:* Fifty-six 25-watt incandescent bulbs for a 10,000 bird laying house can be replaced by the same number of 15-watt fluorescent bulbs. The electricity to power the incandescent bulbs for 14 hours a day would cost $357/yr (at 5 cents/kwh) compared with $214/yr for the fluorescent. In a 10,000 laying house, changing from incandescent to fluorescent would lead to an electricity savings of $143/yr.

Table 1. R-values for common insulation materials.

Material	*R-value**
Plywood ½ in. (34#/cu ft)	0.6
Wood — fir or pine sheathing 25/32 in	1.0
Asbestos — cement board 1/8 in	0.03
Gypsum or plaster lath ½ in (50#/cu ft)	0.5
Wood fiber board 1 in (31#/cu ft)	2.0
Mineral wool blanket, fibrous form, processed from rock, slag or glass, 1 in	3.6
Expanded polystyrene (molded) 1 in (1.0–1.25#/cu ft)	4.0
Expanded polystyrene (extruded) 1 in (1.8#/cu ft)	3.5
Urethane, closed cell, rigid, 1 in (1.5–3.0#/cu ft)	6.0
Mineral wool, fill type, 1 in (2.0–5.0#/cu ft)	3.5
Vermiculite (expanded) 1 in (7.0#/cu ft)	2.0
Concrete, stone aggregate, 1 in (140#/cu ft)	0.1
Concrete blocks, stone aggregate, 8 in	1.0
Air space ¾ to 4 in	1.0
Air space with one reflective surface	2.0
Outside surface film (15 mph wind)	0.17
Inside surface film	0.68

**The higher the R-value, the better the insulation value.*

2. A more efficient use of light at the level of birds' eyes can be obtained when every other row of bulbs are staggered. *Example:* In houses with 5 rows of bulbs, the 2nd and 4th row bulbs should be located half-way between the 1st, 3rd and 5th row bulbs. One foot candle of light is necessary at the level of the birds' eyes, while 3- 5-foot candle intensity is required for the caretaker to adequately care for the birds. Thus, extra light for the caretaker must be turned off when the caretaker leaves the house.

3. A clean reflector will increase the light intensity at bird level by about 50 percent compared with no reflector. Avoid inverted cone-shaped reflectors. They confine the light rays to a small area. Use flat-type or saucer-type reflectors with a rounded edge. When reflectors are used, the pitch of the reflector

will determine the area illuminated. Reflectors should be about 10-12 in. in diameter.

4. Very dusty bulbs emit about one-third less light than clean bulbs. The following indicates equivalent light intensities:

Type of bulb	Equivalent light intensity
Clean bulb, clean reflector	25 watt bulb
Clean bulb, no reflector	15 watt bulb
Dirty bulb, dirty reflector	15 watt bulb
Dirty bulb, no reflector	10 watt bulb

Light bulbs should be cleaned every two weeks under normal circumstances, and more often if necessary.

5. Mercury vapor lamps may be used in poultry houses. A mercury vapor lamp provides more than twice as much light per watt as do standard incandescents (see Table 2).

6. Replace dim or fading fluorescent bulbs. Their efficiency decreases rapidly.

Table 2. Lighting chart.[1]

Type of lamp	*Size by watts*	*Average output in lumens*	*Approximate lumens per watt*[2]	*Average hours of life*[3]
Standard incandescent	25	225	9	
	40	480	11	
	60	810	14	
	100	1,600	16	750 to
	150	2,500	17	1,000
	200	3,500	18	
	300	5,490	18	
Standard fluorescent	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] *Care must be taken to provide equal distribution of one foot candle or light at bird level regardless of type of lamp.*

[2] *Includes the power requirement for the ballast when appropriate.*

[3] *These hours vary, and you should check the specifications on the package. "Long-life" incandescent bulbs are available in the range of 3,500 hours, but they deliver 10-15 percent fewer lumens per watt.*

Egg Cooling

Egg cooling may require about 7 percent of the energy used in egg production. While this percentage is not a major share, egg cooling deserves close attention. Electricity costs 3 to 4 times as much as an equivalent amount of energy from other fuels, such as LP gas and diesel fuel. Poultrymen use refrigeration systems to cool the egg room. The amount of refrigeration capacity varies with the area to be cooled, the amount of insulation, the outside temperature, and the egg production. The following calculations will provide the refrigerator capacity necessary for the egg cooler:

	BTU heat removal per hour
1. Floor area in sq ft times 3.75	______
2. Wall plus ceiling area in sq ft times 5.00.	______
3. Number of dozens of eggs cooled per day times 10.50.	______
4. Miscellaneous: cooler fan motor and lights (add 35 BTU for each 10 sq ft of floor space).	______
5. Total BTU required.	______

Also, as with other equipment, you must follow operating recommendations:

1. Check and oil the electric motor regularly.
2. Check the alignment and tightness of the fan belts.
3. Clean the screen covering the vent outlet.
4. Make sure the compressor head is adequately ventilated. Do not restrict the air flow—the condensing unit should be at least 18 inches from the wall.
5. Keep condenser coil clean.
6. Egg pick-up program—If you are running a large laying house, you may reduce the cooler room size by one-half if the pickup is once every four days instead of every eight days.

Material Handling

Feeds, egg collection, water and manure handling account for about 10 percent (Fig. 1) of the total energy on the average egg production farm.

1. Electric cost for feeders is about 5 percent of your total electric bill (Fig. 1). All the instructions for fan motors should be followed for the maintenance of feed conveyor motors. Otherwise the efficiency of the motors decrease and adds dollars to the electrical bill. Also it is necessary to check the feeder chains regularly for wear and tension.

2. Egg conveyor motor sizes depend mainly on the length of the conveyor. Motors must be checked, oiled, aligned and cleaned regularly.

3. The cost of electricity for water may be quite minimal but possible savings should not be overlooked.

4. There are various methods of removing manure from the poultry house. If your method involves mechanical equipment (mechanical scraper) to remove the droppings from the pit, the heavy motor requires considerable cost as well as electricity so should be regularly aligned, cleaned and lubricated.

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