

IMPROVING ENERGY USE EFFICIENCY - REDUCING AND REFINING THE USE OF ENERGY INPUTS ON FARM

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INTRODUCTION

There are three main energy consumers on most swine farm: heating, ventilation and lighting. Another load that will be large is on-farm feed mills. This presentation will focus on the main areas and describe techniques for determining how energy efficient a farm is and methods to achieve optimum energy efficiency.

THE VALUE OF AN ENERGY AUDIT

Over the last several years, OMAFRA has worked with Agviro to develop an energy audit program. Over this time period, about 100 farms have received an audit. At the same time, other organizations including Natural Resources Canada, Enbridge Gas Distribution, Union Gas, as well as many local Electrical Utilities have all been providing partial funding for energy audits.

What is an Energy Audit?

An energy audit is defined as a “series of actions aimed at the identification and evaluation of energy management opportunities within a defined site.” The energy audit is a systematic approach for the farm operator to examine the current energy consumption and identify some alternatives for reducing energy costs. The first step in reducing the energy usage rate is to know how energy is used. The goals of an energy audit are as follows:

- To clearly identify the different types of energy use.
- To understand how this energy is being used.
- To identify alternatives that could reduce energy costs.
- To develop an implementation strategy, based upon an economic analysis of the alternatives, that is cost effective to the farm owner/manager.

The end result of an energy audit is to identify “energy management opportunities” (EMOs). EMO’s can be analyzed, implemented and then monitored as part of the farm’s energy reduction strategy.

What are the Benefits?

The immediate benefit to the farmer of conducting an energy audit is the knowledge that an organized audit brings to the farmer. Once this knowledge is imparted, the farmer can make cost

effective decisions that can be translated into a more efficient operation. The implementation of many EMOs is related to good maintenance practices that have the added benefits of decreasing other operating costs. The benefits to the farmer of improving farm energy efficiency are as follows:

- the opportunity for on-going substantial monetary savings
- a better understanding of the operating cost of production
- the possible reduction of nuisance breakdowns and emergency repairs
- an improved operating environment

Energy not used results in instantaneous cost savings now and into the future. Energy not used is cost savings shielded from future rate increases. Energy not used is stand-by and back-up energy capacity not required.

How to Conduct an Audit?

An energy audit need not be a complicated process. In general the audit process can be divided into nine general principles:

1. Define the study boundaries and prepare for the audit

Decide what part (or all) of the farm operation that is to be audited. Assemble the necessary equipment (checklists, tape measures, meters, etc.).

2. Gather site energy documentation

Put together a full year's worth of energy bills. This should include not just electricity bills but also propane, natural gas, tractor fuel and any other energy input to the farm operation.

3. Perform the "walk through" audit

This is the first audit of the farm operation. Carefully note all lighting, motors and heating arrangements and their energy use. Take note of energy use patterns.

4. Perform preliminary analysis

Review both the billing data and the walk-through audit information collected. Try to match the estimated energy used as observed with what is being billed. Take note of those areas that consume the most energy. Take advantage of any available energy audit checklists/templates and energy audit software available commercially or through your local OMAFRA office.

5. Identify "energy management opportunities" (EMOs)

Based upon the preliminary analysis, list those areas where the implementation of a change would result in an improvement of energy efficiency. These are your energy management opportunities (EMOs).

6. Perform "diagnostic audit"

Return to the EMOs for more detailed consideration. At this point, if the walk-through audit is showing some serious opportunity for savings, a closer look at energy use patterns and technology options may be advantageous. The use of metering and data logger to track "real" trends may be incorporated. The services of an energy professional may also prove beneficial.

7. Analyze EMOs and make recommendations

Analysis of the results of the diagnostic audit in addition to the information already collected from the walk-through audit should be performed to determine the true extent of each energy management opportunity. The end result of this step is a set of recommendations and a plan for implementation that has been based upon careful data analysis, cost/benefit analysis and review of alternate options.

8. Implement recommendations

Implementing the carefully considered recommendations developed is essential for taking advantage of any energy savings.

9. Perform “Monitoring and Targeting” (M&T) activities

An on-going energy auditing program is a prudent practice for understanding and taking advantage of developments to energy savings on farm operations. The initial audit can act as the “benchmark” against which continuous improvements can be monitored and tracked. The farmer may target new energy efficiency goals subsequent to each audit review.

Should I Do It Myself or Contract Out?

Whether or not the farm manager/operator conducts a self assessment or sub-contracts a more detailed audit to an energy expert is an individual choice dependent upon the farmer. An initial self assessment, such as the “walk through audit” discussed above, may reveal some obvious EMO’s that can be easily implemented. A more detailed or diagnostic audit performed by a third-party energy expert may provide access to more sophisticated approaches, equipment and improvement strategies that could significantly benefit the farm operation.

What are the Costs?

The energy audit, particularly the walk-through audit, is a data collection and analysis process. No special equipment or capital expenditure is required. The initial self assessment is the cost of labour and time to the operator with some possible expenses for instrumentation such as voltmeters, wattmeters, light meters, leak detectors and airflow measuring devices. Access to a computer and the cost of some basic energy auditing software may be a worthwhile investment. A more detailed audit replete with cost/benefit recommendations may cost \$200-\$500 if performed by a local energy specialist or Professional Engineer versant in energy auditing issues.

Is there Funding Assistance Available?

Currently there is no financial assistance available to the agricultural community for energy auditing activities. The return on investment of an energy audit is, however, extremely attractive. In addition to the many benefits discussed above, energy savings resulting from a thorough knowledge of farm operation make the implementation of at least a “walk through audit” an essential and prudent farm practice.

There are a number of incentives for both new and retrofit building projects. These include, but are not limited to:

- Your electricity company
 - New facilities through the High Performance New Construction Program (HPNC)
 - Existing facilities through Electricity Retrofit Incentive Program (ERIP) or similar type programs
- Enbridge and Union gas, if you have natural gas supplied from them
- Natural Resources Canada (NRCan)

After the Audit, What Next?

Completing an energy audit on even a part of your farm operation is the first step in developing a long term habit and vision of energy efficiency for the farm. Identifying significant EMOs, performing a diagnostic audit and following through with implementation recommendations will result in a more cost efficient farm operation. This energy knowledge will also assist the manager in making a wide assortment of critical decisions from current production adjustments to large expansion projects. Energy auditing should be an on-going practice. Careful documentation and analysis of energy use on a continuous basis will provide the farm manager with a “benchmark” against which to monitor and target continuous improvement activities. Finally, the knowledge gained from an energy audit can assist the farmer in making strategic decisions when considering renewable energy options.

ENERGY BENCHMARKING

Conducting an energy benchmarking analysis on the farm is a natural first step to understanding how you compare to other similar types of operations. Although there are many issues that make it difficult to ensure that each farm is being analyzed exactly the same way, it still provides some eye opening data. Some things that make it harder to directly compare include: house on the same meter as the barns; and an on-site feed mill, also on the same metering.

Agviro, with the Ag Energy Cooperative, has developed interactive, internet based energy benchmarking software at www.energybenchmark.com. This software allows users to input their own relevant energy and production data; and make exclusions of houses and feed mills to make the comparisons closer to other facilities.

Data so far has been quite dramatic (see Table 1). For example, the difference from the low to the high in the case of Farrow-Finish farms is from 11-44 kWh/sow/year, a difference of 4 times.

Average savings per farm have been in the \$2300/year. Note that this is for all farm sizes, and smaller farms have lower savings potential. The highest savings achieved was \$28,000 per year, with an average payback of less than one year.

Table 1. Energy benchmarking data from audited farms.

Swine	Farrow	Farrow-Finish	Farrow-Nursery	Finish	Nursery	Nursery-Finish
	kWh/sow	kWh/100 kg	kWh/100 kg	kWh/100 kg	kWh/100 kg	kWh/100 kg
kWh Max	338	44	136	17	19	16
kWh Av	296	31	91	12	14	16
kWh Min	254	11	46	9	12	16

Main Opportunities

There have been a number of identified technologies to save energy costs on swine farms. The main list is as follows:

1. Lighting

The main opportunities for lighting involve conversion to fluorescent systems. The temptation to install compact fluorescent has always been high, due to their low cost and easy retrofit. However, where lights are used for more than 6 hours/day, the longer lasting T8 4 ft tube fluorescent systems, in vapour tight housing, are a longer lasting, more economical and reliable system. These are best installed when doing major upgrades or building new.

2. Insulation, Air Sealing and Leaks

Insulation, properly installed and maintained, provides many benefits that simply cannot be over-emphasized: Reduce supplemental heat requirements, reduce radiation effects in summer, and extended building life.

Many barns as they age will develop leaks (and even new ones may not be properly sealed). Leaks mean the ventilation system will not direct air in where it should, disrupting air patterns and creating large variations in temperature and air quality. Smoking the barn for leaks and sealing with a good quality, long lasting silicone such as GE will be well worth the effort.

3. Ventilation: Dual; EE Fans

Where possible, dual ventilation (fans for colder weather and natural for summer) should be considered for grow, finish and breed/gestation barns. Electrical costs for fan systems will be reduced by up to 80% and reliance on the grip in hot weather is eliminated, also reducing generator size requirements.

Energy efficient fans should also be selected when renovating, replacing or building new. In many cases, a grant towards the cost is available. Check with the sales rep or your local utility for eligible products, or visit the web site: www.powerauthority.on.ca

4. Cooling: Water Based, Ceramics

Cooling has become more of an issue over the last 20 years. Water is the lowest cost method of providing relief from hot temperatures. There are a number of systems, with the lowest cost and simplest known a sprinkler system, to more complex high pressure mist and evaporative cooling

pads. Where major renovations are required on roof systems, the retrofitting of ceramic paint is a viable option to reduce attic heating. Ceramic paint reflects the sun's infrared rays away, and keeps attics at or close to ambient.

5. Heating

Heating is often the highest energy consumer on the farm but the use of natural gas, propane and oil keeps the costs significantly lower than if electricity were used. There are many different opportunities in the heat area:

- i) Creep heat systems can use higher efficiency 175 W Retrolite heat lamps with controls.
- ii) Creep heat systems can be converted to electric (or hot water) heat pads, also with a controller. Incentives are available for the electric models.
- iii) Conversion of forced air heaters to infrared tube (primarily nurseries).
- iv) Installation of high efficiency condensing boilers, for both space/creep heating and hot water for pressure washing.

6. Controls

Management of controls is a major reason why the benchmarking data ranges can be so widely different. Over ventilating minimum fans and improperly set stage settings waste large amounts of heat energy and also electricity to remove the wasted heat.

CONCLUSIONS

Many other things can be done around the swine farm to keep the systems as energy efficient as possible, such as cleaning all fans, soffit and air intakes regularly. And, the beautiful part is the reduced energy will not only save dollars but, without exception, performance of the animals will be maintained or even improved.