CHAPTER 10.0

Energy Efficiency

This chapter discusses beneficial management practices that address energy efficiency on your farmstead.

Energy costs are a significant part of a farmstead's total operating budget. The burning of fossil fuels contributes to air pollution and greenhouse gas emissions. By improving energy use on your farmstead, you can help minimize or reduce your financial costs and environmental risks.

Before you can make energy efficiency changes on your operation, you need to know how much energy you are actually using. This can be accomplished by completing an energy audit.

10.1 On-Farm Energy Audit

The purpose of an energy audit is to determine what energy costs are associated with your home and farm, including what and where the energy is being used. The first step is to look at the cost and consumption rate of electricity, natural gas, gasoline, diesel and other energy sources, from which a base cost assessment can be developed.

The next step in the audit is finding where the energy is being used. When looking at operation costs and efficiency, it is necessary to conduct on-farm inspections of all buildings, doors, lights, windows, equipment, etc. Insulation levels, the hours lights are on, ventilation settings and age of equipment all need to be taken into consideration when conducting the walk-through. This knowledge will give you a better understanding of energy use and loss on your farm.

Some important questions to ask when looking for energy problems and possible solutions include:

- Have buildings and equipment been regularly maintained?
- Can sealing of windows and doors be improved or should they be replaced?
- Can insulation be added?
- Can operating temperature be reduced?
- Could automated controls help save energy?
- Does equipment need to run as long?
- Can more efficient equipment be installed?

On average, farm costs can be reduced by 10 to 15 percent by practicing proper maintenance and making minor modifications to operation practices. The actual cost savings will depend on how energy efficient the operation was before modifications were implemented.

For more information on conducting energy audits, contact your local energy supplier.

10.2 Field Operations – Tractors and Equipment

For farm equipment and other machinery that is used on your farmstead, regularly scheduled maintenance helps maximize energy efficiency and reduce wear and tear. Selecting the proper machine for the proper task, that is matching implements and tractors so the tractor is operating at its full rate load, helps to prolong engine life and the life of the equipment itself. For example, much of the work performed by a large farm tractor may be "light load work." It is estimated that a farmer with an annual fuel bill of $2,000 could save $400 per year by shifting up and reducing engine speed when doing light work.

Using the gear-speed ratio recommended in the tractor user's manual helps prevent unnecessary repairs. For example, if a load on the tractor reduces the engine speed to less than half of its original setting, cylinder wall scarring may occur due to improper lubrication.

Keep a list of all electric motors in use, and record the preventative maintenance measures performed on each to be sure they are checked, cleaned and lubricated regularly.

Fuel efficiency can be improved with fuel saving measures such as maintaining tires at the lowest correct pressure for the load to be carried, using the right fuel for the season and performing regular maintenance. Poor maintenance schedules can reduce the life of an engine by one-quarter to one-half. A properly maintained engine gets 6,400 hours of operation before an overhaul is needed. The average tractor gets less than 4,000 hours.

10.3 Lighting

The type of lighting you use depends on the application and environment. Consider how much light is needed, duration of lighting, type of environment (indoors, outdoors, temperature, moisture, dirt), paint surfaces, etc. to determine the most efficient lighting for each situation.

General maintenance of light bulbs can be as simple as wiping the dirt off. This small step allows the correct light level to be emitted through without additional lamps being added.

Lights come in various forms, and each type of light has different characteristics (see Table 10.1). Consider your lighting options.

Colour Rendering Index (CRI) is the ability of a light source to represent colour, based on a 0-100 scale. The higher the CRI, the closer to natural light the colours appear.

Watt (W) is the amount of electricity a light bulb uses to produce light and is not an indication of brightness.

Ballasts in fluorescent lights are used to convert line current into the proper form for the light to work. Ballasts can be either electric or magnetic. Magnetic ballasts are the older style and have a buzz noise to them. They are much lighter than electric ballasts, and the bulb lights up almost immediately with no flickering. Electric ballasts are more costly but more energy efficient.

TABLE 10.1 **DIFFERENT TYPES OF LIGHT AND EFFICIENCIES**

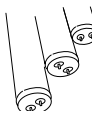
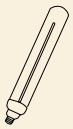
LIGHT TYPE	APPEARANCE	APPLICATION	COMPARISON/ EFFICIENCY	COMMENTS
T12 fluorescent 	• Tubular • Most common lengths · 1 m (4 ft) and 2 m (8 ft)	• Offices, large interior lighting areas	• Last up to 20 times longer than incandescent • Cooler than halogen and incandescent (save on air conditioning) • More energy efficient than incandescent • Typically: · most 1 m (4 ft) draw 40 W – energy saver T12 draw 32 W (but put out less light) · most 2 m (8 ft) draw 60 to 75 W	• 70+ CRI • Low maintenance costs • The 12 represents the diameter of the tube · 12/8=1.5 ~ 1.5” • Same socket (pins) as T8 • Ballast alters the electric current flowing through the tube (activates the gas, causing it to glow)
Low pressure sodium 	• Only emit light in the yellow portion of the visible spectrum	• Outdoor lighting	• Of high pressure and metal halide: · most energy efficient · lowest CRI	• Less popular over the years because more emphasis has been put on CRI ability

TABLE 10.1 (CONTINUED) **DIFFERENT TYPES OF LIGHT AND EFFICIENCIES**

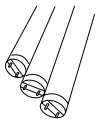
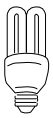
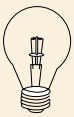
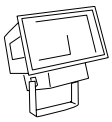
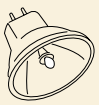
LIGHT TYPE	APPEARANCE	APPLICATION	COMPARISON/ EFFICIENCY	COMMENTS
High pressure sodium 	• Orange or amber colour		• Moderate to excellent CRI (though this depends on specific lamp design) • Uses 50% less electricity than mercury vapour	• 22-75 CRI
T8 fluorescent 	• Tubular • Most common lengths · 1 m (4 ft) and 2 m (8 ft)	• Offices, large interior lighting areas	• Last up to 20 times longer than incandescent • Up to 30% more energy efficient than T12 • Cooler than halogen and incandescent (save on air conditioning) • Typically: · 1 m (4 ft) draw 32 W and produce as much light as a 40 W T12 · 2 m (8 ft draw about 59 W • Better CRI compared to standard fluorescent • Stays brighter over the life of the bulb; therefore, you can get by with fewer lamps	• 70-80+ CRI • The 8 represents the diameter of the tube · 8/8=1 ~ 1" • Same socket (pins) as T12 • Ballast alters the electric current flowing through the tube (activates the gas, causing it to glow) • Eliminates the familiar flicker and hum sound of old fluorescent lights
Metal halide 	• Bluish white	• Exterior lighting • Best used in public and commercial parking	• A 32 W can replace an incandescent in the range of 100-150 W · over 50% savings • A 100 W can replace a 175 W mercury vapour (a retrofit kit or new fixture will be required) · roughly 40% savings • Has best CRI	• Least energy efficient of high pressure and low pressure sodium • Most efficient of white light lamps • 90 CRI for ceramic lights and 65-80 CRI for most types
Compact fluorescent 	• Typically has a "figure eight" appearance • Similar lighting to incandescent	• Most incandescent applications (screw in bottom or pins for specially designed fixtures)	• Produce less heat than incandescent • 1/4 to 1/3 the energy requirements that an incandescent requires • 15 W can replace incandescent up to 60 W, 23 W up to 90 W; for incandescent over 90 W, try 28 W compact • 42 W offers a light output equivalent to an 80 W mercury vapour	• Do not use with standard incandescent dimmer switch; use a compact fluorescent switch • No flicker or hum associated with them • May require two to three minutes to achieve full light output • Does not require a cool down period after power interruption

TABLE 10.1 (CONTINUED) **DIFFERENT TYPES OF LIGHT AND EFFICIENCIES**

LIGHT TYPE	APPEARANCE	APPLICATION	COMPARISON/ EFFICIENCY	COMMENTS
High efficiency incandescent 			• Use a 67 W high efficiency incandescent in place of a 75 W (5% less light but uses 11% less electricity)	
Incandescent 	• Standard light bulb	• Interior lighting		• Electricity heats up a wire filament – causing it to glow and give off heat • >90% of the energy produced is heat – not light (acts like an electric heater) • Inexpensive • Good CRI • Work well with dimmers
Mercury vapour 	• Bluish light (good for night vision)		• A 100 W metal halide (HID) can replace a 175 W mercury vapour (a retrofit kit or new fixture will be required) • Roughly 40% savings	• Poor efficacy and CRI • Efficacy deteriorates significantly with age
Halogen 	• Gives off a whiter light than incandescent	• Popular as spotlights or narrow floodlights • Light quite focused (when used in a light stand, light is concentrated on the ceiling)	• Last 2,250 to 3,500 hours longer than incandescent • Maintain light output over time without fading • Creates 4 times more heat than an average incandescent • 500 W reaches temperatures of 1,200°C • Uses 40% less electricity for the same amount of light as a standard incandescent	• Also called tungsten halogen or quartz • An incandescent bulb with gases from the halogen family sealed in a glass case • Excellent CRI • Fire potential when incorrect voltage used • Standard halogens are efficient; most people use a high wattage (wasteful) bulb

10.4 Homes and Buildings

R-2000 construction is the most energy efficient to help prevent shell heating loss in homes and buildings on the farmstead. Insulating buildings to recommended levels by using R20-R30 insulation for walls and R30-R40 for ceilings is helpful. Thermopane windows also help decrease energy loss in the home, as do tight fitting doors and windows sealed with caulking and weather stripping. Installing a continuous air-vapour barrier to keep outside air and moisture from entering a building will also be effective to reduce energy losses.

Energy can be lost through water heaters and furnaces, so regular maintenance is crucial. A dirty water heater can operate as low as 73 percent efficiency, whereas a clean one operates at 90 to 95 percent. Periodically drain your water heater to remove accumulated sediment from the tank.

Whenever possible, use electricity outside of peak demand times (6:30 to 9:00 a.m. and 5:00 to 9:00 p.m.). This decreases the load on the community's electricity system and decreases overall electricity costs.

10.5 Shelterbelts

Energy conservation is a growing public concern. Shelterbelts can provide a reduction in energy consumption because the rows of trees and shrubs around the perimeter of a farmstead provide additional protection for farmyards or livestock facilities from adverse weather conditions. Shelterbelts reduce wind speeds, resulting in lowered heating and maintenance costs. Therefore, planting new shelterbelts or improving existing ones can produce economic benefits for the farm.

According to Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration (AAFC-PFRA), research indicates a typical farmhouse can reduce its heating costs by up to 30 percent with a correctly constructed shelterbelt. The optimal design for a windbreak of this type depends on the farm location and the site.

Shelterbelts are most effective when planted across prevailing wind directions. For increased sheltering effects, plant shelterbelts closer together; for maximum wind erosion control, plant the rows less than 200 m (660 ft) apart.

Besides reducing energy losses, shelterbelts also provide other benefits on the farm:

- increase aesthetics and property value
- control snow drifting by trapping snow
- decrease evaporation and improve water absorption
- increase soil moisture
- reduce wind and water erosion
- provide dust, odour and noise barriers
- store carbon
- provide wildlife habitat and biodiversity

Shelterbelts provide additional protection from windy conditions, resulting in lower heat costs — *Courtesy of PFRA*

10.6 Alternative Energy Sources

Renewable energy resources are great alternatives to fossil fuels. Alternative technologies include wind, solar, geothermal and small hydro-based power sources. Today's renewable energy technologies involve biomass-based products such as wood, straw, grasses, manure, corn/wheat-based ethanol or biodiesel.

When considering alternative energies, you first want to reduce your energy consumption. It is easier to save a watt than it is to produce a watt. Alternative energies can benefit many farmsteads as the cost tends to be less expensive than conventional sources over the long term. They also produce fewer greenhouse gases, which benefits the environment. It is up to you to determine which technology best suits your farmstead. The key is to look for alternatives that are practical, reliable, cost-effective and environmentally sustainable.

10.7 For More Information

All Alberta government offices may be reached toll-free by dialing the Rite Line: 310-0000

Alberta Agriculture, Food and Rural Development

Publications: 1-800-292-5697

- First Steps to Energy Management: Save Time and Money Agdex 818-2
- Shelterbelts in Alberta
- Shelterbelt Varieties for Alberta
- Wind Power Uses and Potential Agdex 767-2

Ag-Info Centre: 310-FARM (3276)
Website: www.agric.gov.ab.ca

Alberta Agriculture, Food and Rural Development - AgTech Centre

Publications: 403-329-1212

- AgTech Centre Innovator Series
- Energy Free Water Fountains Report 706
- Field Study of Electrically Heated and Energy Free Automated Livestock Water Fountains
- Focus On Alternative Energy series
- Focus On Alternative Fuels series

Canada Plan Service

Publications: 780-422-4844

- 9700 – Fan Ventilation Principles and Rates
- 9702 – Troubleshooting Livestock and Poultry Ventilation Problems
- 9705 – Selecting Fans for Livestock Buildings
- 9710 – Fresh Air Inlets
- 9750 – Ventilation and Heating Small Livestock Rooms

Website: www.cps.gov.on.ca

Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration

Publications: contact your regional office

- Basic Shelterbelt Establishment Guidelines for Prairie Livestock Facilities
- Energy Savings and Farmyard Shelterbelts
- Livestock-Powered Water Pumps
- Planning Farm Shelterbelts
- Planting and Care of Shelterbelts
- Shelterbelts Help Cut Heating Costs
- Solar-Powered Water Pumping Systems for Livestock Watering
- Spacing Recommendations for Farmstead Shelterbelts
- Wind-Powered Water Pumping System for Livestock Watering

Website: www.agr.gc.ca/pfra

Natural Resources Canada

Publications: 1-800-387-2000

- Heating your Building with Solar Energy
- Photovoltaic Systems – A Buyer's Guide
- An Introduction to Stand Alone Wind Energy Systems
- Stand Alone Wind Energy Systems – A Buyer's Guide

Website: www.nrcan.gc.ca

Natural Resources Canada - Office of Energy Efficiency

Publications: 1-800-387-2000

- Infosearch 2001: Energy Efficiency at Your Fingertips
- There are several other publications available to help you become more energy efficient in these topic areas:
  - Appliances
  - Energy Efficient Products
  - Heating and Cooling
  - Home Building (R2000)

Website: www.oee.nrcan.gc.ca

Prairie Swine Centre Inc.

Office: 306-373-9922

- Energy Efficiency in Barns: Part 1
- Energy Efficiency in Barns: Part 2

Website: www.prairieswine.usask.ca