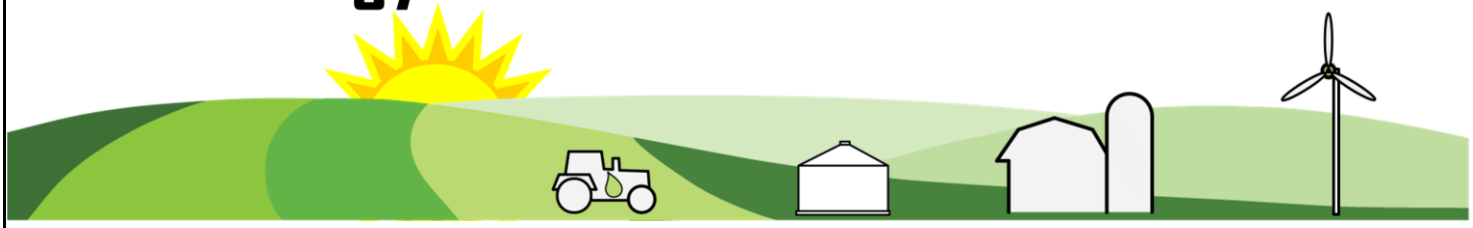
Farm Energy IQ



Tree Fruit Training Module Overview

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PENN STATE EXTENSION

LEARNING OBJECTIVES

Participants in this training session will understand how energy is used on tree fruit farms, as well as how it can be effectively conserved. Learning objectives include the ability to:

1. Explain how energy is used in a tree fruit horticultural application

2. Describe major users of energy on a tree fruit farm

3. Explain the significance of an energy use indicator (EUI) for a farming operation

4. Identify and explain strategies for improving energy efficiency without harming productivity

5. Utilize the *Orchard Fuel Use Estimator* online tool to calculate fuel use and reduce absolute or relative fuel use for an orchard operation

6. Be ready to visit a tree fruit farm and conduct a walk-through energy efficiency assessment

PRESENTATION FILE

Saving Energy for Fruit Production.pptx

PRESENTATION OUTLINE

05 min: Introduction on Tree Fruit Production Module - *Introduce self, purpose of presentation; give brief overview of tree fruit production operations*

05 min: Energy Use on Tree Fruit Farms - *Outline major users of energy on the farm and specific equipment involved*

10 min: Making Irrigation Efficient - *Discuss common energy wasters in irrigation systems and how these problems can be remedied*

10 min: Refrigeration Systems - *Outline how energy can be needlessly wasted in a refrigeration system and measures that can be taken to avoid waste*

10 min: Fuel Use in Field Operations - *Explain how mobile equipment is used on the farm, how to select and maintain high efficiency equipment, and cultural strategies that can reduce fuel use*

05 min: Orchard Fuel Use Calculator - *Introduce the fuel use calculator, show how it is used, and run through a demonstration of how to enter data and obtain results*

ACTIVITY

Agricultural Service Providers will be given a field layout scenario and will use the orchard fuel use calculator to estimate fuel use for two different field layouts. This activity is a natural follow-up to the module presentation. Participants will need access to the internet so that they can utilize the calculation tool. The exercise should take no more than 10 to 15 minutes.

ACTIVITY INSTRUCTIONS:

- Hand out the accompanying sheet titled "Orchard Block Fuel Use Calculator"
- Read over the instructions to ensure that everyone understands what is being asked
- Be on hand to answer questions as needed.

CALCULATION TOOL

The calculation tool for this module is the *Orchard Fuel Use Calculator*, which is introduced in the presentation and utilized in the activity. It is available online at http://www.personal.psu.edu/users/d/e/dec109/FuelUseCalculator/FuelUseCalculator.htm

PRESENTATION FILE

Tree Fruit Energy Top 10.pptx

PRESENTATION OBJECTIVES

Participants will learn how energy is used in a tree fruit operation, including: 1) Major energy users on the farm, 2) Key areas for improving energy efficiency, and 3) Resources for help with improving energy efficiency.

PRESENTATION SCRIPT

SLIDE 1. INTRODUCTION

Introduce yourself, and introduce this presentation. Energy conservation is an important opportunity for making your orchard operation more efficient and cost effective. The objective is to reduce wasted energy without disrupting the smooth operation of your facility. Sometimes it is even possible to improve the performance of your farm while improving energy efficiency. In this presentation, we will go over some of the most common ways orchardists can improve their energy efficiency, thereby reducing energy use and cutting costs.

SLIDE 2. ENERGY ON THE FARM

Where do you use energy on your farm? Tree fruit operations use energy in the form of electricity, transportation fuel, and sometimes heating fuel. Energy use can be broken down according to where the energy is used - namely in field operations and at the farmstead. The amount of energy that goes to different uses varies from farm to farm, but here is an example of the breakdown of electricity use on a typical family-size fruit farm that has a small storage and packing facility.

Electricity use is dominated by refrigeration, which consumes more than half of total electricity use. In general, a family-sized farm is supplied a 1-phase service from their electrical utility. Refrigeration units require a 3-phase power source in order to operate. Other than refrigeration units and packing lines, there is a limited amount of equipment that requires 3-phase power. It is most cost-effective to purchase a phase converter that converts a typical 1-phase power source to 3-phase. When adding in phase converters to supply the refrigeration compressors, over three quarters of all electricity is for refrigeration. Therefore, electrical energy efficiency improvements to the refrigeration system represent the greatest opportunity. The pie chart at right shows a breakdown of the energy consumed on a typical family-size fruit farm with a market. The startling thing here is that engine fuel is the

dominant use of energy, accounting for about 75% of all energy use. Therefore, there is great potential to save money by focusing on conservation and efficiency for fuel use in fleet operations on the farm. Electricity accounts for the remaining 25%. Market and farm electricity use are fairly similar.

So, how can tree fruit growers improve their energy efficiency? Here is our top 10 list:

SLIDE 3. NUMBER 10 - IRRIGATION: REDUCE THE PRESSURE

Drip irrigation systems require operating pressures between 15 to 25 psi at the pump and 10 to 12 psi at the drip tape. If you have pressures higher than that, you are using too much energy for pumping. Monitor pressure with one pressure gauge at the field entrance and several in the field.

SLIDE 4. NUMBER 9 - IRRIGATION: ELIMINATE LEAKS

Leaks in drip irrigation systems waste pumping energy unnecessarily. Leaks reduce the pressure at the emitter and, in turn, reduce the volumetric flow rate in areas that need to be watered. Leaks often get ignored, or operators may simply increase pump pressure to compensate for leaks. Ignoring leaks reduces allocation efficiency of water needed in the field. Increasing the pump pressure not only reduces allocation efficiency, but also uses more water and energy which leaks out of the system.

SLIDE 5. NUMBER 8 - IRRIGATION: MINIMIZE KINKS AND ELBOWS

Friction from water traveling through piping systems is a source of wasted energy in irrigation systems. Friction increases with high flow rate, narrow pipes, and kinks and elbows in pipe systems. The higher the friction, the more is the energy required to pump water to the field. To reduce friction, reduce any unnecessary obstructions and keep flow rates minimal.

SLIDE 6. NUMBER 7 - IRRIGATION: HIGH EFFICIENCY EMITTERS

Drip irrigation systems use energy efficient emitters that use a fraction of the water that sprinkler and surface irrigation systems use. High efficiency drip emitters put water where it is needed rather than soaking the entire ground. Less water use equals less pumping energy.

SLIDE 7. NUMBER 6 - UPGRADE YOUR REFRIGERATION SYSTEM

One way to save on energy is to switch to higher efficiency “scroll” compressors with high efficiency condenser fans. Typically the payback period for purchasing a scroll compressor is long. However, if and when a compressor fails, it can cost-effectively be replaced with a high efficiency scroll compressor because the incremental cost of the high efficiency unit will be more than compensated by the energy savings.

Evaporator fans, which blow air over the coils inside the cooler, are notoriously inefficient. Inefficient fan motors not only waste electricity, but they also add heat to the cooler, which causes the compressors to work harder. EC motors can be controlled to operate on low speed or to shut off when the temperature set-point has been reached, further reducing electrical energy consumption and heat production inside the cooler.

Evaporator fans typically run all the time, even when the refrigeration compressor is not running. EC motors can be very easily controlled by a variable frequency drive that slows the fans down when the system is not calling for cooling. This results in a large reduction of fan electricity use, and less heat is generated in the cooler.

SLIDE 8. NUMBER 5 - IMPROVE INSULATION

Make sure that your farm cooler is well insulated—insulation is one of the best long term investments and will save you a lot of money down the road. Plan on at least R25 of insulation in the walls, ceiling and

floor of the cooler (some folks choose to have even more). Make sure that there aren't any gaps in the insulation (the bottom of the outside wall is a common spot that gets missed), and that insulation is covered to protect it from wear and tear. Condensation that appears on the floor around your old cooler is a sure sign that the floor is not sufficiently insulated. If you were planning to keep using that cooler, that would be one of the first recommendations for improvement.

Older cold storage rooms tend to have inadequate insulation, either from skimpy design or from degradation of the insulation over time. For example, foam insulation can slowly break down and hidden cracks can develop over time. Fibrous insulation can settle or become wet and matted. It is recommended to carefully inspect and replace (as needed) insulation on any refrigerated storage that is 10 or more years old.

Plastic strips for cooler doorways are an economical and effective way to reduce heat loss when cooler doors are open—but they don't work when they are tied up out of the way. The proper use of the strip curtains, while a slight inconvenience, should be mandatory for all personnel—just like turning off the lights when leaving a room. If you have a refrigerated warehouse with large doors, strip curtains save even more. Depending on traffic through the opening and location, strip curtains for refrigerated warehouses can save 200-700 kWh/ft^2 door opening per year.[i]

SLIDE 9. NUMBER 4 – TUNE UP YOUR REFRIGERATION SYSTEM

For all refrigeration systems, it is important to conduct routine maintenance to ensure that equipment is operating at top efficiency. Regularly check the "sight glass"—a clear glass lens in the refrigerant line that shows the flow of refrigerant—to make sure that refrigerant pressure is adequate. The refrigerant should appear in the sight glass as a clear or greenish liquid. Any signs of bubbles, or a "milky" appearance, indicates that refrigerant pressure is low and the unit requires service. Also, have the outdoor coils cleaned regularly to prevent dust buildup from interfering with heat removal.

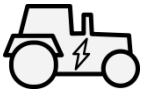
It is important to clean the refrigeration system fans on a monthly basis. If dirt is built up on the fan blades, the fan motors expend greater amounts of energy in order to cycle air throughout the refrigeration unit.

SLIDE 10. NUMBER 3 - UPGRADE YOUR LIGHTS

There are many lighting technology improvements that produce equivalent light with less wattage. Retrofitting old "T12" linear fluorescent lamps and ballasts with energy efficient "T8" lamps and electronic ballasts makes sense not only because of energy efficiency, but also because the old T12s are no longer manufactured. You can replace incandescent light bulbs with compact fluorescent or LED lamps, which is as easy as unscrewing a light bulb and screwing in the replacement. Not only do compact fluorescent and LED bulbs use about ¼ the electricity of incandescent lamps and add less heat to a cold room, they last much longer than incandescent bulbs—many LED lamps have a 5-year warranty. LED lamps thrive in a cold environment and are a great option for refrigerated environments. Fluorescent lamps can dim in the cold, so be sure to use outdoor rated ballasts in coolers. Refrigerated warehouses with metal halide or high pressure sodium lights represent an excellent opportunity to save electricity. You can replace a 400 Watt metal halide light with a 230 watt fluorescent or a 150 Watt LED.

Occupancy sensors can save lots of energy by turning lights off automatically when rooms are unoccupied.

SLIDE 11. NUMBER 2 - IMPROVE FIELD OPERATIONS



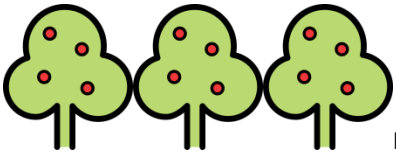
It is important to regularly tune up and maintain all field equipment—new plugs and filters save much more money in fuel than they cost. Smoky tractors are a sign it is time for a rebuild! The smoke is soot going out of the exhaust as unburnt wasted fuel. Don't

take out the big tractor if the small one will do the job. Using an oversized vehicle for the job wastes fuel. When looking at new equipment, be sure to check how much power it requires or what kind of mileage it gets. Equipment that uses the minimum amount of power to get the job done will save fuel.

Orchard block design impacts fuel consumption. Fields with long rows save energy compared to fields with lots of short rows because frequent turns increase the distance travelled and result in higher fuel use.

To keep tractors running optimally, ballast them to control slippage on the wheels, and keep tires properly inflated. Believe it or not, good fuel storage also can save fuel. Placing your fuel storage tank in a shady spot, or at least painting it a light color, will reduce the amount of fuel lost to evaporation.

SLIDE 12. NUMBER 1 - CONSIDER A "FRUITING WALL"



Fuel use by tractors and other farm equipment is the biggest energy expense for in-field tree fruit operations. Penn State research conducted in commercial orchards demonstrated that, although tractor miles traveled are greater in a high density orchard block, smaller equipment used in high density systems has lower fuel costs per acre than medium-density blocks. Because high density systems have increased yield per acre, they saved 71%, or $0.15 per bushel on fuel costs compared to medium density blocks.

For more information, refer to the Case Study on "Bearing Fruit with Energy Savings."

SLIDE 13. SUMMARY

Energy-efficient practices on the farm mean doing the same work with less purchased fuel and electricity. You don't need fancy new technology or major investments to reap the savings. With just a few simple changes to your operation, you can start to see real savings at the pump and on your electricity bill.

SLIDE 14. WHERE TO LOOK FOR HELP

[Will need to put project website address here when it is available]

FACT SHEET

"Top 10 Ways Fruit Famers Can Save Energy"

CASE STUDY

"Bearing Fruit with Energy Savings"

OTHER REFERENCES

http://extension.psu.edu/plants/tree-fruit/news/2011/saving-energy-for-fruit-production

http://extension.psu.edu/plants/tree-fruit/resources/specialty-crop-innovations

http://postharvest.tfrec.wsu.edu/PC2001T.pdf

This project supported by the Northeast Sustainable Agriculture Research and Education (SARE) program. SARE is a program of the National Institute of Food and Agriculture, U.S. Department of Agriculture. Significant efforts have been made to ensure the accuracy of the material in this report, but errors do occasionally occur, and variations in system performance are to be expected from location to location and from year to year.

[i] 2014 PA Technical Reference Manual, Section 3.16