ENERGY EFFICIENCY:

BEST MANAGEMENT PRACTICES FOR PISTACHIO PROCESSING

College of Engineering
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ENERGY EFFICIENCY: BEST MANAGEMENT PRACTICES FOR PISTACHIO PROCESSING

NEW MEXICO STATE UNIVERSITY
INSTITUTE FOR ENERGY & THE ENVIRONMENT

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Introduction

The United States Department of Agriculture's Rural Energy for America Program (REAP) has provided funding for New Mexico State University's Institute for Energy & the Environment (IEE) to conduct energy audits at agricultural producers in southern New Mexico. The goals of the REAP audits are to measure the energy use of agricultural processing operations, specifically the energy use and loss from electrical and processing equipment, and to make recommendations for increased efficiency in electrical performance.

As a part of this effort, USDA-Rural Development (RD) funded IEE to conduct a professional energy audit for a single pistachio grower and has now produced this more general set of Best Management Practices (BMPs) for the pistachio industry in New Mexico. This set of guidelines is intended to be a handy reference manual for those producers who wish to increase efficiency within their pistachio-processing lines, reduce energy use and related expenses, and consider the installation of renewable energy sources for their operations.

IEE wishes to thank the staff at the Albuquerque office of the U.S. Department of Agriculture for their generous funding of this project; the staff and students of IEE at New Mexico State University; Dr. Tracey Carrillo of the NMSU Agricultural Extension; Lucio Garcia of LMG Engineering; the NM Manufacturing Extension Partnership; and, most importantly, the Schweers family of Alamogordo, NM for their kind hospitality, cooperation, insight and enthusiasm during our many hours of on-site work at Eagle Ranch.

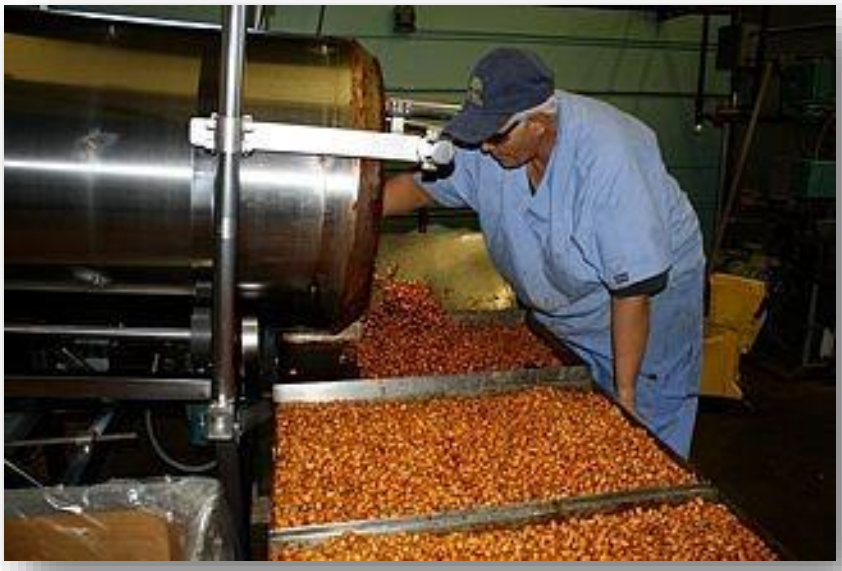
Definitions

Best Management Practices (BMPs): A practice or combination of practices determined to be effective and practicable (including technological, economic, and institutional considerations).

Energy Audit: A document that analyzes an operation's current energy use and recommends actions to increase energy efficiency. An audit contains a description of your farm's current baseline usage for various systems, specific recommendations to increase energy efficiency, and an explanation of the energy and cost savings you can expect from the recommendations. The American Society of Agricultural and Biological Engineers has a Standard for Conducting On-Farm Energy Audits; it is important that any auditor for your farm is following this standard.

Energy Efficiency: The use of less energy by changing energy-related practices and equipment. If you replace your lights or furnace with a more efficient model, you have reduced your energy use without changing the amount of heat or light available to you. This guide contains many recommendations for energy efficiency. Generally, energy efficiency measures have a cost, but the cost is worthwhile due to higher energy savings.

Renewable Energy: Energy sources that can be replenished, such as energy from the sun, wind, biomass, geothermal or hydroelectric projects.



Best Management Practices – Pistachio Processing

Process Description

When pistachio nuts ripen on the trees, usually around the end of August, they are easily removed with a mechanical tree shaker and collected on tarps. They are transferred into field bins and transported to a hulling plant where the actual processing begins. A system of hullers, pressure hoses, float tanks and dryers remove the outer hulls and prepare the nuts for further processing. A series of machines variously clean, sort and discard the nuts based on size, color and condition, and then the nuts are divided between shelled and un-shelled pistachios. Depending on the facility, the final sorting stage is often performed by hand to determine final quality of the nuts or nutmeats.

At this point, nuts can be diverted and marketed as an unroasted, unflavored raw product, or diverted to the roasting stage. Once there, batches of nuts are roasted in ovens at 225 °F for 15 to 20 minutes. Some batches can be designated for flavoring which means they are sprayed with salt solutions, chile, garlic, lime or onion flavorings, rotated in large drums to assure even covering, and then roasted.

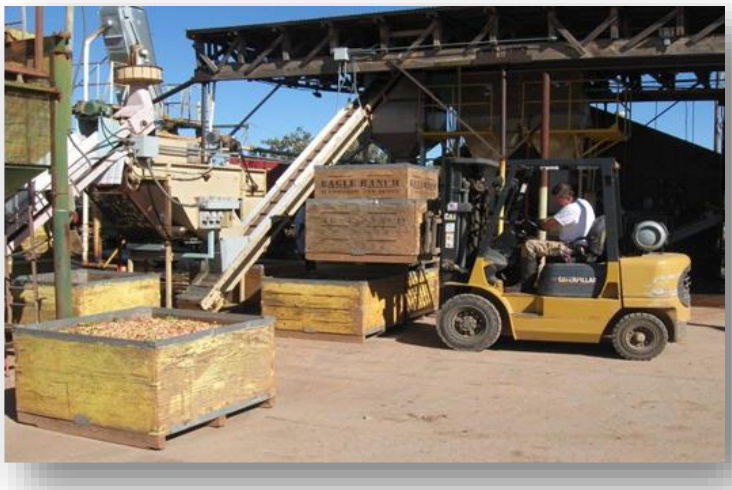
Pistachio processing involves the use of numerous machines with motors that require standard maintenance, repair, or replacement, which means that best practices for energy efficiency can be useful to the pistachio farmer and producer.

Recommended Maintenance - Motors

Motor maintenance will prolong motor life and to foresee motor failure. Motor maintenance measures can be categorized as either preventative or predictive. Preventative measures are preferred and are designed to prevent unexpected downtime of motors. The purpose of predictive motor maintenance is to observe ongoing motor temperature, vibration, and other operating data to identify the need to overhaul or replace a motor before failure occurs. The savings associated with an ongoing motor maintenance program can be as high as 30% of total motor system energy use.

Since maintenance is the first step in increasing energy-efficiency and reducing energy costs, it is recommended that all pistachio producers practice regular procedures for the maintenance of all motors. The first step is to follow the manufacturers' user guides and focus on the following actions: (1) lubricate all parts including bearing; (2) clean all fan filters; (3) check for belt slippage and fan speeds; (4) check for air leaks at doors and seals; and (5) check and repair insulation around all processing machines.

Facilities can have leaks in their air compressors that go undetected without a program of regular inspection and maintenance. Repairing leaks in processing systems can lead to energy savings of approximately 5 to 10% and will allow the facility to operate more efficiently.



Evaluating Upgrades or Replacement

Even if you have practiced proper maintenance, it may become more energy efficient to upgrade or replace some or all motors. The following procedures can be followed for a more efficient facility where motors and/or fans are running at near capacity and may only need upgrading: (1) creation of motor/fan inventory and tracking system; (2) creation of guidelines for proactive repair/replacement decisions; (3) development of guidelines to follow once motor failure occurs; (4) creation of a spare-parts inventory; (5) development of repair procedures to better evaluate costs and other impacts of repairing motors/fans; and (6) development of a preventive maintenance program for all motors/fans.

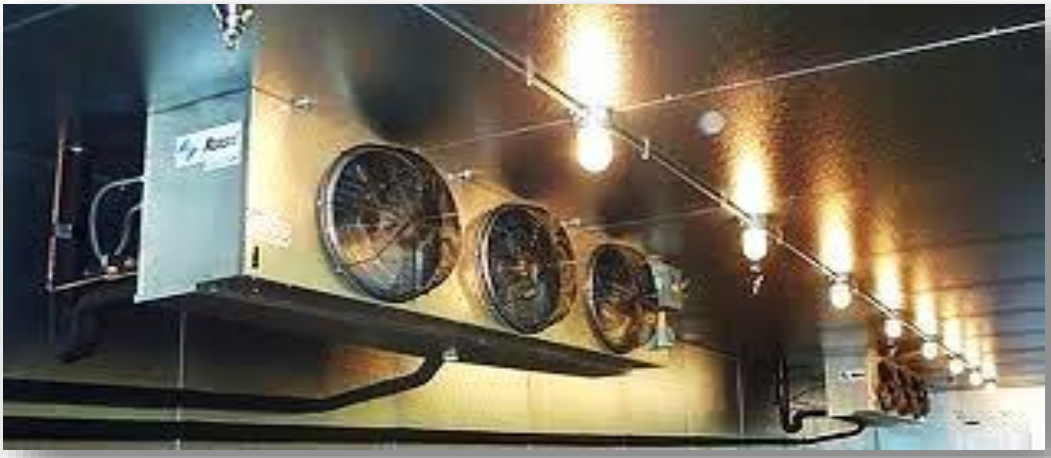
A good practice before looking at upgrades is to rewind a motor. The decision to rewind a motor or to replace it comes down to the basic rule that if rewinding costs exceed 60% of the costs of a new motor, purchasing the new motor may be a better choice. Only a professional should handle rewinding a motor as an improper rewinding will only lead to the need to replace the motor.

If, by using the criteria above, you determine that replacing any motors is the best way to achieve improved efficiency, it will be important to estimate the costs of such replacements. The following procedures can be followed: (1) list all motors (including fans) and their locations at your facility; (2) on the list, describe the conditions of the motors/fans (efficiencies, vibrations, exterior wear) and the specifications noted for each; (3) describe the use of each motor/fan and note the

piece of processing equipment with which it is being used; this is an important matter as it will detail if the motor/fan is properly sized for that piece of equipment; (4) note any need to replace and/or repair motors/fans; (5) conduct a cost analysis for repairs and upgrades to realize energy efficiency improvements.

Best Maintenance Practices - Storage and Refrigeration

In the pistachio-processing industry, storage usually consumes the highest amount of energy overall. Because of this, pistachio producers should focus on maintaining proper temperature settings and well-insulated refrigerator units or freezers.



Temperature Settings

Ambient temperatures in both refrigerator and freezer units are to be maintained at constant levels year-long. The goal is to establish and maintain the ambient refrigeration temperature at 35-40 °F (1.6-4.4 °C) and freezer temperature at 0 °F (-17.8 °C), thereby providing optimal long-term storage for the pistachio products.

Insulation

Proper insulation allows a facility to maintain a constant desired temperature. This avoids wasting energy by avoiding the need to constantly adjust temperatures. All insulation is rated according to its resistance to heat flow, measured in units of "R-value" in the United States. Insulation should be installed according to proper R-value for space size. IEE recommends foam or fiber for storage and freezer areas.

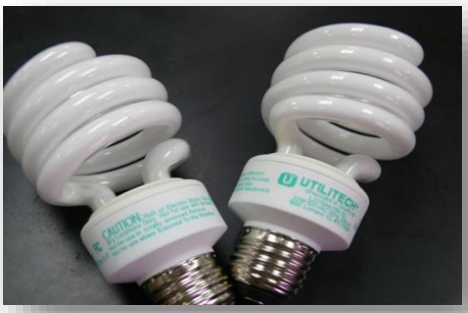
Foam insulation comes in either rigid sheets or spray. Rigid foam insulation generally has a higher R-value per inch than fiber insulation, because it uses HCFCs (hydro chlorofluorocarbons) instead of air to create pockets or bubbles in the foam sheet, thereby achieving values from R-3.6 (expanded polystyrene) to R-7.7 (isocyanurate).

Rigid foam costs per R-unit are much higher than those of fiber. Sprayed-in foam can be used in open or closed cavities as well as around ducts or pipes that pass through the building envelope. Low-density urethane spray foams can achieve up to R-11 per inch, though most foams are rated much lower, with values around R-4 to R-6. Like wet cellulose, spray foams are effective at sealing out drafts.

It is recommended that proper care should be taken in selecting rigid foam insulation as it can contribute to insect problems. Insects and termites will tunnel through polystyrene and polyisocyanurate (PIR) foams to create nesting cavities or to create a protected passage to wood inside a building. If rigid foam is selected, it is recommended to add a boric acid insect repellant to the foam insulation annually.

Best Management Practices – Lighting

It is recommended that Compact Fluorescent Lamps (CFLs), like those pictured below, be installed in all light fixtures for potential energy savings of 38 to 75%. If possible, increase the use of natural light as much as possible during daylight hours.



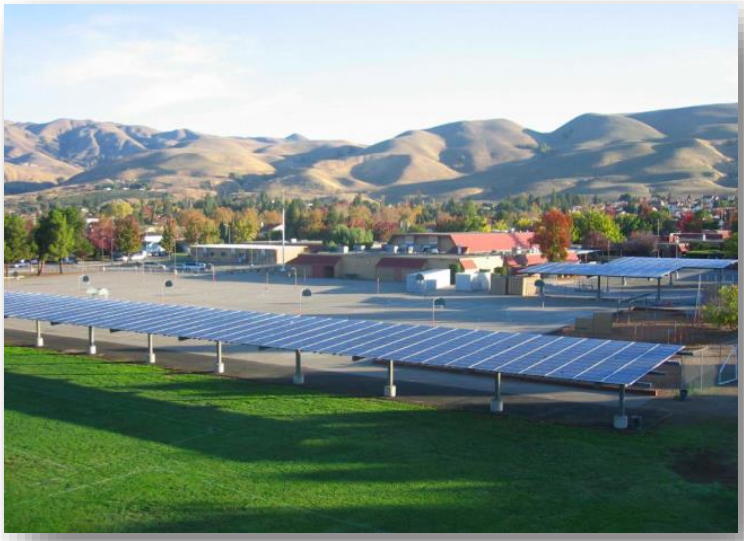
Best Management Practices - Pollution Prevention and Recycling

Pollution Prevention (or "P2") is the voluntary reduction of waste at its source, which can improve health and safety for facility operators and staff. P2 can help reduce energy use by eliminating both the need for overly-lit storage areas and the need for the transportation of hazardous materials to and from your facility.

The following P2 practices can be followed:

- Reduce chemical exposure by storing cleaning or other chemicals in proper containers and only in quantities needed for immediate use;
- Provide clear instructions for chemical clean-up in English and Spanish, and provide regularly-scheduled training on spill clean-up;
- Provide proper, contained storage for gasoline, diesel fuel, oils, solvents, paints, and pesticides;
- Reduce solid waste accumulation on-site by putting recyclable material into separate collection bins for recycling and/or re-use;
- Divert any reusable organic material into containers for composting;
- Track amounts of solid waste and recyclables to calculate cost-savings;
- For any sites with installed solar panels, properly dispose of or recycle all batteries; and
- If soldering is part of the process, properly dispose of all lead solder residue.

Best Management Practices – Solar Photovoltaic Energy



Since most pistachio production in New Mexico is located in the southern portion of the state where sunshine is abundant, pistachio processors have an opportunity to implement solar renewable energy to effectively meet their facilities' energy demands. Southern New Mexico receives a monthly average of 6.5-7.0 kWh/m^2/day of solar radiation. Therefore, producers should consider the installation of solar photovoltaic systems.

One approach is to install solar panels to power motors for agricultural well pumps in the field; another is to install a parking shade structure with a small solar array located on top to power any nearby processing units. The table below shows the cost of installing a solar energy system (including savings from federal and state tax credits), solar energy production, monthly savings and a payback period. The table is based on a 20.0 kW installation at a cost of $2.60 per watt; this size of an installation would cover approximately 2,000 square feet. As can be seen, current federal and New Mexico tax credits significantly help with cost-reductions.

System size	Approximate cost	Approximate cost after 30% federal tax credit and 10% state tax credit	Monthly solar production	Average monthly savings	Payback Period (years)
20.0 kW	$52,000	$31,200	4,175 kWh	$459	5.66

Net Metering

Net metering allows electricity customers who have their own PV system and own electricity from on-site generation to pay only for the net energy they obtain from the utility. Since the output of a PV system may exceed the on-site demand for electricity, a facility with a PV system can export excess power to the electric grid at times and import power from the grid when needed. PV solar systems generate the most electricity during the middle of the day, when demand and the cost of electricity are highest. With net metering, individual PV systems can offset expensive peak electricity purchases by the utility, resulting in lower electricity bills for all customers. Although the State of New Mexico allows net metering up to 80 MW capacities, there may be some local utility services that prohibit it; please check with your local utility or electrical co-op to verify what is permitted in your community.

Best Management Practices – Resources for Technical Assistance

As presented above, increased energy efficiency combined with renewable energy can significantly reduce electrical use in the agricultural sector. In order to learn more about agricultural energy efficiency, please visit the following web sites:

NMSU/Institute for Energy & the Environment
http://ieenmsu.org/

US Department of Agriculture

http://www.rurdev.usda.gov/energy.html

http://www.aceee.org/white-paper/energy-efficiency-opportunities-usda

American Council for an Energy-Efficient Economy
http://www.aceee.org/topics/agriculture

Energy Solutions for Independent Farms
http://www.agenergysolutions.org

Environmental Law & Policy Center/Clean Energy & Rural Economic Development
http://farmenergy.org/clean-energy-guide/energy-efficiency

EnSave
http://www.ensave.com/

American Society of Agricultural and Biological Engineers

http://www.asabe.org/

In addition, New Mexican pistachio growers and producers can access technical assistance and resources for analytical advice at no cost. **NMSU's Institute for Energy & the Environment (IEE)** provides free assistance on analyzing energy consumption and electrical billing in order to make informed management and investment decisions. Staff at IEE can be reached at 800.523.5996 or through www.ieenmsu.com.

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