



By John W. Bartok Jr.

Solar heat is not an option, yet

I'M FREQUENTLY ASKED WHETHER there are any solar collector systems that will help heat greenhouses. A look around the industry should provide a slight clue. Other than a few solar hobby greenhouses, very few commercial installations have a solar system in place.

The reason is most solar systems have a long payback. A conventional system using hot water or hot air collectors generally costs \$25 to \$50 per square foot to install. If a solar system could collect 100,000 Btu per square foot over a six-month heating season and the price of fossil fuel is \$25 per 1 million Btu, the payback would be 10-20 years.

There are other heating alternatives that give a much shorter payback and may be a better choice. If the price of fuel doubles, then the payback shortens and solar may become more attractive.

Reduced heating needs

Since the energy crisis in 1973, there has been a considerable amount of research conducted and many new heat alternative products developed. As the price of conventional fuels continues to rise, some of these ideas may have application in the greenhouse industry.

Heating needs are much less in today's greenhouses. During the last century, greenhouses were relatively inefficient. Today, greenhouses can be equipped with double- or triple-layer glazing, multiple energy curtains, perimeter insulation, condensing boiler systems and floor heat. Greenhouses can also be built to produce multiple layers of plants. These reduce heating needs and conserve fuel.

Previously, it frequently required 2-3 gallons of fuel oil (2.75 to 4.15 therms of natural gas) to heat a square foot of old glass greenhouse. A well-constructed and managed modern gutter-connected greenhouse should be able to be heated with about a 0.5 gallon of oil (0.7 therm of natural gas) per square foot. This makes solar more attractive as it will provide a larger percentage of the daily heat needs.

Passive and active systems

Solar systems can be classified as passive or active. A greenhouse is a great passive solar collector. If kept closed, the temperature inside can reach 100°F during winter and 150°F during summer. This heat could be

captured and stored in the greenhouse floor or in barrels of water. But research has shown that in a full greenhouse, about half of the solar energy that reaches the inside of the greenhouse is used to evaporate water from the leaf and soil surfaces. This reduces the amount of heat available for storage.

Orientation of the greenhouse to get maximum solar pickup and insulation of non-solar gathering surfaces are important. Placing the greenhouse partially below-ground would also allow the heat collected to be used more efficiently.

Another relatively low-cost, passive system is a solar-heated salt pond. The pond is similar to an in-ground swimming pool filled with water and covered by a greenhouse. Sodium chloride or other salt is dissolved in the water to form a uniform concentration in the lower half and decreasing concentration gradient from the pond middepth to the surface. The water, which is heated all summer, reaches a temperature above 150°F and is drawn off when heat is needed during the cooler parts of the year. Water is pumped from the pond to heat exchangers in the greenhouse. Research on this system was conducted at the Ohio Agricultural and Research Development Center in Wooster.

Active solar system

An active solar system to heat a greenhouse requires a collector, heat storage and method of transferring the heat to the greenhouse. Here are a few of the systems that may have application for greenhouse heating.

Active collector systems made from sheet metal painted black could be added to the side of a head house or storage building if the orientation is correct.

Another system consists of water solar collectors similar to the EPDM mats used for bench heat. These can be placed along the back wall of a greenhouse. The heated water, which can reach 80°F, could be stored in insulated tanks either inside the head house or buried below ground. These same collectors could be used for radiation at night to transfer the heat back to the greenhouse.

A low-cost, collector system developed by Rutgers University researchers in the late 1970s used five layers of 6-mil plastic, a black layer surrounded by an inflated layer of clear on the top and bottom. Water is supplied by a perforated pipe at the top and collected by a gutter at the

bottom. The heated water is pumped to a PVC-lined, insulated sump below the greenhouse floor. A porous concrete floor is used above the sump.

Heat storage

About 80 percent of the heat needs of the greenhouse are at night so storage is necessary. On a volume basis, water will store about three times as much heat as stone, concrete or sand.

Rock storages will store about 720 Btu per cubic foot at 80°F air temperature. Stone size should be between ½- to 1½-inch diameter to get good air movement. Wet sand in an insulated cellar below the greenhouse is another idea that has been tried. Either ducts for air movement or PEX tubing for water are placed within the sand bed.

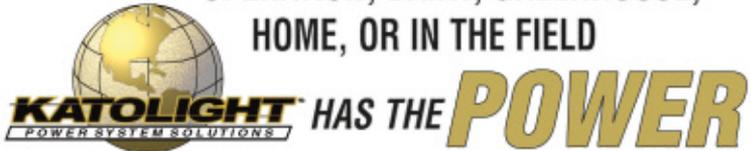
Phase change salts have been tried for heat storage in greenhouses. There are several salts that change from a solid to a liquid in the 70°F-90°F range. There is a large storage of heat in the change of phase. The heat is given up when the liquid salt changes back to a solid. Phase change salts are expensive and require plastic or stainless steel containers. Another recently developed material is a phase change wax. This could possibly be used as a heat collector in benches.

The heat recovery from medium temperature water from a solar collector system can be done by heat exchangers such as the Model GLW from Modine Manufacturing Co. ❖❖

CONTACT INFORMATION

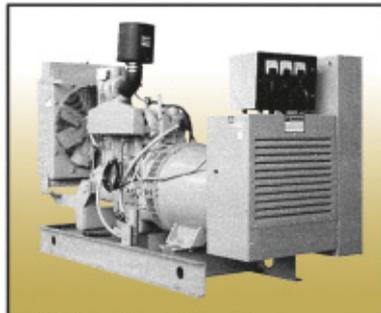
John Bartok Jr. is faculty emeritus, University of Connecticut, Department of Natural Resources Management and Engineering, jbartok@rcn.com.

STANDBY POWER FOR YOUR FARM, CONFINEMENT OPERATION, DAIRY, GREENHOUSE, HOME, OR IN THE FIELD



The Leader in Automatic Farm Power Systems

Katolight Automatic Farm Power Systems feature superior design for instant response to any emergency power outage. Only seconds after a power failure occurs the set will sense the emergency, start itself and transfer the load...automatically. The Katolight package is complete. Everything needed for an automatic standby power system installation, from the engine to transfer switch, is included in the package. Instant Emergency Power from Katolight. Contact Katolight for the name of the Distributor nearest you.



Katolight celebrates 55 years in the Business in 2007!

KATOLIGHT Corporation
100 Power Drive • Box 3229
Mankato, MN 56002-3229
(507) 625-7973 • FAX (507) 625-2968
800-325-5450 • www.katolight.com

▲ Request 66 ▲

SINCE "1969" WE'VE BEEN BUILDING ONLY THE BEST!

AGRI-CARTS



HAND CARTS



RETAIL WAGONS



TRACKING TRAILERS



TREE DOLLIES

1-800-503-3310

COMBUSTION SERVICE CO., INC.

P.O. BOX 40, MASCOTTE, FL. 34753

PHONE: 800-503-3310 • FAX 888-9WAGONS (992-4667)

WWW.AGRICARTS.COM

Limited Dealer & Distributor Opportunities Available

▲ Request 67 ▲