

Going Concerns Unlimited:

Subterranean Heating and Cooling Systems for Solar Greenhouses

Subterranean Heating and Cooling System Explained

Subterranean Heating and Cooling System — SHCS — is an innovative approach to optimized solar greenhouse heating and cooling design that uses the magic of phase-change for heat exchange.

This proven system can heat your greenhouse for as little as 7 cents per square foot per year! in sunny Ag Zone 4. Supplementary heating and fan cooling costs are often eliminated!

Using research from Canadian government studies, **Jerome Osentowski** of the **Central Rocky Mountain Permaculture Institute** was one of the first to pioneer this approach. He has consulted for many more projects, soliciting the technical assistance of **Going Concerns Unlimited** to optimize the designs for his clients. Since their collaboration began, the system has gained in popularity and efficiency. **Going Concerns Unlimited** can now take the primary design goals and quickly refine them into **working drawings** for clients. Initial "test of concept" only requires a floor plan of the greenhouse, sometimes a few minutes on the phone, and a small fee for the working drawings. Do-it-yourself is the practicum of choice — **Going Concerns Unlimited** is dedicated to setting the course straight for the solar greenhouse grower interested in optimum yields with minimum inputs.

Phase Change — The Physics behind the system

The magic of phase change from liquid to vapor and back again drives the SHCS. The system functions like a simple refrigeration system, but a typical 1200 square foot greenhouse needing only the equipment and running costs of a single household refrigerator!

By circulating the hot, moist daytime air of the greenhouse down underground where it is always cooler, the SHCS forces the vapor to condense. By doing so, the heat that had evaporated the moisture is forced into the soil. The "miracle" is that by inducing temperature change over the phase change barrier we harness 500 times the energy transfer potential that would normally occur if we simply tried to solar heat objects cluttering up the greenhouse. And by inducing this "dewpoint" condition in the soil of the greenhouse, the plant roots are always being bathed in warm, moist conditions — the perfect balance for plants and solar greenhouses. The space is heated by the massive amount of radiating solar heat stored in the soil under the greenhouse! **The physics behind this effect is fully explained here.**

Heating Storage

Dewpoint conditions created underground cause the hot moist air of the greenhouse to give up its daytime heat into the soil of the planters. A small two-speed fan is turned on to high speed by a thermostat set in the 75 deg. F to 80 deg. F range. As the sun heats the space, the air begins to move underground, the entire volume of the space moving underground once every 10-20 minutes. The air enters the system hot and moist, and exits right back into the greenhouse cooler and dryer.

Cooling

By inducing a phase change while it is underground, the air returning back into the greenhouse is cooler (usually a 30 degree F. drop!) and much dryer. Being dryer, it has the ability to evaporatively cool the space once again, returning back underground to continue storing heat and moisture, and then returning to continue the cooling effect every 10-20 minutes. Colorado greenhouses don't even need cooling fans with this system in place! Passive ventilation is all that is needed.

Space Heating

With the soil as the heat storage medium, only the air needs to be heated at night. This is accomplished by the very same fan that is used to store the heat during the day. This time, a second thermostat turns the fan on in low speed when the air temperatures approach the low limit. By circulating the cool air underground and then back into the space, the air extracts heat from the soil and returns to warm the space — exactly the opposite of the heat storage cycle, but using the same fan in low speed and one more separate night heating thermostat. Colorado greenhouses can easily maintain a Mediterranean environment all year without any supplementary heat needed!

Equipment and Materials

- Several hundred feet of thin walled 4" corrugated, perforated, filter sock covered flexible polyethylene drainage tubing (commonly called ADS -Advanced Drainage System) You will need approximately six linear foot of ADS for every 4 square feet of planter space. Enough tubing must be in place to result in tubing air speeds in the neighborhood of 2-4 feet/sec.
- One two speed blower for every 1200 square feet of greenhouse. The blowers are sized to move all the air underground every 10-20 minutes in high speed operation.
- Two 30-100 deg F adjustable remote sensing heating / cooling line voltage thermostats
- A tubing plan, electrical schematic, typical blower plenum diagram and fan sizing schedule to suit the greenhouse size and layout. (examples of plans I provide are at www.sunnyjohn.com)
- The Free SHCS Design Calculator is available at www.sunnyjohn.com.
- Contact **Going Concerns Unlimited** for services. If you need a customized schedule, as little as \$150 gets you one. All you need to supply is a floor plan and the 3D dimensions of the greenhouse in mind. If you understand the system well enough, you can use the numbers I provided here to design your own system free of charge!
- Additional consulting off site is available, enquire for rates.

Going Concerns Unlimited specializes in designing Subterranean Heating and Cooling Systems for solar greenhouses.

Supplying free and low cost consulting services for the sustainably inclined home and land owner since 1976:

- Greenhouse Structures and Solar Heating
- Natural Building
- Permaculture Systems
- Energy Conservation