CERES
GREENHOUSE SOLUTIONS®

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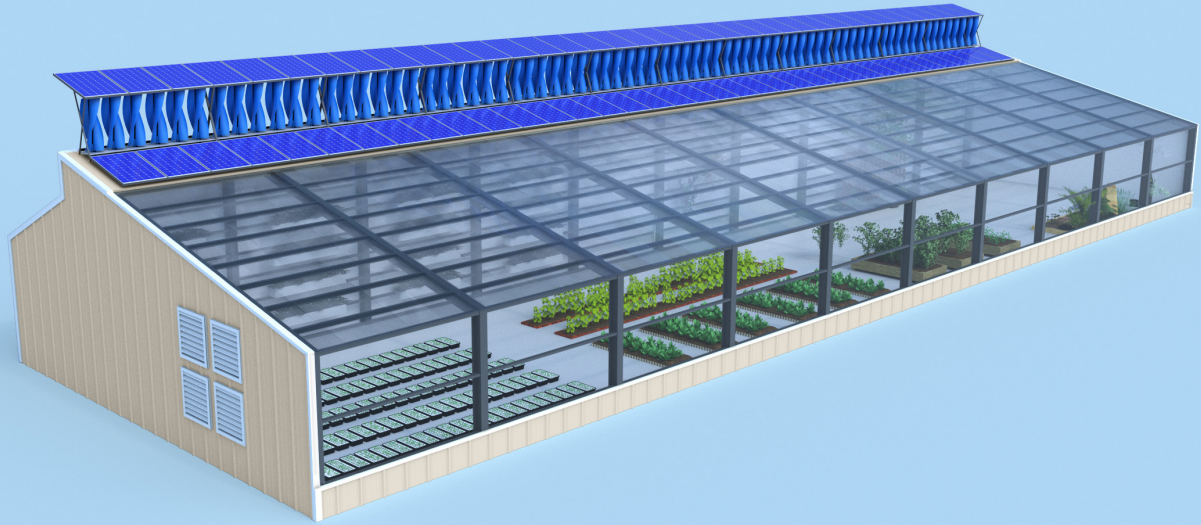
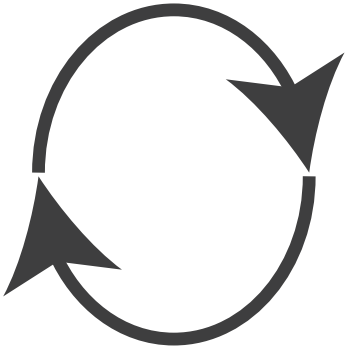
NETZERO GREENHOUSES



YEAR ROUND ABUNDANT GROWING • NO UTILITY COSTS

What is a *NetZero* Greenhouse?

- Energy Production = Energy Consumption
- Designed with a concentration on renewable resources



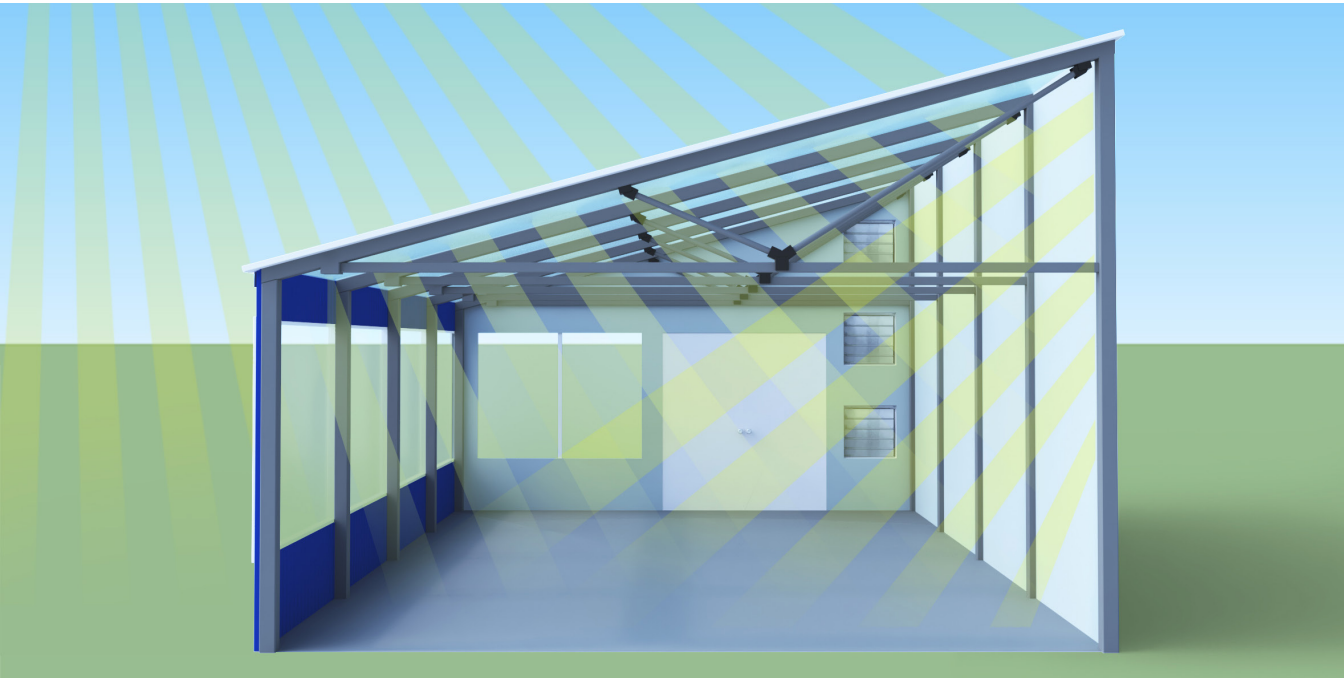
NetPositive

- Energy production exceeds energy consumption.

In addition to good *PASSIVE DESIGN*, the proper implemenation of specific efficient *SYSTEMS* will create a **NetZero** or even **NetPositive** greenhouse.

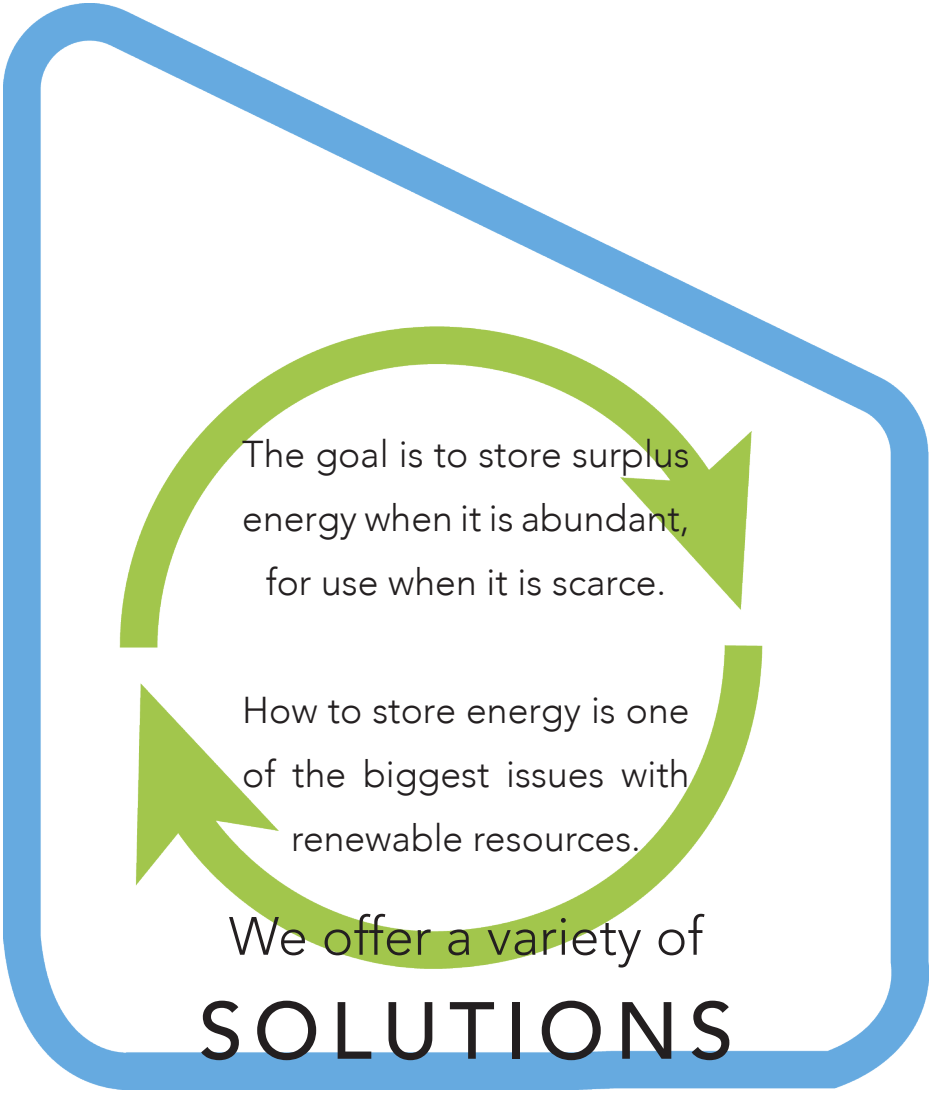
PASSIVE DESIGN

- Balance between insulation and glazing
- Orientation toward the sun
- Solid north wall
- Insulated metal panels
- Durable steel frame



High Efficiency & Energy Savings

SYSTEMS


The goal is to store surplus energy when it is abundant, for use when it is scarce.
How to store energy is one of the biggest issues with renewable resources.
We offer a variety of
SOLUTIONS

SYSTEMS BY REGION

	Hot/ Wet (ex. Florida)	Hot/ Dry (ex. Arizona)	Cold/ Dry (ex. Montana)	Cold/ Wet (ex. Oregon)
Phase Change Material	●	●	●	●
GAHT™	●	●	●	●
Geothermal	●	●	●	●
Venting	●	●	●	●
Heat Recovery Ventilator			●	●
Wood Burning Stove			●	●
Pellet Stove			●	●
Compost Heat			●	●
Biochar Kiln			●	●
Portable Evaporative Cooler		●	●	○
Wet Wall		●	●	
Battery/ Electrical Storage	●	●	●	●
PV	●	●	●	●
Wind	●	●	●	●
Energy Screen	●	●	●	●
Solar Thermal			●	●
Shade Screen	●	●	●	●
Shade Paint	●	●	●	
Root Zone Heating			●	●
Solar Food Dehydrator	●	●	●	●
Smart Controller	●	●	●	●

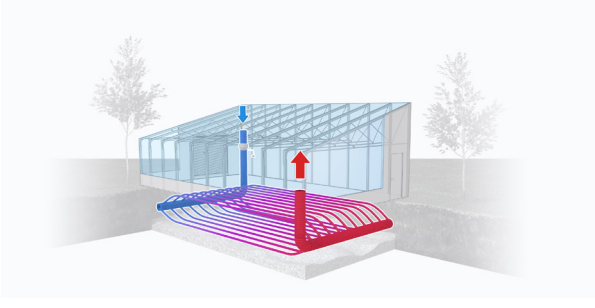
• States used as example climates may not reflect all climates

○* Might be used

Which systems to include will depend on climate and growing needs, and will vary from project to project.

GAHT™ SYSTEM

(GROUND TO AIR HEAT TRANSFER)



Heat from the greenhouse is stored in the soil underground using a system of fans and buried pipes. The soil acts as thermal mass, helping regulate the air temperature of the greenhouse.

COOLING

When the greenhouse heats up during the day, the GAHT™ system draws the hot air from the greenhouse underground. The cooler soil absorbs thermal energy from the air. The air is then exhausted back into the greenhouse cooler and drier.

DE-HUMIDIFICATION

As hot humid air is circulated underground during the day, it cools and reaches the dew point. Water vapor condenses and percolates into the soil through perforated pipes. The exhausted air is cooler and drier, helping reduce the risk of greenhouse pests and diseases.

HEATING

A GAHT™ system also allows the greenhouse to be 'self-heating.' At night or on cold days, the GAHT™ system circulates air through the soil again. The warmer soil now heats the air. Warmer air is exhausted back into the greenhouse, providing low-cost, sustainable heating.

ECO-LOOP™

GEOTHERMAL HEAT PUMP

REFRIGERENT LIQUID

• The liquid moves through subsurface piping via pumps in order to bring steady earth temperature to the surface.

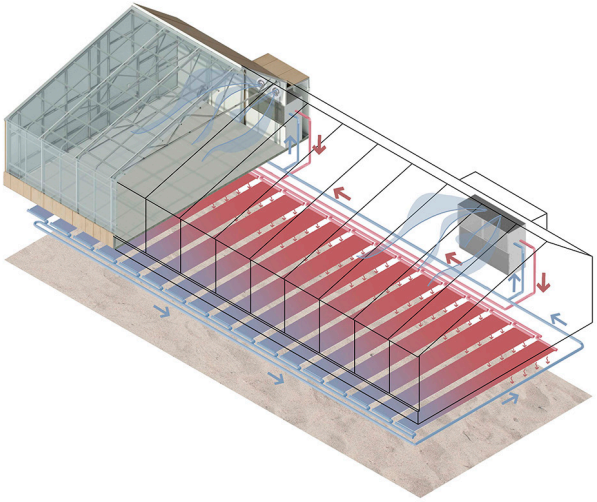
• Heat pumps pull heat or coolness from the liquid and force air over the heat and / or coolness to regulate the climate.

CLIMATE CONTROL

• Pulls moisture out of air as it cools. Water can be collected in reservoirs and used on site.

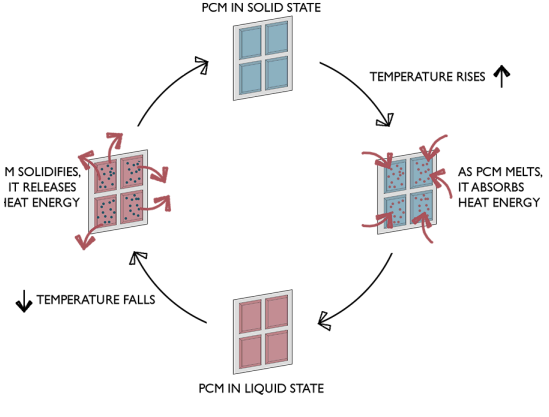
• Will provide cooling in the summer and heating in the winter, as well as dehumidification down to 40%

A closed-loop system that utilizes earth steady temperature to stabilize the climate within the greenhouse. The geothermal, or ground source heat pump, works by exchanging heat with the ground. This system is more energy-efficient because underground temperatures are, typically around 55 degrees, are more stable than outside air tempurature.



PCM

(PHASE CHANGE MATERIALS)



PASSIVE HEAT STORAGE

PCM passively absorbs and releases heat in the greenhouse through the energy transfer of phase changes, going from solid to liquid.

During the day, as the material melts, it absorbs huge amounts of energy called latent heat. When greenhouse cools at night, the PCM 'freezes' and releases this heat.

MASSIVE STORAGE CAPACITY

By passively storing heat in the greenhouse, PCM acts like a battery, just like water barrels (also called thermal mass). However, due to the latent heat transfer of phase changes, PCM has about 5x the storage capacity as the same volume of water.

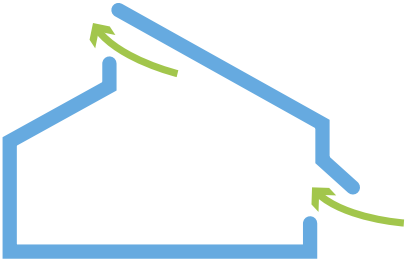
EASY INSTALLATION

Can be built into a new wall or added onto an existing wall, passively evening out temperature swings without sacrificing growing room.

SOLAR THERMAL

Solar energy is used to generate thermal energy. Solar thermal panels are used to collect heat. Particularly in conjunction with an aquaponics greenhouse, the hot water can be used for maintaining appropriate temperatures for the fish and the plants.

VENTING

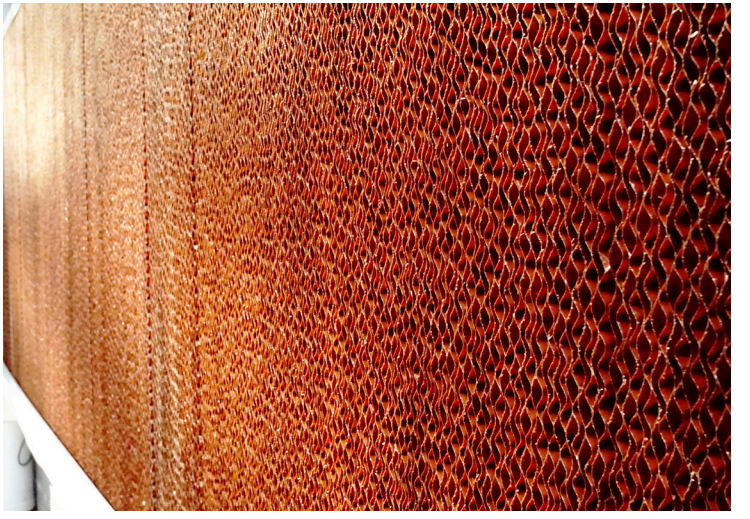


Passive solar vents or solar powered. When designed appropriately vents will encourage natural air flow into and out of the greenhouse, allowing for dehumidification and cooling.

HEAT RECOVERY VENTILATOR

Air-to-air heat exchanger. A device that can provide dehumidification and CO2 supply without overcooling the greenhouse. Incoming air is preheated (or precooled) using the outgoing air of the greenhouse. These systems can recover around 60-95% of the heat in the exhausted air when implemented correctly.

WET WALL



Greenhouse vents allow outside air to enter the greenhouse. Hot air passes through evaporative water wall. Hot air picks up moisture as it passes through water wall, increasing humidity and lowering air temperature by up to 30 degrees .

Wet wall vent is automated and insulated, operated by a greenhouse controller. Opens when air is needed, closes when insulation is needed.

- Air passes through a perpetually watered screen.
- Most effective in hot, dry climates.
- Low energy consumption, high water consumption.

Requires exhaust vents to create airflow in greenhouse.

WOOD BURNING/ PELLET STOVE

A rocket stove is a good example, burning wood or pellets at high temps and heating up surrounding mass, which slowly radiates heat outward. There is more control with pellets maintaining steady temps.

BIOCHAR KILN

Similar to a woodstove, but burns plant material instead of wood, and then uses resultant biochar as a soil ammendment. An anaerobic compost digester is another method to produce energy for a greenhouse, producing methane gas which can then be used to fuel equipment or directly for heating.

COMPOST HEAT

Utilizing the high output of heat, a compost pile produces millions of BTUs of heat per day. Additionally, at the end of a compost pile's life, it leaves a high-quality organic soil amendment/ fertilizer.

ROOT ZONE HEATING

A Co2 distribution system focused on heating the roots. Heating through the root zone is more efficient, leading to higher yields, shorter production times, and even heat distribution. Can cut heating by 50%.

WIND

Wind power is converted directly into electricity. We photovoltaic panels with wind turbines in locations where there is enough wind to generate power.

PV

Solar cells are convert from sunlight into electricity by combining our greenhouses with standard photovoltaic panels. The North edge of the roof is a good place to position these panels, providing both shade where it is needed as well as the power to maka net zero energy greenhouse.

BATTERIES/ ELECTRICAL STORAGE

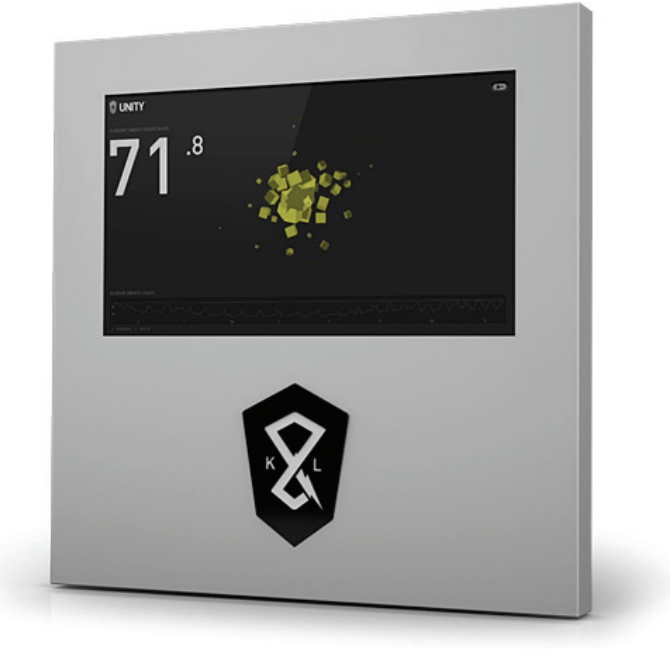
Used to store excess electrical energy produced by solar or wind. Examples include: Lithium ion batteries or a Tesla wall.

SMART CONTROLLER

A controller can help track conditions related to the health of your plants and grow operation, including:

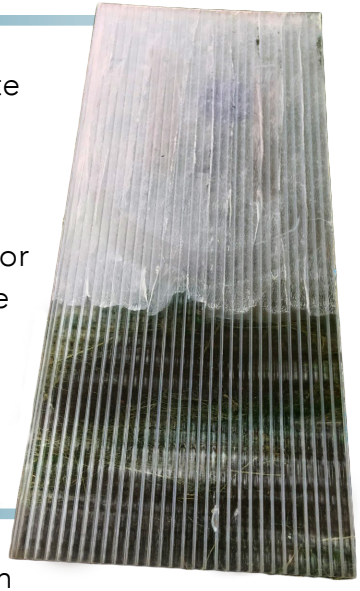
- Temperature and humidity
- Light Levels
- CO2
- Temperature fluctuations
- Soil moisture
- Soil Ph
- Microclimates (for best plant placement)

kW usage and management



SHADE PAINT

Paint is applied to the outside of the polycarbonate glazing. Can be applied when greenhouse temps start to increase above comfortable levels for the plants. Application and removal are easy. Dilution rates will depend on specific greenhouse needs. For example, at a 5:1 dilution at 3,200 sq ft you will see 30% heat reduction and 15% light reduction.



SHADE SCREEN

Simple and low cost. Helps reduce heat gain, when temperatures get too hot. They come in a variety of shading factors, rated by how much light they block, and are most effective when applied to the ouside of the greenhouse.

ENERGY SCREEN

Used as an added layer of insulation during colder months, trapping thermal heat in the greenhouse. Can also be used during warmer months for minimizing light into the greenhouse. Can be used instead of shade screen depending on the climate.

SOLAR FOOD DEHYDRATOR

Dehydration occurs at fairly low temperatures between 100-130 ºF. This removes the moisture from the fruit without creating the hard "crust" that seals in moisture when the fruit is exposed to high temperatures. Heat and air flow are the most important factors when it comes to dehydration. Heat is supplied by solar thermal collection, while air flow is provided by fans in the bottom of the housing, or created passively with convection.

Learn More!