Increasing Energy Efficiency in Greenhouses

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What is a solar greenhouse?
Don’t all greenhouses use the sun?
Types of greenhouses

Cold frames & Hoop houses
- A good 1st step but limited
- Cheap upfront, costly over time

Conventional Greenhouses
- No insulation; hard to grow many things year-round without heating

Solar greenhouses
- Rely on the solar energy for growth, plus heating and cooling needs
4 Design Principles of a Smart Greenhouse

1. Glazing – just right
2. Insulation – wherever there is no glazing
3. Earth is your friend – use it wisely. The greenhouse is just the top of the iceberg AND without good soil you will not succeed no matter how good the greenhouse
4. Increase thermal storage – Phase change, water, stone, etc.
Conventional Greenhouse
Orientation
North - South

Limited Insulation
• Overheating
• Undercooling
Ceres Greenhouse
Orientation
East - West

Good Insulation
• More light
• Stable environment
Challenges with Conventional Greenhouses

- No insulation or heat retention = very high heating load if trying to grow many crops through the winter
- Not made for high wind or snow loads
The Problem: Conventional Greenhouse Design

R-Value normal greenhouse: 2 (best case)
Heating / cooling cost: $3-4/SF/year

R-Value normal house: 8-15
Heating / cooling cost: $0.10-$1/SF/year

A typical greenhouse is 30x more energy intensive than a home if growing year-round in most N. American climates
So how do we get there?
A Ceres™ Greenhouse will be more than 90% more efficient than a conventional greenhouse saving $200,000 (heating with propane) over 10 years in St. Joseph with min. temp of 50F
HighYield™ Framing

- 14 gauge hot dipped galvanized steel
- Rust proof, 25 year warranty
- Local snow and wind requirements up to 95 psf and 130 mph, stamped engineered architectural plans
- Shorter install time, no need for specialized heavy equipment
- Scalable from 30 feet to 200 feet.
The best Polycarbonate

- Designed to maximize 24 ft material spans
- Highest snow and wind load – can be designed as needed
- Thickest upper layer for best hail resistance
- 10 yr warranty
- Aluminum Megalock™ track system dovetails with steel stud framing
- Leak proof design
- Ample opportunity for sealing around glazing
- Easy to replace polycarbonate if ever needed
High Yield: Tougher Insulation

- 24 gauge embossed steel built to last
- 2” to 6” thick – up to R-42
- Insulated metal panels (IMPS) go on the outside and automatically provide inside walls
- Easy install, impermeable vapor and air barrier
- A variety of colors and finishes
HighYield™: The Complete Package
Custom Greenhouse
Many variations

Alberta Canada
Verge Permaculture

Colorado

Dallas, Tx
Golden Hoof Farm

China

Colorado
One step further… A Ground to Air Heat Transfer (GAHT) System

**Cooling**
- Hot days & the summer

**Heating**
- Cold days & the winter
GAHT system in practice
Phase Change Material (PCM)

- Think of this as water 2.0.

- It works to store and release energy in the same way as water does, but can store / release much more energy in a much smaller space.

- Why? Because by absorbing / releasing energy during the phase change from a liquid to a solid

- Heat storage capacity about 5x more than the same volume of water
Other options

- Rocket mass stoves
- Compost heaters
- Solar hot water

Photos:
Top - The Sage School, Idaho
Bottom – Verge Permaculture, Alberta Canada
+ Renewable Power
Growing systems
Customizable

Combine with chicken coops, sheds, sunrooms, sitting area, saunas
Educational
The Result

An abundant year-round garden that relies on the sun

Your own slice of Costa Rica, right in your back yard

Fresh, home-grown bananas, veggies, tomatoes, figs…
Fresh, local food grown food that is smart, sustainable & abundant is possible with energy-efficient greenhouse design!