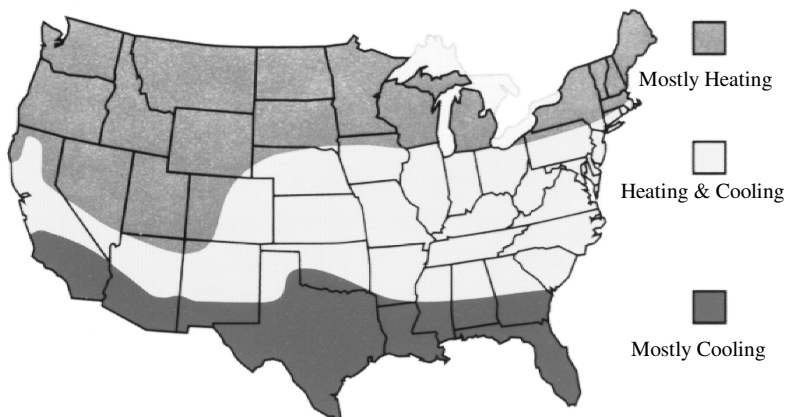

CLIMATE & CLOUDS

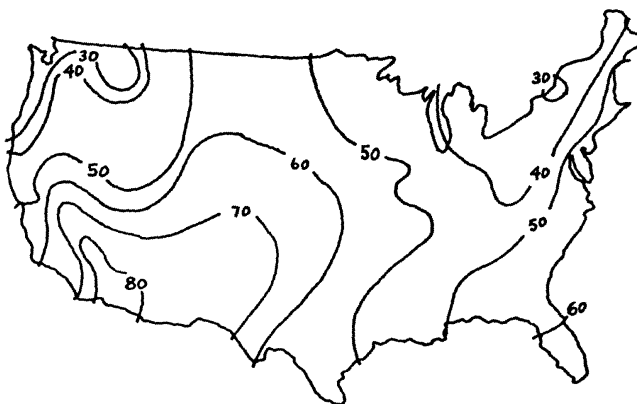
SOLAR THAT WORKS

Where you choose to live will determine, in large part, where your home energy dollars are spent. In much of the U.S., the simple solar strategies outlined here will let you keep more of those heating dollars while giving you an inviting climate responsive home to live in.

Ask yourself two questions: What is the general climate of my site? (Map-1) and how often can I expect to see the sun? (Map-2) The combination of these two factors will help you understand the best solar strategy for your particular location.



Map-1 *Where Americans spend their home energy dollars*



Percent of Possible Winter Sunshine 1899-1938

Map-2 *Percent of Possible Sunshine*

If your goal is a bright, light-filled house with lower heating bills, there are two very simple solar strategies that work in all but the hottest parts of the U.S.:

Build a "sun tempered" house (a conventional home laid out to take advantage of sunlight.)

Add a sunroom to the south side of a standard home.

Either strategy can **save 10% to 30% of your home-heating bill.**

Start with these and then add solar "tweaks" (discussed later) as your interest, budget and climate allows. The more sun you get during the heating season, the more your "tweaks" will pay off.

Only in the sunniest climates (the southwestern states) should you attempt an all-out passive solar home. The payoff there is that it can approach 100% solar heating.

On to "tweaks" for your specific climate and how to think about property before you buy it.

Microclimate

Besides the broad strokes of climate and cloud cover presented by these two maps, each site will have its own microclimate pattern. Look for these local variations when purchasing land in heating climates. They can be the equivalent of moving the house several hundred miles to the south.

For example, **a site open to and slightly sloping to the south will be warmer in winter than surrounding property.** If the site is also protected from winter winds, it will have many natural advantages and will be both brighter and more comfortable than an "average" site of

the same area. This is simple and obvious, but often forgotten by suburban developers.

Ancient homebuilders always took these things into account. In prehistoric China for instance, home designers developed different names for the character of a site and discovered many "lucky" house positions and room arrangements. This became the basis of Feng Shui.

The Natural House chart below has general guidelines for planning a house to meet your local conditions. Make sure you start with a well-insulated house. This reduces both the heating and cooling costs and makes any strategy you adopt that much more effective.

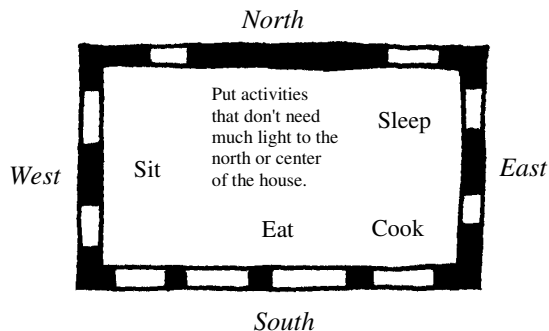
THE NATURAL HOUSE: A CLIMATE-APPROPRIATE HEATING & COOLING STRATEGY

Climate Style	Appropriate Solar Strategy	Notes
Cloudy mild winters	Low to moderate thermal mass with moderate south glass areas.	Good insulation, good windows. Sun tempered and sunspace houses.
Cloudy cold winters	Low to moderate thermal mass with low to moderate south glass areas.	Maximum insulation, the very best windows or use insulated covers at night
Clear cold winters	High thermal mass with large south glass areas	Maximum insulation, the very best windows. Full passive solar houses.
Clear mild winters	Moderate thermal mass with moderate south glass areas	Good insulation, good windows. Some passive solar features.
Hot dry summers	Porches, exterior shades, roof overhangs and deciduous trees all reduce high summer sun into house. Control low west sun particularly.	Provide good ventilation and consider evaporative cooling to augment air conditioning. West windows will need solar reflective coatings or exterior shades.
Hot damp summers	Porches, exterior shades, roof overhangs and deciduous trees all reduce high summer sun into house. Control low west sun particularly.	Provide good cross ventilation at night and design the insulation system to work well with air conditioning. West windows will need shading.
Mild dry summers	Porches and deciduous trees, especially on west.	Provide good cross ventilation and consider evaporative cooling.
Mild damp summers	Porches and deciduous trees, especially on west.	Provide good cross ventilation. Air conditioning seldom needed.

NOTES: Clear means more than 50% of possible sunlight. Cloudy less than 50% of possible.

House shape for solar gain

In a climate where most energy dollars are spent on heating, the rooms should be laid out to follow the sun with the widest side of the house facing south. The largest window areas should also be along this south wall. This is

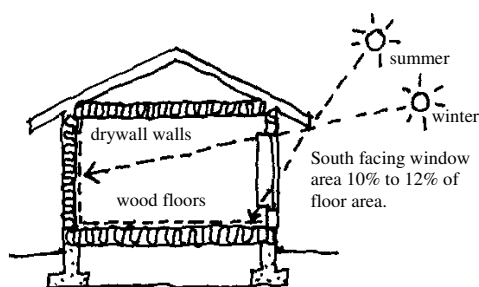


Building shape and room layout for solar

part of the low-cost sun tempered strategy.

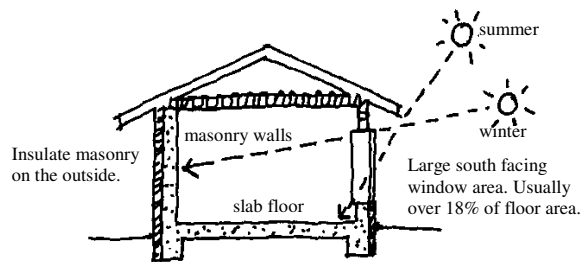
In addition to shape, a house has a certain ability to absorb and store heat. This is called its "thermal mass." A standard wood frame house with a drywall interior has a low thermal mass. It heats up and cools down quickly.

A concrete, adobe or stone house is built with heavy materials and has a high thermal mass. This mass can absorb solar heat without



Sun tempered (low mass) house

overheating the rooms. It will give that heat back later when the temperature in the room drops. When you have a lot of thermal mass



Passive Solar (high mass) house

and a lot of south facing glass you have a true "Passive Solar" home.

Thermal mass sounds good, doesn't it? In the early days of solar home building (the 1970s), these heavyweight solar homes were built all over the U.S. They didn't work very well in cloudy climates.

In sun-starved northern climates, winter sunlight is usually not strong enough to bring a large thermal mass up to temperature. Also the large glass areas lose additional heat at night and on gray winter days. We now know that in such a climate a low to moderate thermal mass is better able to take advantage of those occasionally sunny winter days. Buying better-insulated windows and not overdoing the glass areas also keeps more of the heat inside a northern home.

Simple Solar Recap:

In just about any climate where heating is needed you can build a sun-tempered house (at no additional cost) or an attached sunroom (additional space at additional cost). Either one of these solutions will reduce home heating and provide for a light-filled living space.

If you're building in a cold clear climate like the desert SW, you can build a high mass, high glass full passive solar home and enjoy some spectacular energy savings in a house wide open to the sky.

In between these two solar extremes you can

adjust the thermal mass and south glass areas and fine tune your home to specific climate conditions. The chart below will give you guidelines for inexpensive options.

The Sun-Tempered House

This is the basic solar strategy. **A sun-tempered house is nothing more than a standard wood frame house that is properly sited to see the sun.** The south wall glass area should not be so great as to overheat the low thermal mass. Such a house will often provide much of the spring and fall heating and some of the winter daytime heat (when the sun is out). Because of its low thermal mass, the house does not store much heat overnight.

Sunrooms and Greenhouses

Sunrooms work in all climates because they are an unheated space that gives heat to the house when the sun is out. During much of

the year such a room serves as a bright daytime living space and plant growing area. In summer the sunroom can be left open to vent heat.

A sunroom or greenhouse makes a great entry space and serves as a natural airlock and buffer zone for the house. It can also be added to an existing house that was not laid out well for sunlight.

Solar Tweaks for mass and glass

If your climate gets decent winter sun, let's say 50% or better of possible sunlight (map-2), then you may want to consider adding glass and mass to the basic sun tempered house design. Doing so will increase the winter time light levels and lower the heating costs.

The easiest of these moderate mass strategies is to double the layers of drywall. It adds a bit of cost of the house, but you may want to do it just for the sturdier walls it gives you.

SIX OPTIONS FOR A LOW COST SOLAR HOME

	Strategy	South Glass Area	Thermal Mass	Notes
Works in All Climates	Sun tempered house	10-12% of open floor areas	Standard construction: wood floors &	Open floor plans work best. Can save 10-30% of heating costs. Works everywhere.
	Sunroom or greenhouse addition	Unlimited. Control overhead glazing to reduce summer heat.	Slab floor plus additional mass as appropriate.	Open to house when solar heat is available. Close off at night and on cloudy days.
Solar tweaks for Intermediate Climates	Double drywall	10-14% of open floor areas.	Distributes additional heat storage throughout	Two layers of drywall. First is screwed to studs, second uses adhesives. Gives a high quality solid wall.
	Concrete topping slab over wood floor	12-16% of open floor areas.	2" to 4" of concrete	Often used for radiant floor heating systems. Use higher density concrete to increase thermal mass.
	Slab on grade floor system	12-18% of open floor areas.	Insulate at edges and under the slab.	Build on dry well drained soil. Do not cover with carpet and pad in solar areas.
Clear & Cold	Vertical masonry walls	Over 18%. Consult a local designer.	Masonry should see the sun and be dark colored.	Should be used only in strong winter sun climates such as the desert SW. This is full passive solar.

Radiant Floor Heating

Adding thermal mass to a house often increases comfort levels because it evens out temperature fluctuations. This is one reason radiant heated floors are so popular. Such a heating system can be built on a standard wood floor (this is called a topping slab) or as a slab poured on grade. Either of these can also be used to store solar energy. The slab on grade floor will soak up more heat because it is thicker and usually made with denser concrete.

Whether or not you put heating coils in the slab, any dark colored flooring surface will absorb solar heat and even out interior temperatures. See the options chart for suggestions on how much south facing glass to install.

Floor area and south glass areas

Let's go through an example to understand how to calculate glass areas. Let's say the

main floor of your house has an open floor plan with the kitchen, eating and living areas having a combined area of 800 SF. Into that space we could put 80 to 96 SF of south facing windows to get the sun tempering effect. This is 10-12% of the open floor area. This will make for a bright open interior. If you have a slab-on-grade floor you could increase the south windows to 144 SF. That's eight 3' by 6' windows!

What if I put in more south glass than recommended?

If you go too far, your closed up house will likely overheat on sunny spring and fall days. If you can vent this excess heat or always be there to open windows, go for it!

There are no fixed numbers that are gospel for any specific location — weather and microclimate patterns vary too much for that. Consider these numbers as general guidelines. Once you have the concept of balancing mass and glass you can find out what has worked well locally and make appropriate adjustments to your plans.