



Sun 101: Solar photovoltaic and heating systems

THERE IS something profoundly wild about integrating nature into a home. While most strive for this, few attain true assimilation of the earth, wind, sun, and water into the built environment. The compelling aesthetic of timber frame homes is their reference to times past where man was literally closer to his environment. The massive wood structure recalls the trees of ancient forests.

In the previous Ecologic column, I addressed how geothermal earth-tied systems are the most efficient, very comfortable, and the premier solution for indoor air quality. In this issue, I will touch on a second aspect, simply called Sun 101.

Rather than jump into technical system configuration for solar heating or power generation, we must understand at a macro perspective how to harness the sun's energy for our benefit. In doing so, we will be protecting the Earth's limited resources. For those readers needing "the approved solution" for solar heating, you will find web-based references within this article. I am excited about solar technology; other than attic insulation, do-

mestic solar hot water has the highest financial payback and the lowest environmental impact of all heating systems.

The available power (either as heat or PV energy) is determined by the duration and intensity of the sun and is referred to as "solar insolation." Solar insolation varies by the latitude in degrees north of the equator for the northern hemisphere and by the time of year. The annual change in the position of the Earth's axis relative to the sun governs the duration and intensity. Solar insolation charts showing the solar power available for a particular location in the world are available on the web. With few exceptions, solar panels (whether electrical or thermal) should be oriented for optimal solar exposure with an emphasis on capturing the winter midday insolation. Due to higher heating loads in the winter, a fixed tilt array is set favoring winter operation, i.e., set steeper to favor lower winter sun energy.

For typical residential applications, install solar panels on fixed mounts. You can also mount the panels parallel to a south-facing roof with some efficiency loss; how-

ever, you should always put a 4- to 6-in. gap underneath to prevent snow build-up and allow rain runoff. As an option, you can install a mount that allows you to manually adjust the vertical tilt angle for the seasons. This would improve your fall and spring performance by up to 25% over the winter insolation.

Contrary to the solar systems installed in the mid 1970s, today's solar hot water systems are simple to understand and implement with high reliability. Any system should: 1) function year round, requiring little maintenance and no operator intervention when it is freezing outside; 2) provide safe hot water for potable applications; 3) be energy efficient; and 4) be integrated into the other house systems (boiler, radiant heating, domestic hot water heater, etc.). These requirements can be met with less than a \$3,000 investment in components for a typical 4-person residence (estimating \$750 per person).

I need to complete this installation on my own house, integrated with the geothermal heat pump. I figure I need a heat exchanger, a circulation pump, some solar panels, a control or two, and some 3/4-in. hardwood pegs. If the system works as advertised, I will report back to you. If it fails, the hardwood pegs will keep the ethanol water in the solar panels from draining out until I figure out what to do next.

—Al Wallace

Internet resources for solar power

U.S. solar insolation map:

howto.altenergystore.com/Reference-Materials/Solar-Insolation-Map-USA/a44/

World solar insolation map:

howto.altenergystore.com/Reference-Materials/Solar-Insolation-Map-World/a43/

Detailed solar insolation and climate data from the National Renewable Energy Lab by U.S. city:

<http://rredc.nrel.gov/solar/pubs/redbook/>

Focus especially on the first chart, Flat-Plate Collectors Facing South for Fixed Tilt, and the last chart, Average Climatic Conditions.

Site specific survey evaluation for solar energy:

www.builditsolar.com/SiteSurvey/site_survey.htm

Orientation for solar panels based on latitude and site:

www.macslab.com/optosolar.html

Example configuration that satisfies the four requirements cited at left:

www.azsolarcenter.com/technology/solarb20.html.