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Renewable Energy Fact Sheet

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Solar Architecture

Designing buildings to use solar energy for heating, cooling, and lighting

Key Facts

- Simple architectural modifications allow residential and commercial buildings to use solar energy directly for heating, cooling, and lighting.
- By designing buildings to match local conditions, solar energy can be harnessed anywhere in the world, even in cold, northern climates.

Solar Architecture Technologies

- *Passive lighting systems:* Large south-facing windows are the easiest and cheapest way to increase light in a building, since the south side of a building receives the most sunlight. Clerestories, rows of windows near roof peaks, are also used to provide natural lighting. An open building design, with glazed apertures, light shelves, and light pipes can transmit sunlight into building interiors.
- *Passive heating systems:* Absorptive materials can also be built into south-facing walls to store heat during the day and then slowly release this heat at night. These walls, known as Trombe walls, could have a dark outer layer, or they can be painted to look no different from the rest of the building. Sunspaces, glass rooms built on the south side of a building, can provide up to 60 percent of a home's winter heating, and homeowners often consider them one of the most pleasant rooms in their home. Proper ventilation allows the heat from the sunspace to circulate through the rest of the building.
- *Active heating systems:* Active heating systems pass air under or through heat-absorbing metal plates, and then use fans to blow the warm air throughout the building.
- *Active cooling systems:* Evaporative cooling systems use solar collectors to evaporate refrigerant. A heat exchanger uses this evaporation process to cool the ambient air, and fans circulate the cool air throughout the building.

Benefits

- *Durability:* Most of these architectural features require little or no maintenance and will last for decades once installed.
- *Passive designs:* Many of these designs are passive and do not require electricity, so they continue working through power outages and brownouts.
- *Pollution prevention:* Using solar architectural features does not release greenhouse gases or other pollutants.
- *Security:* Solar architecture can reduce electricity demand significantly, reducing electricity bills and helping to reduce energy security concerns associated with depending on foreign countries for oil and natural gas.

Cost

- Solar architectural systems are cost effective in many applications. New office buildings, for example, can achieve 30 to 50 percent energy cost reductions below national averages through a combination of energy conservation and passive solar systems, according to the US Department of Energy. These new buildings realize an annual cost savings of $0.45 to $0.75 per square foot.
- With savings in electricity or natural gas, active solar heating systems pay for themselves in 7 to 10 years. The initial cost of a solar space heating system for an average single-family house is between $5,000 and $10,000, while a new electrical heating system costs on average $1,500. Solar panels often come with a 10-year warranty and have an expected lifespan of 20 years, so solar heating systems should result in lower heating bills for years.

Issues

- *Summer heat gain:* Keeping solar buildings cool in the summer requires additional architectural features. Overhangs and trees can shade windows, and advanced glazings can let in light while rejecting heat. Trombe walls and sunspaces can be sealed off from the rest of the building during summer months, and well-designed ventilation can help keep buildings cool.
- *Seasonality:* Solar energy may only be available seasonally. In northern regions, for example, short winter days and overcast skies may reduce the light and heat available from solar energy, although buildings can still be designed to take advantage of all available solar resources.

For More Information

Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory
http://eetd.lbl.gov/BT.html
National Renewable Energy Laboratory http://www.nrel.gov/clean_energy/solar.html
Sustainable Buildings Industry Council http://www.psic.org/
DOE Office of Efficiency and Renewable Energy http://www.eere.energy.gov/solar/solar_heating.html

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