SERVICE IN ACTION

COLORADO STATE UNIVERSITY EXTENSION SERVICE

Energy conservation for the home

Betty Jo White[1/]

no. 9.935

Quick Facts

Siting and house design can contribute to an energy efficient structure.
Natural features of the site should be used to best advantage.
The house should be oriented with the sun and wind in mind.
Landscaping should protect the house as well as beautify.
House shapes and types that are practical to heat and cool should be selected.
Floor plans can be designed to conserve energy.
Large glass expanses should be limited.
Construction and mechanical systems in a home can be designed to make a difference in energy savings.
Heat loss occurring from slabs, crawl spaces and basements can be reduced.
Installation of insulation and vapor barriers can reduce heat loss.
Correct color and lighting can help in energy saving.

Many features of the home can make a difference in both winter and summer comfort, as well as in energy savings for heating, cooling and lighting. The following checklist can help consumers learn about energy efficient structures and evaluate a home.

Siting

When planning the siting and orientation for a home, the local zoning ordinances and subdivision regulations should be checked. In many communities, the setback requirements may be inflexible so that good siting is difficult. However, in open, rural areas, proper siting for energy conservation may be possible and is particularly important.

_____ *Natural features of the site should be used to best advantage.*

Houses can be tucked into valleys instead of built on hilltops, put on protected sides of hills, built on the south or southwest (sunny) sides of slopes, or built partly into hills for natural insulation.

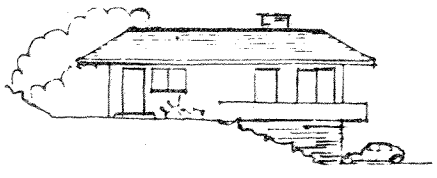

Figure 1: Houses can be built into hillsides for natural insulation.

Rooms at basement level or partly underground have additional earth protection against weather. The relatively constant year-round ground temperature reduces winter heat loss through below-grade walls and provides a cooling effect during summer. Excessively exposed foundation walls have high winter heat loss through the concrete. The ground surface around the house should be adequately sloped so that surface water will drain away from the dwelling.

Avoid clearing vegetation and protruding rock formations that can act as protection. Natural streams should not be filled in or covered during construction: a site with running water will be cooler in the summer than a dry one.

_____ *Orient the house with wind and sun in mind.*

If there is a choice, it is thermally advantageous to have the main roof of the house about parallel to the east/west axis allowing more south-facing windows for better summer cooling and to provide a more desirable location for a solar heat collector in the future.

In cold weather areas, winter winds generally come from the north, hence walls with the best insulation and the least glass should face that direction. If design permits, the shortest wall should face north; however, with a mobile home, the short side should face into the prevailing wind, from whatever direction it comes.

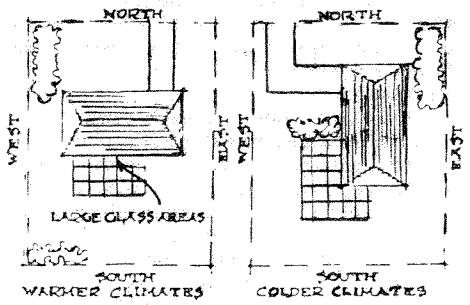

Figure 2: Houses should be oriented with climate in mind.

If extensive glass areas are used, they should face south so that the low winter sun will shine into them during much of the winter daylight hours and be shaded by an overhang from warm summer sun. This is equally important in warmer climates where cooling is the primary concern. With properly designed (wide) roof overhangs or awnings, little or no sun will come in during the summer. By contrast, east or west windows pick up heat almost half the day, putting an extra load on the cooling system.

[1/] *Betty Jo White, CSU assistant professor, housing (revised 8/1/80; formerly Service in Action sheets 9.935 and 9.936)*

_____ *Garages/carports/porches can be placed to reduce energy load.*

In cold climates, locate attached garages on the north, northeast or northwest exposures. Keep the doors of any attached garage closed when not in use. In hot climates, the attached garages or carports should be on the east or west walls of the dwelling to shade east or west glass, thereby reducing heat gain. Attached porches also shade walls and windows from direct sun rays.

_____ *Landscaping should protect as well as beautify.*

A row of evergreens or a slatted fence located a short distance to the north or northwest of a house can be an effective barrier to cold winter winds that increase heat loss from buildings. Shrubs or berms that surround an exposed doorway have the same effect.

Tall, deciduous shade trees on the south, west or east sides will reduce solar heat gain of walls, windows and roofs in the summer, yet in winter when the leaves have fallen, will not block the roof and walls from the warming rays of the sun. Vines and low shrubbery on the south and west sides of the house also provide protection. Cooling units (compressor-condenser units) also should be shaded by structures or plantings.

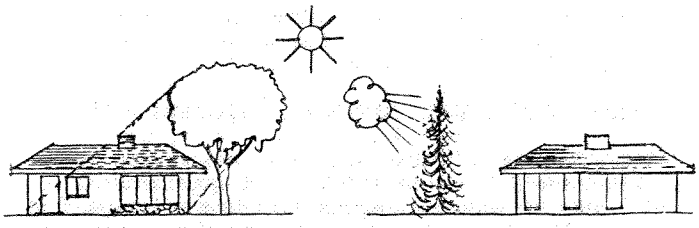

Figure 3: Landscaping should protect as well as beautify.

House Design

When designing or planning to have a new home built, a check with local authorities on building codes should be made to see if the design can be built in the area.

_____ *Local climate conditions must be considered.*

A house that is functional and practical in southern California might look just as good in Colorado, but a sprawling layout and large glass expanses could make it very expensive to heat and cool.

_____ *Choose house shapes and types that are practical to heat and cool.*

The key is the ratio of wall area to floor area; reducing the ratio of exterior wall area to floor area will reduce energy demand. A round house is the most efficient in this regard, but this shape is difficult to build and perhaps to live in. A square house is the next best, and after it, the simple rectangular shape.

Avoiding the use of L-, H-, U- and T-shaped dwellings conserves energy. One can see why mobile homes present a special heating and cooling challenge since they provide more outside wall surface for heat loss.

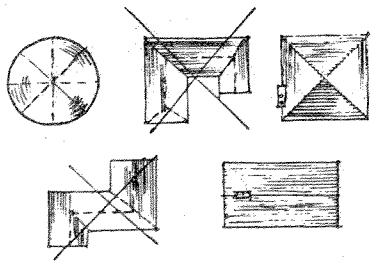

Figure 4: Some house shapes are more practical to heat and cool.

Wherever practical and especially in colder areas, two-story houses should be built. Less heat is lost through the roof in a two-story unit since there is a lower proportion of roof area to floor area.

Multifamily construction reduces heat loss and heat gain. Townhouses, semi-detached dwellings, duplexes, triplexes and apartments in multifamily structures all have less heat loss per square foot of floor area than single-family detached dwellings, other things being equal, since they each share one or more common walls with another dwelling unit.

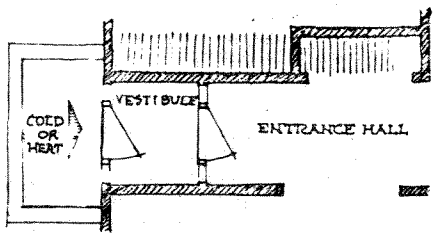

Figure 5: Entry halls can reduce the flow of cold air into the house.

_____ *Floor plans can be designed to conserve energy.*

Entry halls for front and back doors can be closed off to form "vestibules," reducing the flow of cold air into the house and preventing the warm air from escaping, especially in homes with heavy traffic. Additionally, a family trained to open and close doors quickly and no more than necessary can reduce its fuel costs. An aid for an "untrainable family" is the automatic door closer.

Grouping common living space in one part of a house and the sleeping quarters in another facilitates zoned heating and cooling and also allows one section to be easily closed off when not in use.

If the main living area has as few partitions as possible, heat can be distributed best. Family rooms, living rooms, kitchens and dining rooms facing south and west will be warmed by the afternoon sun. Bedrooms can be oriented to the morning sun, thus easily cooled down for comfortable sleeping.

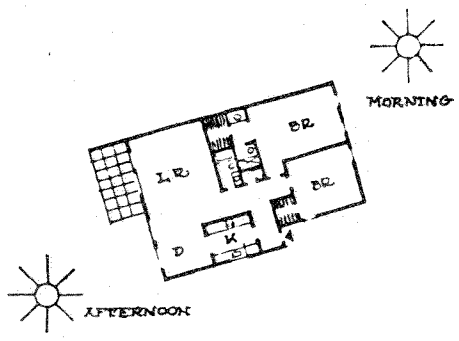

Figure 6: A good floor plan can help conserve energy.

_____ *Large glass expanses should be limited.*

Glass is the single largest source of heat loss from a structure, even with storm glass or double glazing. The window area of the typical dwelling is probably equal to about 15 percent of the floor area. This can be reduced under most local building codes to 10 percent.

When reducing window area, it is preferable to do so by raising the sill height. This has two advantages. First, it keeps the upper portion of the window that provides better natural illumination. Second, it helps to reduce heat gain in the summer because the upper portion of the window is more easily shaded by the overhang.

Windows should not be positioned only with a view in mind; wind and sun direction also must be considered. East and west windows should be kept to a minimum unless they can be shaded by trees, tall shrubs, fences, awnings or tinted glass. Panoramic windows may not be advisable on the east or west sides of a house even if the most scenic view is there. As noted previously, large glass expanses should almost always be located on the more temperate southern side.

Shading southern exposure glass with a retractable overhang, awning or operable shutters is an important method of reducing heat gain in the summer without impairing heat gain in the winter, while providing wind

protection at all times. If half of the 10-percent glass area is in operable windows and the other half in fixed-glass (inoperable, *insulated*, double glass windows), the result will be the benefits of both ventilation (operable) and less heat loss (inoperable). Operable windows should be placed so that cool air can travel through the house in summer and escape at the high point of interior space, such as an upstairs hallway window.

_____ *Roofs should be designed with climate in mind.*

Even with a well-insulated ceiling, the color of the roof makes a difference in heat gain. Light-colored roofing materials reflect rather than absorb sunlight, thus considerably reduce the load on cooling equipment in warm climates; however, a dark-colored roof may be better in cold areas.

Cathedral or vaulted ceilings are dramatic but can create serious problems in both heating and cooling. Since warm air rises, heating high-ceiling rooms is especially difficult. Energy may be wasted conditioning air in the high unused spaces except with forced air heat where return air grilles are placed high in that area.

Construction

These points on construction have been separated from design, but they cannot be achieved unless they are designed to be constructed to reduce heat loss and gain.

_____ *Reduce heat loss from slabs, crawl spaces and basements.*

In slab-on-grade construction, heat loss occurs mostly around the edges of the slab; thus, the use of edge or perimeter insulation will save energy. If a perimeter heat duct system is used under the slab, the savings using edge insulation are even greater.

Floors over unheated basements or crawl spaces should be insulated to at least the same degree as exterior walls. If a crawl space is unheated, using closeable vents (open in summer and closed in winter) and a moisture barrier ground cover will reduce heat loss and control moisture problems even if the floors, heating ducts and pipes are insulated. A crawl space foundation also needs perimeter insulation. The vents should not be closed in winter if the heating unit is in the crawl space.

An alternative and sometimes more economical design is a heated crawl space used as a plenum with a vapor barrier on the ground and insulation on the perimeter walls rather than in the floor. This reduces the area and costs of required insulation and cost of duct work.

"Skirts" should be built around any exposed base of a house, especially under porches or mobile homes, to reduce air flow under the structure. Additionally, insulating the portion of basement wall exposed above ground saves energy. Basement walls can be insulated by installing furring strips, adding insulation and covering with gypsum board or plywood.

_____ *Reduce heat loss with insulation and vapor barriers.*

Vapor barriers should be installed on the "warm" (room) side of all insulation to protect it from moisture absorption (which will reduce its insulation capacity and damage the house framing structure).

Adequate amounts of insulation installed properly (no gaps) in the exterior walls, ceilings, basement walls, floors over unheated garages, basements and crawl spaces, and slab and crawl space perimeters make a large difference in heat loss and heat gain. (See Service in Action sheet 4.651, *Building insulation for comfort and energy conservation.)*

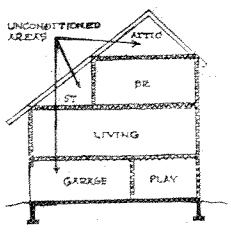

Figure 7: Enough insulation should be used between conditioned and unconditioned areas.

Heating ducts and hot water pipes in unheated spaces (including attics) should be wrapped with insulation. A loss of heat in the distribution ducts influences the temperature of the entire house.

_____ *Use double-pane glass in all windows and exterior doors—either insulating glass or storm glass.*

No single glass windows should be installed. Double glazing or storm doors and windows are just as functional in warm climates as in cold ones.

Metal windows without thermal breaks or barriers should not be installed. Thermally conductive metal frames cause heat loss and condensation and make balanced heating difficult. Thermal break-type metal windows reduce heat loss and condensation. Wood sash windows have less heat loss and condensation problems.

_____ *Prevent air infiltration with weatherstripping and caulking.*

Air leaks are one of the biggest causes of energy waste. Doors and windows seldom fit perfectly into their jambs. Weatherstripping is a simple way to make them tight. A compressible sill sealer-filler between the top of the foundation wall and the sill of the house is especially important to reduce air infiltration, as is caulking outside joints and cracks. Caulking may dry out and need replacing on occasion.

Mechanical Systems and Equipment

When buying a house, ask for a description of the insulation and data on the efficiency of space heating, air conditioning and water heating plants or have an independent engineer advise you about the efficiency of the equipment provided.

_____ *Attic ventilation.*

When insulation is used in the ceiling, attic ventilation is required. Ventilation of the attic space can remove unwanted moisture and reduce air temperatures significantly during the summer. Good ventilation can reduce the need for mechanical cooling. In fact, in many regions air conditioning would be unnecessary if houses were properly ventilated. Attic ventilators must be positioned properly to operate efficiently. Air should be drawn from the cooler, shady side of a house. Cross ventilation should be designed wherever possible.

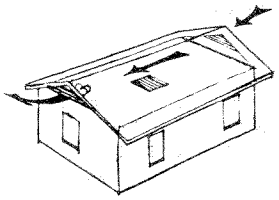

Figure 8: Ventilating fans should be used to reduce air-conditioning loads.

_____ *Kitchen and bathroom exhaust fans.*

Exhaust fans should be installed in kitchens, baths and laundry rooms to help reduce the cooling load. Without ventilation, these rooms tend to become hot spots and can affect the operation of nearby thermostats. The use of ducted kitchen and bath exhaust fans should be minimized in cold weather because they remove heated air from the house and can be the source of large amounts of infiltration air due to backdrafts. (To avoid this, a model with a positive closure shutter and/or unvented, recirculating filter type can be used.) Overuse of exhaust fans can be costly. Timers should be installed to insure that fans operate only the few minutes needed to remove smoke, steam or odor.

_____ *Heating/cooling systems.*

Heating and cooling equipment should be properly selected, installed, operated and maintained. The heat loss and heat gain requirements of the home should be carefully determined and properly designed equipment installed. Efficiency ratings of most comfort conditioning systems are available and should be

consulted before a purchase is made. Oversized equipment operates in short cycles resulting in poor comfort conditions, lower seasonal efficiency and higher energy consumption. Individual room air conditioning units use proportionately more electricity and are less efficient than a properly-sized central system.

Thermostats must be located on interior walls and be unaffected by drafts, heat generating appliances, sunlight, etc. The use of zoned heating and cooling systems will permit conditioned air to be channeled where it is needed most at specific times; i.e., heat only bedrooms at night. Additionally, the installation of a clock thermostat will automatically reduce heat a few degrees at a regular hour (i.e., bedtime) and return it automatically at another preset hour (i.e., morning).

Some heating and cooling systems feature other energy-saving extras. Heat retrieval systems capture heat that might otherwise be totally lost. Open-air cycle devices, offered on some newer air conditioning systems, automatically compute whether indoor or outdoor air can be cooled more efficiently; whichever is cooler and less humid is used. A continuous air circulation (CAC) type of forced air heating system results in more even temperatures. If electricity is the source of energy for heating the use of heat pumps can reduce energy needs.

The furnace should be centrally located to reduce the length of air ducts. Clogged filters substantially reduce efficiency both for heating and cooling.

Fireplaces.

Fireplaces can be sources of heat loss as heat travels up and out a chimney. A fireplace with an automatic damper, a built-in heat distribution system and a glass firescreen is ideal. Proper damper control (closed except when there is a fire) is very important. A glass firescreen insures that minimum house heat will be lost up the chimney; ventilating holes provide the oxygen needed to keep the fire alive and also allow the odor and crackling noise to escape into the room.

Fireplaces and/or chimneys should be placed on interior walls if possible so that heat from the chimney is radiated within the house instead of escaping through an exterior wall.

Water heaters.

Avoid water heaters with greater capacity than needed. Select a water heater with thick insulation on the shell and install in a heated space as close as possible to areas of major use. If gas is used for heating water, install a water heater with modulating capacities. These have two burners and overall efficiencies are higher than for the single-burner type.

Water heater temperatures can be lowered for most uses to save energy. A setting of 120°F (48.8°C) is adequate for bathing and clothes and dishwashing, but not to disinfect dishes or clothing. Additionally, a low water consumption shower head (a flow restrictor that fits into the pipe to the showerhead) can be used to restrict the flow to an adequate 4 gallons (15 liters) of water per minute.

Humidifiers:

Higher humidity provides equal comfort at a lower air temperature. For example, if the relative humidity is increased from 10% to 40%, equal winter comfort can be achieved with the air temperature reduced approximately 3°F (2°C), thus an energy savings. Dehumidifying in the summer has the reverse effect; it allows the thermostat setting on the air conditioner to remain a few degrees higher without discomfort.

Home appliances.

Unfortunately, some major and minor appliances are needless energy wasters. Consider the wattage requirements vs. the need for convenience and specify the most efficient model and size of each appliance purchased. (See Service in Action sheet 9.715, *Energy conservation—wise use of appliances.)*

The location of appliances can affect their efficiency. A refrigerator placed near a radiator, range, or in the direct sun is forced to work much harder than necessary; likewise a range installed near a frequently-opened window or door has to overwork to keep hot. Laundry appliances should be placed in warm areas to give optimum performance.

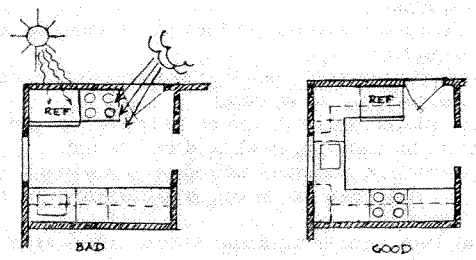

Figure 9: Position of appliances can affect their efficiency.

Color and lighting.

Light to medium colors for interior walls, ceilings, floor coverings, draperies and upholstery reflect light and thus reduce the amount of artifical light needed.

Although lighting consumes a relatively small portion of the electricity used, it should not be wasted. During the winter, heat loss from lighting is regained in the structure; however, in the summer lighting adds heat to a dwelling. Not much can be done about this in terms of installed capacity, although the use of less general purpose lighting and more specific purpose lighting will tend to cut back the total energy use.

Fluorescent lamps should be used when possible since they produce nearly four times as much light per watt as does the typical incandescent light bulb. Incandescent bulbs do, however, put off more heat and less heating fuel may be consumed with their use, depending on the amount of lights used and the season.

Do not use recessed or "bullet" lamps that penetrate into unheated space such as an attic, since all heat from such lamps will be lost and they can be a source of air infiltration. (Furthermore, they are a substantial noise transmitter, particularly for airplane noise.) All light fixtures should be located so they can be easily cleaned since dust on bulbs and tubes reduces illumination.