Energy Management in the Home
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This publication offers a wide variety of ways to manage your energy costs. You may be surprised at how many simple and inexpensive techniques there are to reduce your monthly energy costs.

ENERGY COSTS IN THE FUTURE
Although the use of energy in the United States has not increased as rapidly in recent years as it has in the past, use here and abroad is increasing. Because the world’s supply of fuels is limited, the price of oil, natural gas, liquid propane, and electricity is expected to rise.

Enormous expenditures are required to:
- explore for oil and gas at greater depths and in remote areas, including the ocean floor, and to move these resources to the consumer;
- pay prices set by other nations, which already supply more than half of U.S. petroleum needs;
- construct nuclear power plants, especially those with advanced technology;
- extract sulfur from coal in order to reduce acid rain and to haul that coal to distant power stations;
- retrofit existing power stations with expensive scrubbers to remove sulfur dioxide from flue gas;
- develop plants to convert oil shale, tar sands, and coal to gas and liquid fuels;
- investigate the development of alternative sources of power, such as solar, geothermal, and tidal.

These costs and interest on long-term investments in power facilities will be paid by consumers through higher fuel prices. Managing our rate of energy use now will extend our energy supplies and slow the rate at which prices will rise.

CHECK LISTS FOR HOME ENERGY MANAGEMENT
Of the total amount of energy produced, more than one-fifth is used to heat and cool houses, offices, schools and factories. The following suggestions will help you better manage your home energy costs without making major changes in your lifestyle or house.

DESIGN AND CONSTRUCTION
In winter and summer your home should shield you and your family from outdoor temperatures, precipitation, and wind. Planning is the key to making sure your home is comfortable.
**Room over garage.** The floor of a room over a garage should have six to nine inches of insulation and a vapor retarder. The ceiling should have fire protection, such as Type X gypsum drywall.

**Windbreak planting.** Winter winds increase heat loss from buildings. A tall fence or a dense growth of evergreens will reduce wind impact.

**Earth protection.** Basement rooms or earth-bermed houses provide additional protection against weather. Homes built fully underground are prone to moisture problems and may lack fire exits from rear rooms.

**Summer**

**Building orientation.** For a given building design, an orientation with the long axis of the house east-west will result in less solar heat gain in the summer and more solar heat gain in the winter, particularly if there is a properly designed overhang.

**East- and west-facing glass.** Solar heat gain through unshaded east and west windows is twice as great as through equal-sized south windows.

**Roof surface.** A light-colored roof reflects more solar heat than a dark-colored roof. This is not as important if the attic is properly insulated and ventilated. A flat roof can be sprayed with a reflective paint or covered with white stone chips.

**Attic ventilation.** The attic should be properly ventilated to remove solar heat gain and moisture build-up. A proper combination of continuous overhang and ridge vents eliminates the need for power venting.

**Crawl spaces.** A polyethylene vapor retarder should cover the entire soil surface to control moisture evaporation into the house.

**Porches.** A wide porch serves as an outside living space and shades the walls and windows against solar heat gain.

**Shade planting.** Tall deciduous trees on the east, south, and west sides will reduce solar gain of walls, windows, and roofs.

**Drainage.** Landscaping should be sloped to divert water away from the foundation. Water collecting around the foundation may cause a damp basement or crawl space, requiring a dehumidifier. Gutters must be cleaned and maintained. Window wells and area-ways can be covered with glass or plastic to divert rainwater.

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**EQUIPMENT SELECTION**

Just as planning for the design and proper construction of your home is important to enhancing your comfort, so is selecting the most efficient and cost-effective equipment to serve your energy needs year round.

**High-efficiency heating systems**

There have been significant advances in the design of furnaces and boilers in the last 20 years. Heating units converted from coal to gas or oil may have an efficiency as low as 45 percent. Gas- and oil-fired units made before 1965 often have an AFUE (Annual Fuel Utilization Efficiency) as low as 55 percent. Units produced from 1960-1975 seldom had efficiencies greater than 65-75 percent. Prior to 1992, gas- and oil-fired furnaces and boilers were manufactured with efficiencies as low as 65 to 80 percent.

Implementation of federal energy regulations in 1992 set minimum efficiency standards for heating and cooling systems. Furnaces and boilers are now required to have AFUE efficiencies of 78% or higher. Heating units that conform to present minimum efficiency regulations usually use electric ignitions and automatic flue dampers or induced draft fans, and they operate in the high 70s to
New furnaces are required to have an efficiency rating of 78 percent or higher.

**SEER Example**

Assume a home requires a unit with a cooling capacity of 36,000 BTUh and is located where the cooling system necessitates running the unit a total of 1000 hours. Assume electricity costs residents 10 cents per kilowatt hour. To determine the projected annual operating costs of a unit with a SEER of 6.5 compared to one with a SEER of 10.0, apply the following formula:

\[
\text{Electric Cost of Operation} = \left( \frac{\text{Capacity (BTUh)}}{\text{SEER}} \right) \times \frac{1000}{10} \times 10 = \text{Cost of Operation}
\]

### SEER 6.5

- **SEER**: 6.5
- **Capacity (BTUh)**: 36,000
- **Operating Hours per Year**: 1000
- **Electric Rate (cents per kWh)**: 10

\[
\text{Cost of Operation} = \left( \frac{36,000}{6.5} \right) \times \frac{1000}{10} \times 10 = $554
\]

### SEER 10.0

- **SEER**: 10.0
- **Capacity (BTUh)**: 36,000
- **Operating Hours per Year**: 1000
- **Electric Rate (cents per kWh)**: 10

\[
\text{Cost of Operation} = \left( \frac{36,000}{10.0} \right) \times \frac{1000}{10} \times 10 = $360
\]

### High-efficiency cooling systems

The efficiency of air conditioning units, both central and window, has changed substantially. Units manufactured before 1975 usually had a Seasonal Energy Efficiency Ratio (SEER) of 6.0-6.5. Due to implementation of the 1992 energy efficiency regulations, a SEER of 10 is now the minimum efficiency required for a manufactured central unit.

Replacement air conditioning systems should be properly sized. Oversized or over-capacity units may create problems with the control of interior humidity. Units are available with a SEER of 10-12 and some exceed 15. Geo-thermal based systems can reach as high as 20.

### MAINTENANCE

When serviced annually, heating and cooling equipment operates more efficiently, and replacement may be deferred. The following adjustments by a competent service person will produce energy savings with greater comfort.

#### Warm-air systems

- Check and clean burners, oil fan and motor bearings, inspect fan belt (if there is one), and replace or clean air filters. Return-air grilles should be vacuumed as necessary. Adjust thermostat controls for continuous air circulation during cold weather. The start setting of the blower switch should be about 110°F and the cut-out about 85°F.

#### Storm sash (or double glazing)

Install or close storm windows early in the heating season, or leave them closed throughout the year if the windows are not used for ventilation. Multiple glazing with low-emissivity coatings or argon-filled cavities will save energy in harsh climates.

#### Caulking

Caulk all cracks around window and door frames, where wood meets masonry, and where pipes pene-
trate walls. Acrylic-, urethane-, or silicon-based caulks last longer than oil-based caulks. Sealing air leaks by caulking windows will not make your house too "tight." There are enough paths for the entry of fresh air in most homes to eliminate the need to open windows and doors except when doing so to reduce odors or humidity. A tight house may need an air-to-air heat exchanger to maintain a controlled rate of ventilation.

**Ventilation.** Exhaust fans in the kitchen and bath remove heated air from the house. Downdraft range fans exhaust about three times as much air as range hoods. Smoking and cooking odors increase the need for ventilation.

**Clothes drying.** Air-drying clothes reduces dryer use. Venting an electric dryer into the house in cold climates may conserve heat, but will usually cause moisture and lint problems. A lint trap should be installed. Indoor venting must be discontinued if there is a moisture problem. Gas dryers must be vented outside the house.

**Closing rooms.** Unoccupied rooms should be closed and the heat shut off. Partially close bedroom registers to keep rooms cooler. Room temperatures should be maintained at least 50°F.

**Outside doors.** Install a storm door with an automatic door closer or an insulated metal door with a magnetic weather-stripping system.

**Thermostat setting.** Each 1°F setback in the room thermostat setting can save 2.3 percent in fuel. Vacation settings should be below about 50°F.

**Register settings.** Balance a forced air heating system with duct or register dampers to prevent overheating some rooms. Do not close return air grilles. Do not close more than one-third of the supply registers or radiators in a system.

**Night setback.** A setback of 10°F at night may save as much as 7 percent in fuel for poorly insulated houses, but much less for well-insulated houses. A rule of thumb is not to use night setback if the outdoor temperature is below 0°F because morning recovery takes too long.

**Fireplaces.** Be sure to close the damper when the fireplace is not in use. Glass doors are also effective. An outside opening for air intake to the fireplace will reduce the amount of house air flowing up the flue.

**Basements.** When the basement is used for purposes other than storage, the walls and windows should be insulated. If the basement is used only for storage, the ductwork and the floor above should be insulated and the basement left unheated.

**Crawl-space vents.** Vents should be closed during the winter unless the furnace is in the crawl space or there is a moisture problem. If vents cannot be closed, insulating panels can be inserted. Vents may remain closed during the summer if there is no moisture problem.

**Pipe insulation.** All hot water pipes in crawl spaces and attics should be insulated to reduce heat loss from pipes and waste of water during each faucet operation. Insulating may help reduce pipe damage in winter.

**Attached garages.** Outside doors should be closed except when being used. When a furnace or water heater is in a garage or other building, that building should be fully insulated.

**Mobile home foundations.** Insulated skirting should be installed to reduce air flow and raise the temperature below the structure.

**Summer**

**Cooling units.** New units may take 30-40 percent less energy than older ones. The minimum acceptable SEER (Seasonal Energy Efficiency Ratio) rating for a new unit is 10. The compressor-condenser unit should be shaded by a building, a fence, or plantings. Remove leaves, grass, and dust from the condenser fins.

**Register settings.** Re-balance the air distribution system for cooling. Close basement supply registers. Close doors on stairwells and room doors on the upper levels to control the downward flow of cooled air.

**Windows.** To control indoor humidity problems in air conditioned houses, keep windows closed in humid weather even when outdoor temperatures are mild, and operate the cooling system. Pull drapes and shades over windows facing the sun.
Storm windows. Storm windows can reduce summer heat gain. Leave storm windows closed except on windows needed for ventilation.

Shading effectiveness. Window shading devices reduce solar heat gain. The priority of window treatment is east, west, and then south. The effectiveness ranking of shading methods is 1) tree shade 2) external shutters 3) interior louvered screens 4) interior window treatment and 5) tinted glass. Multiple glazing will reduce the heat gain under all circumstances.

Appliances and fixtures. When it's practical, delay running dishwashers, clothes washers and dryers, air conditioners, and ovens — including the oven cleaning cycle — until late evening, when power loads are less and air conditioners are more efficient. Selecting higher-efficiency major appliances (refrigerators, water heaters, etc.) will reduce the heat gain from those sources.

Stoves, conventional ovens, and microwave ovens. The oven is more efficient than top burners when several dishes are cooked at one time. Use lids on pans to retain heat and moisture. Microwave cooking units use less energy than ranges for heating small quantities of food and liquids. Using a microwave to thaw frozen food, however, is a waste of energy. Outdoor cooking reduces odors and heat input to the house.

Clothes dryers. All dryers should be vented outdoors in mild and warm weather. Damp drying clothes on hangers saves energy and may even reduce wrinkling. Clothes may be hung outside to dry as well.

Dehumidifiers. When a dehumidifier is used in the basement, keep basement doors and windows closed.

Water heaters. Hot water should be used conservatively and at the lowest practical temperature. Dishwashers need water at 140°F in order to clean. Temperatures should be reduced while occupants are on vacation. Many units have special settings for this purpose. Insulation may be added to some units (water heater blankets) to reduce operating costs and heat gain to the house. Care should be used as this method is not recommended by some manufacturers. Also, if the water heater is in a garage or other building, that building should be fully insulated.

Lights. Lighting should be adequate, but not excessive, because operation of lighting adds heat to the interior of your home. Smaller bulbs may be appropriate. Fluorescent lights are more efficient than incandescent bulbs. Incandescent can be replaced with compact fluorescent lights. Of course, lights should be turned off when the room is not occupied.

Attics. The attic should be properly ventilated to remove solar heat gain. A proper combination of continuous overhang and ridge vents eliminates the need for power venting.

Crawl-space vents. These may be opened in summer if there is a standing water problem. Condensation on the bottom of the polyethylene vapor retarder is normal and not a problem. Opening vents can cause condensation on uninsulated cooling ducts in humid climates.

Pipe insulation. Insulating cold water pipes reduces the effects of warming on the cold water supply in summer.

Recycling. All materials require energy to be produced, distributed, and discarded. Whether it's winter or summer, reuse and recycling saves energy.

Water conservation. Any water savings in bathing, laundry, cooking, or gardening saves pumping energy. Hot water should be used conservatively and at the lowest practical temperature — dishwashers need water at 140°F in order to clean.

INSULATION AND SHADING

Insulation and multiple glazing are effective in all regions, not only to save heating energy in winter, but also to save cooling energy in summer. Greater winter comfort is also provided by the warmer surface temperatures resulting
from insulation and multiple glazing. In each of the following items, the numbers in Btu per hour (Btu/h) indicate the heat loss from a particular component of the house. The total heat loss is the sum of the losses from the ceiling, walls, windows, doors, and foundation plus the loss from air infiltration. This number may be used to size the heating equipment and to estimate the annual heating energy costs.

The pre-calculated graphs show values for standard frame construction exposed to an outdoor temperature of +7°F and a 15 mile-per-hour wind while maintaining an indoor temperature of 68°F. The attic temperature is assumed to be 3°F.

To calculate your energy use, employ the following procedure: Each 1000 Btu/h of design heat loss represents 2 to 3 gallons of oil or 3 to 4 therms of gas or 55 to 60 kwh of electricity per 1000 sq. ft. per year for each 1000 heating degree days (HDD). To find the heating degree days, consult your local weather data.

Example:

\[
\text{Annual Gas Use in therms} = \frac{\text{Btu/h} \times \text{HDD}}{1000} \times 4
\]

### Ceiling insulation.
The values in Chart 1 show the heat loss of each 1000 square feet of ceiling area with an attic space above. For a 30 ft. x 50 ft. ceiling (1500 square feet), the heat loss will be 1.5 x 4000, or 6000 Btu/h for a 4-inch thickness of mineral wool insulation (or equivalent) in the ceiling joist spaces. The same ceiling with 9-inch-thick insulation would lose 1.5 x 1860, or 2790 Btu/h. When the insulation exceeds 12 inches, the heat loss through the ceiling becomes almost negligible. For comparison, four occupants give off about 1800 Btu/h. The temperatures at the far right in Chart 1 are the surface temperatures of the ceiling facing the occupant. A person loses less heat to warmer surfaces (ceilings, walls, windows, and floors) and is more comfortable as surface temperatures approach the room temperature of 68°F.

### Wall insulation.
For typical frame construction, each 1000 square feet of wall surface, excluding windows and doors, will show the heat loss indicated. For example, a house having 1300 square feet of net wall surface will lose 1.3 x 4725, or 6140 Btu/h with 3-1/2 inch mineral wool batts in the wall. The 5-1/2 inch insulation is based upon 2x6 wall framing, and the 8-1/2 inch and 10-1/2 inch thicknesses are based on double-framed walls. This construction requires deep window and door frames, which are available at extra cost. Foam plastic sheathing is almost equivalent to twice its thickness in mineral wool. See Chart 2.

### Operable windows.
The heat loss through windows is based on the combined loss through the glass and the loss of heated air through the cracks around the window unit. If a house has 150 square feet of single-glazed windows without storm sashes, the heat loss may be as much as 15 x 1050, or 15,750 Btu/h. High-performance (H.P.) glazing units, combining low-emissivity coatings and inert gas fill, are becoming popular. See Chart 3.

### Fixed windows.
Tightly sealed fixed windows will lose heat through the glass, but have insignificant air leakage. The values shown are for each 10 square feet of window area. For example, a picture window that is 4 ft. high and 6 ft. wide (24 square feet) will have a heat loss of 2.4 times the number shown. See Chart 4.

### Outside doors.
Doors have considerable leakage around the frame even when closed. This has been included in these calculations. An insulated steel door with magnetic weatherstrip may be the best combination. The losses shown in Chart 5 are given for a door 3 ft. x 6 ft. 8 in. (20 square feet) and 1-3/4 in. thick.

### Basement foundations.
A warm basement space provides warmer floors above. Most basements are primarily heated by the heat lost from the furnace and ductwork. Heat lost from the basement is just as expensive as heat loss from an upstairs room. To reduce heat loss from the basement, install storm windows, caulk the sills joint, and insulate the band joist and basement walls. An uninsulated basement of 1500 square feet (30 ft. x 50 ft.) will lose 1.5 x 14,320, or 21,480 Btu/h when the outside temperature is -7°F. When properly insulated, the same basement will lose only 1.5 x 6160, or 9,240 Btu/h. See Chart 6 on the next page.
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Crawl-space foundations. A warm crawl space reduces the heat loss through the floor above. In winter, vents in the crawl space should be closed. If there are moisture and dampness problems, correct these first. The vents can remain closed during the summer if there are no moisture problems. This will reduce the problem of condensation on the air conditioning ductwork.

The indicated temperatures and heat losses in Chart 7 are based on a tightly sealed crawl space and an outdoor temperature of -7°F. For example, a 30 ft. x 24 ft. floor over an uninsulated crawl space has a heat loss of 0.72 x 6100, or 4390 Btuh. By insulating the crawl space walls as indicated, the loss can be reduced to about half that amount.

Slab floor foundations. The heat loss from a slab floor (Charts 8 and 9) occurs mainly at the edge of the floor exposed to the outdoors. An uninsulated 30 ft. x 50 ft. slab floor would have a heat loss of 1.5 x 7800, or 11,700 Btuh if heating ducts or cables were not imbedded in the floor.

In an existing house, edge insulation can be installed vertically on the outside of the foundation and up to the lower edge of the siding. Extruded polystyrene or impregnated fiberglass boards will best resist moisture and temperature change. The insulation should be protected from damage.

Implementing any of the suggestions listed within this circular will help you manage your energy use. The more of these tips you try, the less energy you will be using.

Enjoy your energy savings!