

Energy Savers

Home Energy Audits

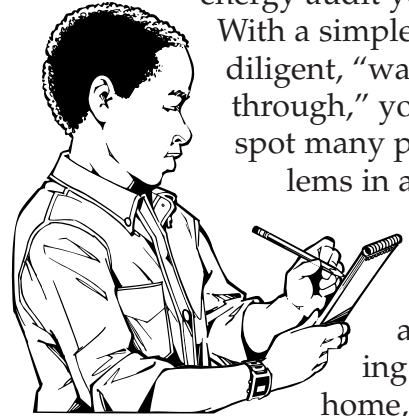
A home energy audit is the first step to assess how much energy your home consumes, and to evaluate what measures you can take to make your home more energy-efficient. An audit will show you problems that may, when corrected, save you significant amounts of money over time. During the audit, you can pinpoint where your house is losing energy.

Audits also determine the efficiency of your home's heating and cooling systems. An audit may also show you ways to conserve hot water. You can perform a simple energy audit yourself, or have a professional energy auditor carry out a more thorough audit.

A professional auditor uses a variety of techniques and equipment to determine the energy efficiency of a structure. Thorough audits often use equipment such as blower doors, which measure the extent of leaks in the building envelope, as well as infrared cameras, which reveal hard-to-detect areas of air infiltration and missing insulation. The following is a discussion of do-it-yourself as well as professional audits.

Do-It-Yourself Audits

You can easily conduct a home



energy audit yourself. With a simple, but diligent, "walk-through," you can spot many problems in any type of house. When auditing your home, keep a

checklist of areas you have inspected and problems found. This will help you prioritize your energy efficiency upgrades.

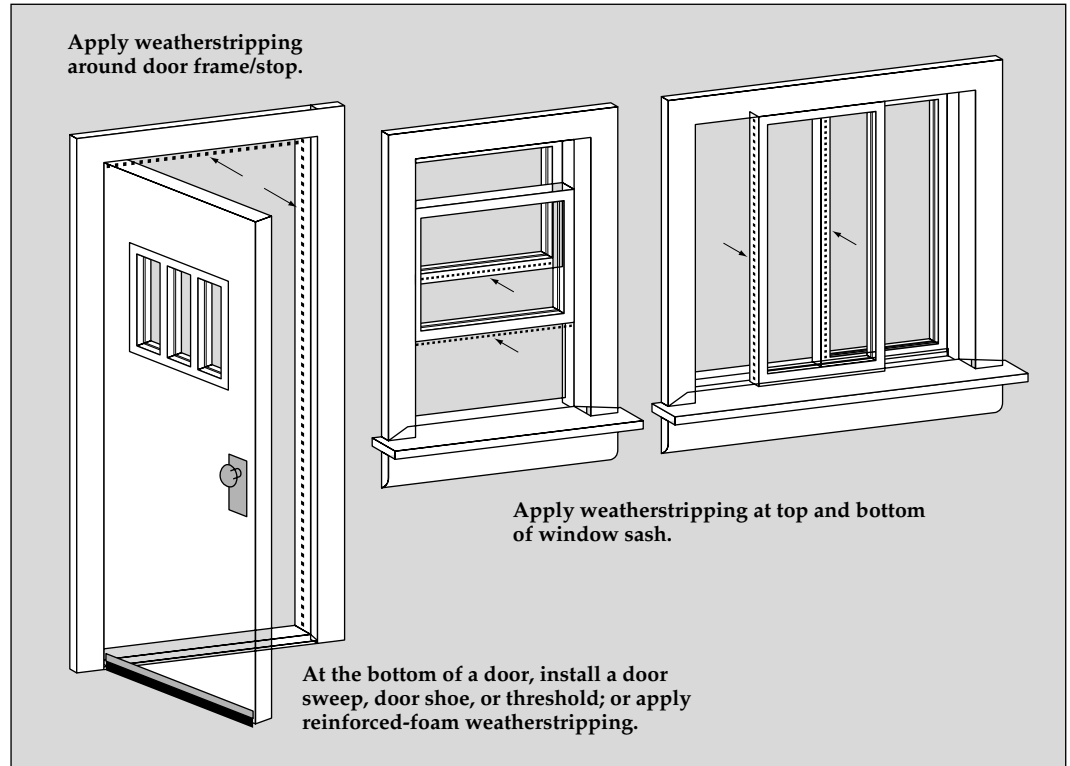
1) Locating Air Leaks

First, make a list of obvious air leaks (drafts). The potential energy savings draft reduction may range from 5% to 30% per year, and the home is generally much more comfortable afterwards.

Check for indoor air leaks such as gaps along the baseboard or edge of the flooring, and at junctures of the walls and ceiling. Check to see if air can flow through electrical outlets, switch plates, window frames, baseboards, weather-stripping around doors, fireplace dampers, attic hatches, and wall- or window-mounted air conditioners. Look for gaps around pipes and wires, electrical outlets, foundation seals, and mail slots.



You may also wish to consider replacing your old windows and doors with newer, high-performance ones.



Check to see if the caulking and weatherstripping are applied properly (no gaps or cracks), and are in good condition.

Inspect windows and doors for air leaks. See if you can rattle them, since movement means possible air leaks. If you can see daylight around door and window frames, then the door or window leaks. You can usually seal these leaks by caulking or weather stripping them. Check the storm windows to see if they fit and are not broken. You may also wish to consider replacing your old windows and doors with newer, high-performance ones. If new factory-made doors or windows are too costly, you can install low-cost plastic sheets over the windows.

If you are having difficulty locating leaks, you may want to conduct a basic building pressurization test. First, close all exterior doors, windows, and fireplace

flues. Turn off all combustion appliances such as gas burning furnaces and water heaters. (Remember to turn them back on when you are done with the test.) Then turn on all exhaust fans (generally located in the kitchen and bathrooms) or use a large window fan to suck the air out of the rooms. This increases infiltration through cracks and leaks, making them easier to detect. You can use incense sticks or your damp hand to locate these leaks. Moving air causes the smoke to waver, and you will feel a draft when it cools your hand.

On the outside of your house, inspect all areas where two different building materials meet. For example: inspect all exterior corners; where siding and chimneys meet; and areas where the foundation and the bottom of exterior brick or siding meet. You should plug and caulk holes or penetrations for faucets, pipes, electric

Any gaps should be sealed with an expanding foam caulk or some other permanent sealant.

outlets, and wiring. Look for cracks and holes in the mortar, foundation, and siding, and seal them with the appropriate material. Check the exterior caulking around doors and windows, and see whether exterior storm doors and primary doors seal tightly.

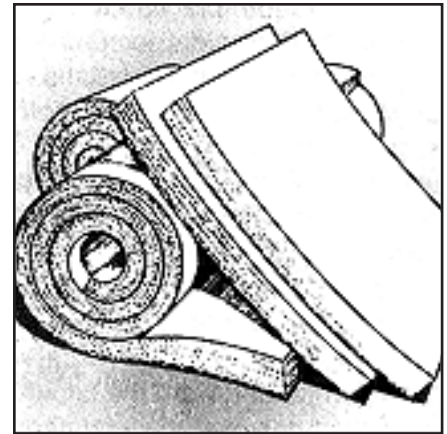
CAUTION: When sealing any home, you must always be aware of the danger of indoor air pollution and combustion appliance "backdrafts." Backdrafting is when the various combustion appliances and exhaust fans in the home compete for air. An exhaust fan may pull the combustion gases back into the living space. This can obviously create a very dangerous and unhealthy situation in the home.

In homes where a fuel is burned (i.e., natural gas, fuel oil, propane, or wood) for heating, be certain the appliance has an adequate air supply. Generally one square inch of vent opening is required for each 1,000 Btu of appliance input heat. When in doubt, contact your local utility company, energy professional, or ventilation contractor.

2) Insulation

Heat loss through the ceiling and walls in your home could be very large if the insulation levels are less than the recommended minimum. You should check to see if the level of the attic and wall insulation of your home is at least at the minimum recommended amount. When your house was built, the insulation recommended at that time was installed. Given today's energy prices, and that

future prices probably will be higher, the level might be inadequate, especially if you have an older home. In 1997, the U.S. Department of Energy updated its recommended insulation R-Values (see *Insulation Fact Sheet*, at end). If the attic hatch is located above a conditioned space, check to see if



it is at least as heavily insulated as the attic, is weather-stripped, and closes tightly. In the attic, determine whether openings for items such as pipes, ductwork, and chimneys are sealed. Any gaps should be sealed with an expanding foam caulk or some other permanent sealant. If you have recessed light fixtures, determine if they are IC rated fixtures. It is strongly recommended that only *air tight-IC rated fixtures* be used. Other types allow large amounts of your heating dollar to escape into the attic. If you do not wish to purchase new IC rated fixtures, be certain to allow a three-inch space around any recessed lights. This will prevent the recessed light from overheating.

While you are inspecting the attic, check to see if there is a vapor barrier (retarder) under the attic insulation. The vapor barrier might be

You could also make a small hole in a closet, behind a couch, or in some other unobtrusive place to see what, if anything, the wall cavity is filled with.

Your electric utility may offer rebates or other incentives for purchasing energy-efficient lamps.

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tar paper, kraft paper attached to fiberglass batts, or a plastic sheet. If there does not appear to be a vapor barrier, you might consider painting the interior ceilings with vapor barrier paint. This reduces the amount of water vapor that can pass through the ceiling. Large amounts of moisture can reduce the effectiveness of insulation and promote structural damage. Make sure that the attic vents are not blocked by insulation. You also should seal any electrical boxes in the ceiling with flexible caulk (from the living room side or attic side) and cover the entire attic floor with at least the recommended amount of insulation.

Checking a wall's insulation level is more difficult. Select an exterior wall and turn off the circuit breaker or unscrew the fuse for any outlets in the wall. Be sure to test the outlets to make certain that they are not "hot." Check it with a lamp or portable radio. Remove the cover plate from one of the outlets and gently probe into the wall with a thin, long stick or screwdriver. If you encounter a slight resistance, you have some insulation there. You could also make a small hole in a closet, behind a couch, or in some other unobtrusive place to see what, if anything, the wall cavity is filled with. Ideally, the wall cavity should be *totally* filled with some form of insulation material. Unfortunately, this method cannot tell you if the entire wall is insulated, or if the insulation has settled. Only a thermographic inspection (discussed below) can do this.

If your basement is unheated, determine whether there is insula-

tion under the living area flooring. In most areas of the country, R-25 is the recommended minimum level of insulation. The insulation at the top of the foundation wall and first floor perimeter should have an R-Value of 19 or greater. If the basement is heated, the foundation walls should be insulated to at least R-19. Your water heater, hot water pipes, and furnace ducts should all be insulated.

3) Heating/Cooling Equipment

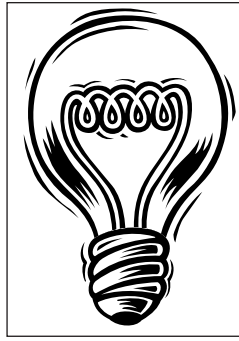
Inspect heating and cooling equipment annually, or as recommended by the manufacturer. If you have a forced air furnace, check your filters and replace them as needed. Generally they should be changed about once every month or two, especially during periods of high usage. Have a professional check and clean your equipment once a year. If the unit is more than 15 years old, you should consider replacing it with one of the newer, energy-efficient units. This would go far to reduce your energy consumption, especially if the existing equipment is in poor condition. Check your ductwork for dirt streaks, especially near seams. These indicate air leaks, and they should be sealed with a duct mastic. Insulate any ducts or pipes that travel through unheated spaces. An insulation R-Value of 6 is the recommended minimum.

4) Lighting

Energy for lighting accounts for about 10% of your electric bill. Examine the wattage size of the light bulbs in your house. You may have 100 watt (or larger)

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bulbs where 60 or 75 watts would do. You should also consider compact fluorescent lamps for areas where lights are on for hours at a time. Your electric utility may offer rebates or other incentives for purchasing energy-efficient lamps.



Professional Energy Audits

All professional energy audits should, at a minimum, include a “walk-through” similar to the one above and a blower door test (discussed below). Most will also include a thermographic scan (also discussed below). Professional audits generally go into great detail. The auditor should do a room-by-room examination of the residence, as well as a thorough examination of past utility bills.

Before the auditor visits your house, make a list of any existing problems such as condensation and uncomfortable or drafty rooms. Have copies or a summary of the home's yearly energy bills. (Your utility can get these for you.) The auditors use this information to establish what to look for during the audit. The auditor first examines the outside of the home to determine the size of the house and its features (i.e., wall area, number and size of windows). The auditor then analyses the occupants' behavior: Is anyone home during working hours? What is the average thermostat

setting for summer and winter? How many people live here? Is every room in use? Your answers may help uncover some simple ways to reduce your household's energy consumption. Walk through your home with the auditors as they work, and ask questions. They may also use equipment to detect sources of energy loss, such as blower doors, infrared cameras, furnace efficiency meters, and surface thermometers.



Blower Door Tests

A blower door is a powerful fan that mounts into the frame of an exterior door. The fan pulls air out of the house, lowering the air pressure inside. The higher outside air pressure then flows in through all unsealed cracks and openings. The auditors may use a smoke pencil to detect air leaks. These tests determine the air infiltration rate of a building. Several reasons for establishing the proper building tightness are: to reduce energy consumption due to air leakage; to avoid moisture condensation problems; to avoid uncomfortable drafts caused by cold air leaking in from the outdoors; and to make sure that the home's air quality is not too contaminated by indoor air pollution.

There are two types of blower doors: “calibrated” and “uncalibrated”. It is important that auditors use a calibrated door. This type of blower door has several gauges that measure the amount of air pulled out of the house by

Your state or local government energy or weatherization office may help you identify a local company or organization that performs audits.

the fan. Uncalibrated blower doors can only locate leaks in homes. They provide no method for determining the overall tightness of a building. The calibrated blower door's data allows the auditor to quantify the amount of air leakage and the effectiveness of any air-sealing job.

Thermographic Inspection

Energy auditors may also use thermography "infrared scanning" to detect thermal defects and air leakage in building envelopes. Thermography measures surface temperatures by using infrared video and still cameras. These tools see light that is in the heat spectrum. Images on the video or film record the temperature variations of the building's skin, ranging from white for warm regions to black for cooler areas. The resulting images help the auditor determine whether insulation is needed. They also serve as a quality control tool, to ensure that insulation has been installed correctly.

A thermographic inspection is either an interior or exterior survey. The auditor decides which method would give the best results under certain weather conditions. Interior scans are more common, because warm air escaping from a building does not always move through the walls in a straight line. Heat loss detected in one area of the outside wall might originate at some other location on the inside of the wall. Also, it is harder to detect temperature differences on the outside surface of the building during windy weather. Because of this, interior surveys are generally more accurate, as they benefit

from reduced air movement. Thermographic scans are also commonly used with the blower door is running. The blower door helps exaggerate air leaking through defects in the building shell. Such air leaks appear as black streaks in the infrared camera's view finder.

Most energy audits take from four to eight hours and cost between \$300 and \$500. Any retrofit work would of course cost additional money.

Finding and Selecting an Energy Auditor

There are several places where you can locate professional energy auditing services. Your state or local government energy or weatherization office may help you identify a local company or organization that performs audits. They may also have information on how to do your own audit. Your electric or gas utility may conduct residential energy audits, or recommend local auditors. Also check your telephone directory under headings beginning with the word "Energy" for companies that perform residential energy audits. Another possibility is to contact the National Association of Energy Service Companies (NAESCO). NAESCO has member companies nationwide that specialize in energy audits for both large commercial buildings and homes. Contact NAESCO for information on which energy service companies are near you.

Before contracting with an energy auditing company, you should take the following steps:

- Get at least five references, and contact all five. Ask if they were satisfied with the work.
- Call the Better Business Bureau and ask about any complaints against the company.
- Make sure the auditor uses a calibrated blower door.
- Make sure they do thermographic inspections or contract another company to conduct one.

For More Information

The following publications and videotape are good sources of information on how to reduce the amount of energy you use at home, and how to keep energy costs down. Some of them provide tips on home energy auditing, how to prioritize your energy efficiency investments, and how to do them, if you are so inclined. The publications may be found in your local bookstore, library, or obtained from the publisher as indicated. You should verify availability, prices, and shipping charges before ordering. This list was updated in August 2003.

"Best-Practice Energy Upgrades," S. Andrews, *Journal of Light Construction*, (18:6) pp. 95-100, March 2000.

Consumer Guide to Home Energy Savings, A. Wilson, J. Thorne, and J. Morrill, American Council for an Energy-Efficient Economy (ACEEE), 1999. 244 pp. Available from ACEEE, Email: info@aceee.org.

Energy-Savers: Tips on Saving Energy and Money at Home, U.S. Department of Energy, 1998.

"Energy-Saving Roundup," *Consumer Reports*, (58:10) pp. 649-67, October 1993.

Five Hundred and Forty-Seven Tips for Saving Energy in Your Home, R. Albright, Storey Communications, 1992. 128 pp. Out of print.

Home-Made Money: How to Save Energy and Dollars in Your Home, R. Heede, et al., Rocky Mountain Institute (RMI), 1995. 285 pp. ISBN 188317807. Available from RMI, Email: orders@rmi.org.

Insulation Fact Sheet, U.S. Department of Energy, 1997.

"Home Energy Audits: Only a Web Site Away," Helen Hunter, *Home Energy*, (15: 6), Nov/Dec 1998.

Residential Energy: Cost Savings and Comfort for Existing Buildings, J. Krigger, Saturn Resource Management, 2001. 288 pp. ISBN 1880120119.

Warm House-Cool House: A Money-Saving Guide to Energy Use in Your Home, M. Florman and Consumer Reports Books Editors, Consumer Reports Books, Fairfield, OH, 1991. 208 pp. Out of print.

"What to Know About a Home Energy Audit," *Consumers' Research Magazine*, (73:19) pp. 17-21, January 1990.

10 Quick Ways to Cut Your Energy Bills (Video), Iris Communications, Inc., 1994. 20-minutes.

