

ENERGY  
EFFICIENCY  
AND  
RENEWABLE  
ENERGY  
CLEARINGHOUSE

## A Guide to Making Energy-Smart Purchases

If you feel that energy bills are taking a big chunk of change out of your pocket, you are not alone. Americans spend more than \$115 billion each year on fuel and electricity for their homes. On the average, heating and cooling (space conditioning) account for about 45% of the energy a home uses. Water heating consumes about 14%, and appliances and other sources consume about 41%. Though energy use varies among homes, there are many ways to lower your energy bills.

Being more energy efficient can be as simple and inexpensive as buying and installing caulk and weatherstripping or as complicated and expensive as building a state-of-the-art, energy-efficient house. However, whatever you do to reduce energy costs will usually require the purchase of goods or services.

Investments in products or systems designed to save energy can provide a return through future savings from lower energy bills. They also reduce the impact of rising fuel prices and usually help improve the environment. However, poor choices of such products or systems can be disappointing and aggravating. Whether you are buying a new heating system or "tightening up your home," be sure to investigate the options before investing.

### Knowing Your Needs

An energy audit is one of the best ways to determine the most cost-effective measures for reducing energy bills. Energy audits can locate areas where

energy is wasted and can determine the efficiency of your heating and cooling systems. Energy audits vary in complexity. You can perform a simple audit yourself by examining your home for obvious leaks or ensuring that appliances work efficiently. More information about do-it-yourself audits can be obtained from The Energy Efficiency and Renewable Energy Clearinghouse (EREC) (see the Source List on page 8 of this publication).

More thorough audits can be conducted by "house doctors," who usually work in teams using special equipment such as blower doors, infrared cameras, furnace efficiency instruments, and surface thermometers. This equipment allows them to find inefficiencies that a visual inspection could not detect. House doctors also analyze previous energy bills and implement some energy efficiency measures at the time of the audit. This type of energy audit, however, may be relatively expensive.

Some utilities offer energy audits for free or for a nominal charge. The extent of these audits varies. Auditors from utilities may or may not use special equipment such as blower doors and infrared cameras, and they may or may not check the performance of your heating system.

### Determining Your Priorities

Results from the energy audit can direct you to the changes that would be most appropriate to improve the energy efficiency, or "tightness," of your home.



*This document was produced for the U.S. Department of Energy (DOE) by the National Renewable Energy Laboratory (NREL), a DOE national laboratory. The document was produced by the Technical Information Program, under the DOE Office of Energy Efficiency and Renewable Energy. The Energy Efficiency and Renewable Energy Clearinghouse (EREC) is operated by NCI Information Systems, Inc. for NREL/DOE. The statements contained herein are based on information known to EREC and NREL at the time of printing. No recommendation or endorsement of any product or service is implied if mentioned by EREC.*



Before you purchase an energy-related product or system, though, you should answer some important questions.

What are your budgetary limits? Which areas are causing your greatest energy losses? How long can you wait for the investment to pay for itself in energy savings? How much time and money are you willing to spend on maintenance and repair? Are you investing solely to save on energy bills or are other factors also important?

Many options that improve energy efficiency are available. Although installing caulk, weatherstripping, and insulation may not be as exciting or impressive as a ground-source heat pump, such energy efficiency measures are very often cost effective. Indeed, if you decide to install a heating or cooling system, you should first ensure that your home is properly weatherized. Using energy efficiently reduces demands for heating, cooling, and electricity, thereby allowing a smaller, less expensive system to be used.

Because of the high percentage of your energy bill that goes toward conditioning the air in your home, detecting heat losses and gains is a great place to start when deciding what measures may improve the energy efficiency of your home. Leaky windows and doors, open fireplace dampers, poorly insulated attics and walls, and cracks and holes in the walls and ceiling are all areas where heat can escape in the winter and enter in the summer. Heat can also escape through light fixtures and switches, electrical outlets, and leaky ducts.

Appliances and equipment can also have a tremendous effect on your energy costs. Hot water heaters, stoves, refrigerators, dish-

washers, and clothes dryers can contribute to excessively high energy bills when they operate inefficiently. Poorly sized and inefficient heating and cooling systems can lead to high costs for space conditioning.

When you decide to implement energy efficiency measures, you can determine the most appropriate product or system by investigating the options. The energy efficiency projects addressed here are divided into two categories—weatherization projects and energy-efficient appliances.

## **Weatherization Projects**

Weatherization projects insulate and tighten the shell of the home. Such projects include, but are not restricted to, caulking and weatherstripping, improving or replacing windows, and installing insulation.

### ***Caulking and Weatherstripping***

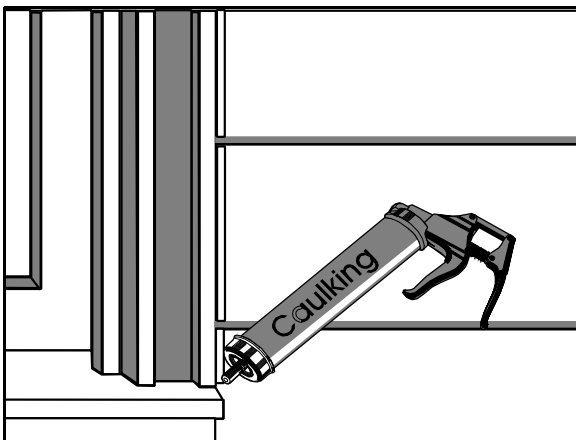
Caulking and weatherstripping are the easiest and least expensive weatherization measures and can save more than 10% on energy bills. They are usually do-it-yourself projects. Choose your supplies carefully and follow instructions closely. High-quality materials and proper installation ensure that you receive maximum performance from your investment.

Caulking and weatherstripping are most often applied to doors and windows, which account for about 33% of a home's total heat loss. Because windows outnumber doors, energy efficiency features of windows are particularly important to lowering energy costs.

### ***Installing Insulation***

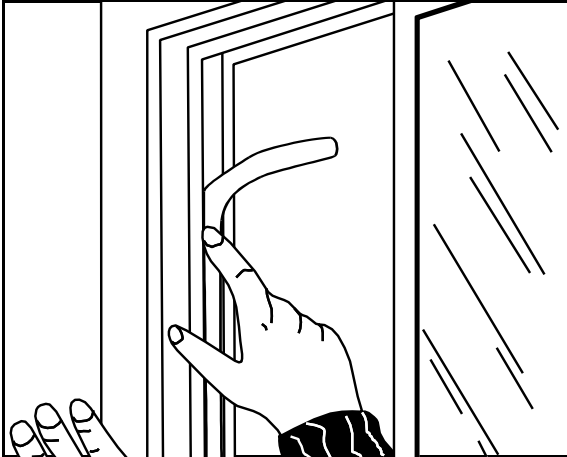
Insulation is probably the most important consideration in improving the energy efficiency of a home. The type and amount of insulation you choose will directly affect energy costs. Factors to weigh in making a decision about insulation material include insulative

*An energy audit is one of the best ways to determine the most cost-effective measures for reducing energy bills.*



**Caulking around windows reduces air infiltration.**

vc-cd6-a0929-01



Weatherstripping can be easily applied.

vc-cd6-a0929-02

value, cost, flammability, toxicity, durability, and availability. When purchasing insulation, check the product label to be sure the material meets specifications of either the federal government or the American Society for Testing and Materials. The label should indicate the insulation material, R-value, quantity, and the name and address of the manufacturer or distributor.

It should also state how much area the insulation can cover, where the insulation can be installed, what the fire resistance of the material is, and what safety precautions should be taken for installation and use. For more information about insulation, see the EREC fact sheet *Insulation*.

If you choose to install the insulation yourself, wear proper clothing and learn how to properly install the insulation to avoid fire hazards and moisture problems. You should also determine if a vapor retarder or other moisture control measure is needed. You may also choose to hire a contractor. The Insulation Contractors of America (see the source list) can help you find a certified contractor in your area. You can also check the Yellow Pages.

### **Improving or Replacing Windows**

Single-pane windows are the most inefficient ones, but it is possible to increase their efficiency. You can install storm windows to add insulating value and reduce air leaks. The simplest type of storm window—a plastic film taped to the inside of the window frame—is usually available in prepackaged kits. It can be installed and removed easily, but it also may damage easily and reduce visibility. Another type,

which uses rigid or semirigid plastic sheets (e.g., plexiglass, acrylic, polycarbonate, fiber-reinforced polyester) can be fastened directly to the frame or mounted in channels around the frame.

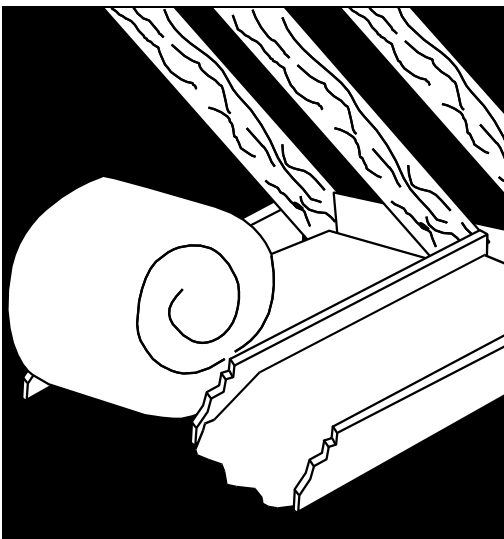
Storm windows made of glass can be attached to the frame with clips or screws. Storm window units should have weatherstripping at all joints, be made of strong, durable materials, and have interlocking or overlapping joints.

If your windows need to be replaced, there are many new types of energy-efficient glazing and frames on the market that suit different purposes. Glazing materials are made of glass or plastic; frames are available in aluminum, wood, vinyl, fiberglass, or combinations of these materials. Each type of glazing material and frame has advantages and disadvantages. Glass is durable and allows a high percentage of solar energy to enter buildings. Plastics can be stronger, lighter, cheaper, and easier to cut than glass, but not as durable and more susceptible to the effects of weather.

When comparing the different types of materials, note whether the glazing is most suitable for blocking or allowing solar gain. (If you live in a hot climate, you will probably want to block out solar gain). You can compare the energy efficiency of similar models by checking written information available from the retailer or manufacturer.

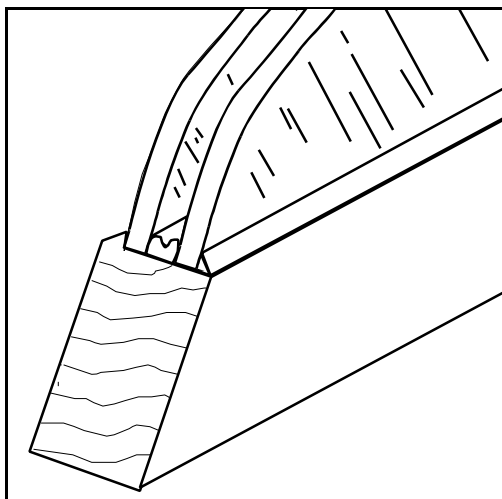
Manufacturers usually represent the energy efficiency of a window as the R-value, or the measure of resistance to heat flow. R-values range from about 0.9 to about 3.0. If the R-value is high, less heat will be lost. Manufacturers may also use the U-value, the measure of heat flow, to indicate a window's energy efficiency. U-values are the reciprocal of R-values. U-values range from about 1.1 to about 0.3. If the U-value is low, less heat will be lost.

When you are comparing glazing, it may be helpful to determine if the U- or R-value is indicated for the entire



Insulation types and amounts will directly affect your energy costs.

vc-cd6-a0929-04



Wood window frames typically have higher R-values than other frame materials. vc-cd6-a0929-03

window or just for the center-of-glass. A window with a high R-value based on the center-of-glass may not be as efficient as one with a lower R-value that is based on the entire window. For a more detailed discussion of windows, see the EREC fact sheet *Energy Efficient Windows*.

## Energy-Efficient Appliances

The energy efficiency of similar appliances can vary significantly. It is usually

more cost effective to purchase appliances with high efficiencies. Determining and comparing the energy efficiency of different models is usually easy, because federal regulations require many types of appliances to display EnergyGuide labels. A label or energy-use information in the product literature is required for furnaces, refrigerators, refrigerator-freezers, freezers, water heaters, washing machines, dishwashers, room and central air conditioners, heat pumps, and fluorescent lamp ballasts. EnergyGuide labels indicate either the annual estimated cost of operating the system or a standardized energy efficiency ratio. Specific information about these appliances is presented in Table 1.

You can also maximize the efficiency of appliances you already own through regular maintenance and tune-ups and system upgrades. Examples of some things that you can do are:

- Check air filters in heating and cooling systems monthly during the seasons they are in use and clean and replace them as necessary.
- Clean air vents, baseboards, and radiators regularly and keep them unrestricted by furniture, carpets, or drapes.
- Release trapped air from hot water radiators once or twice a season by

opening the valve until nothing but water comes out.

- Follow prescribed maintenance (e.g., maintaining certain water levels in steam heat systems).
- Install an insulating jacket on your hot water heater, insulate hot water pipes, and lower the water heater temperature.
- Clean refrigerator coils yearly and maintain internal temperatures between 36°F (2.2°C) and 38°F (33°C) for the refrigerator compartment and between 0°F (17.8°C) and 5°F (15.0°C) for the freezer compartment.
- Move the refrigerator if it is currently located near the stove or dishwasher.
- Regularly defrost refrigerators that do not have a completely automatic defrost capability to eliminate ice build-up on interior coils.
- Clean dryer filters after each use or as necessary.

More complicated jobs, such as furnace tune-ups, will need to be performed periodically by a trained technician. Companies that sell oil and gas usually have trained technicians who can tune-up your furnace or boiler.

Sometimes independent companies provide this service as well. For professional service for other home appliances, you should contact the business where the appliance was purchased.

## If You Need a Contractor

You may find that many improvements involving energy efficiency require a contractor for installation. While finding a quality contractor at the best price can be a little confusing, these suggestions may help along the way.

- Try to limit your choices to local contractors. They are usually less

*When you are comparing glazing, it may be helpful to determine if the U- or R-value is indicated for the entire window or just for the center-of-glass.*

**Table 1. Choosing a New Energy-Efficient Appliance**

This table is a condensed list of appliances that have labels or fact sheets on energy consumption as required by the Federal Trade Commission.

| Appliance                     | Rating   | Rating Range   | Special Considerations   |         |         |          |          |          |     |          |          |     |          |          |  |
|-------------------------------|--|--|--|---------|---------|----------|----------|----------|-----|----------|----------|-----|----------|----------|--|
| Oil and Gas Heating Systems   | Annual Fuel Utilization Efficiency (AFUE) measures the seasonal or annual efficiency, accounting for cyclic on/off operation and associated energy losses. | 80% to 89% for oil boilers<br>78% to 90% for oil furnaces<br>80% to 90% for gas boilers<br>78% to 96% for gas furnaces   | <ul style="list-style-type: none"> <li>● Make sure that you know the proper size of the system you need. Too large a system costs more, operates inefficiently, and performs poorly.</li> <li>● Don't assume that you need the same size system. It's more likely that you'll need a smaller unit.</li> <li>● Check to see if your current system can be upgraded or downsized.</li> </ul> |         |         |          |          |          |     |          |          |     |          |          |  |
| Room Air Conditioners         | Energy Efficiency Rating (EER) is a standardized rating for efficiency.  | Ranges from a low of 8 to a high of 12.6, depending on size.   | <ul style="list-style-type: none"> <li>● Consider installing fans.</li> </ul>  |         |         |          |          |          |     |          |          |     |          |          |  |
| Central Air Conditioners      | Seasonal Energy Efficiency Rating (SEER) rates the efficiency over the cooling season.   | SEER ranges from a low efficiency of 10 to a high efficiency of 16.9.  | <ul style="list-style-type: none"> <li>● Proper sizing is imperative. It's better to undersize than oversize. Oversized air conditioners remove less humidity and operate less efficiently.</li> </ul>   |         |         |          |          |          |     |          |          |     |          |          |  |
| Central Air-to-Air Heat Pumps | SEER indicates cooling efficiency.   | The lowest SEER is 10 and the highest is 16.   | <ul style="list-style-type: none"> <li>● Consider installing fans.</li> </ul>  |         |         |          |          |          |     |          |          |     |          |          |  |
| Domestic Hot Water Heaters    | Heating Seasonal Performance Factor (HSPF) indicates heating efficiency.   | The lowest HSPF is 6.8 and the highest is 10.  | <ul style="list-style-type: none"> <li>● If you live in a cool climate, look for a heat pump with a high HSPF.</li> </ul>  |         |         |          |          |          |     |          |          |     |          |          |  |
| Refrigerator/Freezers         | The Energy Factor (EF) is the overall efficiency of the heater.  | <table border="1" data-bbox="885 840 990 1260"> <thead> <tr> <th></th> <th>Minimum</th> <th>Maximum</th> </tr> </thead> <tbody> <tr> <td>Electric</td> <td>87 to 91</td> <td>94 to 98</td> </tr> <tr> <td>Gas</td> <td>51 to 56</td> <td>60 to 86</td> </tr> <tr> <td>Oil</td> <td>48 to 53</td> <td>60 to 63</td> </tr> </tbody> </table>   |  | Minimum | Maximum | Electric | 87 to 91 | 94 to 98 | Gas | 51 to 56 | 60 to 86 | Oil | 48 to 53 | 60 to 63 | <ul style="list-style-type: none"> <li>● Although most water heaters last 10-15 years, it's best to start shopping for a new one if yours is over 7 years old. Doing some research before one fails will enable you to select a water heater that most appropriately meets your needs.</li> <li>● Make sure that your unit has at least 1-1/2 inches of insulation around the tank.</li> <li>● Consider the First Hour Rating (FHR) of the system. FHR measures the maximum hot water the heater will deliver in the first hour of use.</li> </ul> |
|                               | Minimum  | Maximum  |  |         |         |          |          |          |     |          |          |     |          |          |  |
| Electric                      | 87 to 91   | 94 to 98   |  |         |         |          |          |          |     |          |          |     |          |          |  |
| Gas                           | 51 to 56   | 60 to 86   |  |         |         |          |          |          |     |          |          |     |          |          |  |
| Oil                           | 48 to 53   | 60 to 63   |  |         |         |          |          |          |     |          |          |     |          |          |  |
|                               | Estimated Yearly Energy Cost at \$0.0824 per kilowatt-hour (kWh). Estimated cost per kWh is subject to change. Check label.                                | Some examples of lowest annual energy cost for refrigerator/freezers include \$40 for a 14-cubic foot, single-door manual defrost model and \$67 for a 20-cubic-foot, top freezer automatic defrost model.<br><br>Examples of highest annual energy cost include \$70 for a 14-cubic-foot top freezer automatic defrost model and \$106 for a 20-cubic-foot, side-by-side automatic defrost model. | <ul style="list-style-type: none"> <li>● When buying a frost-free refrigerator, find one with an energy-efficient option.</li> <li>● Refrigerators with freezers on top are more efficient than those with freezers on the side.</li> </ul>  |         |         |          |          |          |     |          |          |     |          |          |  |

*EnergyGuide labels indicate either the annual estimated cost of operating the system or a standardized energy efficiency ratio.*

*. . . maximize the efficiency of appliances you already own through regular maintenance and tune-ups . . .*

expensive. Check the Yellow Pages for the type of contractor you need. Inquiring about contractors through friends and relatives can help you narrow the field.

- Obtain at least three bids before signing a contract. The greater the selection, the greater the chances of finding the right contractor for the job. All terms in the bids should be similar and all details should be in writing. Depending on the job, you should have the contractors visit the site before bidding on a project.
- Make sure that the contractors are licensed and have liability insurance.
- Find out the contractors' previous experience and ask for references. How many jobs have they completed? Have they had any formal training in installing the specified product or system? You should also check their record with the Better Business Bureau.
- Include in the contract the dates that you expect services to begin and end. This protects you from contractors who begin a job very late or leave a job and return at a much later date. You may also want to specify payment for starting a project late. (You can lose money when contractors are late because the savings that the project would have incurred had it been installed are lost.)
- Never fully pay contractors before they start the work. Pay the contractor in increments (e.g., at the beginning, the middle, and the end of the job).
- Find out if the contractor will allow you to buy the materials. Sometimes the materials are less expensive when you purchase them yourself.
- Note whether you need permits and whether permits are included in the contract. Some contractors require you to purchase and obtain these yourself. Obtaining permits can take many

hours. If the contractor is obtaining the permits and is being paid at an hourly rate, find out if he or she is charging by the hour to obtain the permits.

- Beware of contractors who bid much lower than others for the same job. You should thoroughly read and understand the contract before signing it. Make sure that a cancellation form is attached as required by consumer protection laws. This allows you to cancel a contract worth over \$25 before midnight of the third business day after the transaction.

## **Making Good Investments**

Most consumers are looking for the greatest return for the least investment. This does not necessarily mean, though, that you should buy the least expensive product or system on the market. In fact, spending a little more money initially for an energy-efficient product or system (as opposed to spending less and sacrificing energy efficiency) is often more economical in the long run because your investment will pay for itself in energy savings.

Generally, there are two ways to analyze the costs of energy efficiency investments: simple payback period, which is the amount of time required for the investment to pay for itself in energy savings; and full life-cycle cost, which is the total of all costs and benefits associated with an investment during its estimated lifetime.

You can obtain an estimate of the simple payback period by dividing the total cost of the product by the yearly energy savings. For example, an energy-efficient dryer that costs \$500 and saves \$100 per year in energy costs has a simple payback period of 5 years.

Computing life-cycle costs is more difficult. Life-cycle costing is a method of economic evaluation in which all values are expressed as present dollars. This evaluation method sums the discounted

*Products or systems with payback periods that approach or exceed their projected life are usually not worthwhile.*

investment costs (less salvage value); operation and maintenance (nonfuel) and repair costs; replacement costs; and energy costs of an appliance or building system. For definitions of these terms and the formula for performing life-cycle cost analyses, see the *Life-Cycle Costing Manual for the Federal Energy Management Program*, NBS Handbook 135, Revised 1987. This manual is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Before making your decision, examine your budget, the expected payback periods, and estimated lives of different alternatives. Products or systems with payback periods that approach or exceed their projected life are usually not worthwhile. Compare the life-cycle costs of similar products or systems. These include installation (if any), operation, and maintenance costs.

Although most of the federal tax incentives of the early 1980s have been discontinued, your state or local government may offer economic incentives or financial assistance to implement energy efficiency measures. Also, check with your local utility to see what incentives are available.

If you are buying a new home, you may want to investigate the possibility of obtaining an energy-efficient mortgage (EEM). EEMs allow home buyers to qualify for a larger mortgage by allowing a higher debt-to-income ratio than lenders normally use to calculate loan potential. EEMs allow the significant monthly energy savings of an energy-efficient house to be put toward a higher monthly mortgage payment. Home buyers upgrading an existing home to qualify as an energy-efficient home may add the cost of energy measures to the mortgage. By adding this cost into the mortgage, the home buyer may profit from the tax benefits and longer term interest rates.

You can find out if EEMs are an option for you by asking your lender. Four federal lending programs—Federal Home Loan Mortgage Corporation (Freddie Mac), Federal Housing Administration (FHA), Federal National Mortgage Association (Fannie Mae), and Veteran's Administration (VA)—offer EEMs. Therefore, EEMs are available nationwide. Unfortunately, most lenders and home buyers are either unaware of EEMs or choose not to use them.

Currently, 23 states have at least one lender who facilitates EEMs. FHA is establishing an EEM pilot program for existing homes in Alaska, Arkansas, California, Vermont, and Virginia.

*Energy-efficient mortgages allow home buyers to qualify for a larger mortgage by allowing a higher debt-to-income ratio than lenders normally use.*

## Source List

**There are hundreds of groups that can help you make an informed decision when purchasing an energy efficiency product or system. The following organizations are just a few that can assist you in making wise purchases.**

Air Conditioning and Refrigeration Institute (ARI)  
4301 North Fairfax Drive, Suite 425  
Arlington, VA 22203

**ARI answers written inquiries about heat pumps, air conditioners, and refrigerators.**

American Council for an Energy-Efficient Economy (ACEEE)  
1001 Connecticut Avenue, NW  
Suite 535  
Washington, DC 20036  
(202) 429-8873

American Council for an Energy-Efficient Economy (ACEEE)  
2140 Shattuck Avenue  
Suite 202  
Berkeley, CA 94704

**ACEEE provides general and technical information on energy efficiency including a publication titled *The Consumer Guide to Home Energy Savings*. To order this book, write to the ACEEE office in California.**

Association of Home Appliance Manufacturers (AHAM)  
Information Center  
20 North Wacker Drive  
Chicago, IL 60606  
(312) 984-5800 ext. 315

**AHAM provides energy efficiency information for specific brands of major appliances and runs a certification program for certain types of appliances.**

Gas Appliance Manufacturers Association, Inc.  
1901 North Moore Street, Suite 1100  
Arlington, VA 22209  
(703) 525-9565

**The Gas Appliance Manufacturers Association answers questions on residential gas appliances and equipment, electric and oil-fired water heaters, and oil-fired warm air furnaces.**

Insulation Contractors of America  
15819 Crabb Branch Way  
Rockville, MD 20855

**Insulation Contractors of America provides a list of contractors for specific areas of the United States.**

National Association of Home Builders (NAHB)  
15th and M Streets, NW  
Washington, DC 20005  
(202) 822-0200

**NAHB provides a wide spectrum of information on the construction of solar and energy-efficient buildings.**

For information about these energy efficiency topics, contact:

The Energy Efficiency and Renewable Energy Clearinghouse (EREC)  
P.O. Box 3048  
Merrifield, VA 22116  
(800) DOE-EREC

**EREC provides free general and technical information to the public on the many topics and technologies pertaining to energy efficiency and renewable energy.**

**You may also contact your state and local energy offices as well as your utility company.**