Home Energy projects

An Energy Conservation Guide For Do-It-Yourselfers

Arkansas Energy Office
Arkansas Economic Development Commission

www.arkansasenergy.org
An Energy Conservation Guide for Do-It-Yourselfers

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Weatherstripping and Caulking
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Scheduling the Job
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5. Seal Holes, Cracks, and Penetrations
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7. Repair and Reglaze Windows
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This book is divided into the following sections:

**CHAPTER 1:** Home Energy Project Checklist
A quick method for selecting energy conservation measures.

**CHAPTER 2:** The Basics
Explains some of the theory of energy conservation and describes basic energy conservation practices.

**CHAPTER 3:** Getting the Job Done Correctly
Discusses contracting, scheduling, tools, and safety measures for doing the job right.

**CHAPTER 4:** Energy Conservation Measures
Describes in detail how to implement 25 energy conservation measures.

**CHAPTER 5:** Replacement Measures
Describes options available for replacing windows, doors, heating and cooling systems, fireplaces, etc.

**Construction Terminology**
Shows the parts of a house via diagrams.

*The Checklist*, which begins the book, enables readers to develop a prioritized list of conservation measures for their homes. Those having little familiarity with today’s energy conservation options may want to start with Chapter 2: *The Basics*.

In planning the work itself, the reader should review Chapter 3: *Getting the Job Done Correctly*. The reader can then review the detailed discussions in Chapters 4 and 5 on how to prioritize the measures.
The Home Energy Project Checklist will help you decide which energy conservation measures to adopt. It lists current conditions in your house that call for improvement via energy conservation measures or replacement measures. The energy conservation measures are projects such as insulating and sealing air leaks. These projects are appropriate for many do-it-yourselfers. The replacement measures dictate greater skill levels and usually require a licensed plumber, heating and air conditioning contractor, or another home improvement professional. The measures themselves are categorized according to four priority levels:

**URGENT ★★★★★**
These measures should be undertaken at once. They all will pay back your investment in less than three years. Most will pay back in one year.

**ESSENTIAL ★★★**
These measures are critical for energy conservation and savings. They will pay back your investment within five years.

**IMPORTANT ★★**
These measures are what all energy-efficient new homes should have. Their paybacks are up to eight years, but they can significantly reduce energy bills and improve comfort.

**OPTIONAL ★**
These measures are for the energy-conservation enthusiast. You may not recover your investment before 15 years, but you may find the increased comfort worth the money spent.

The installation cost and energy savings are estimated for each measure. Your savings may be greater or lower depending on the number of people in your household, the size of your home, your current level of energy efficiency, how you regulate your heating and cooling system, and other factors. Also, the total savings from several measures will most likely be less than the sum of the energy savings for each.

Once you determine which conservation measures are appropriate for your house, you can begin planning your energy conservation activities. See Chapter 3 for more information on scheduling these various conservation measures.
ENERGY EFFICIENCY CHECKLIST

ENERGY CONSERVATION REPLACEMENT MEASURES

Priority: URGENT ★★★★
- 1. Household members unfamiliar with energy-saving lifestyle actions
  Page 14 - Low-cost/no-cost actions (such as reducing thermostat settings, blocking air leaks, using appliances wisely)
- 2. 0 to 3 inches attic insulation
  Page 17 - Install R-30 insulation (and provide attic ventilation)
- 3. Ductwork leaky and uninsulated
  Page 25 - Seal and insulate ductwork
- 4. Water heater uninsulated
  Page 27 - Insulate with water heater jacket (if in unheated space)
- 5. Holes, large cracks or penetrations for wiring, plumbing, or ductwork in ceiling, walls, or floors
  Page 29 - Seal holes, cracks, and penetrations
- 6. Air leakage through fireplace
  Page 31 - Build fireplace cover
- 7. Windows broken or need reglazing
  Page 33 - Repair and reglaze windows

Priority: ESSENTIAL ★★★
- 8. Showerheads have no flow controls
  Page 35 - Use low-flow showerheads
- 9. Floors uninsulated
  Page 36 - Insulate floors
- 10. Household members willing to vary thermostat setting
  Page 39 - Install programmable thermostat
- 11. Air leakage through electric outlets
  Page 40 - Install gaskets on electric outlets
- 12. Substantial air leakage around door and window frames
  Page 41 - Caulk window and door frames
- 13. Substantial air flow between door or window sash and frame
  Page 42 - Weatherstrip leaky windows and doors

Priority: IMPORTANT ★★
- 14. Walls uninsulated
  Page 47 - Have wall insulation blown
- 15. Discomfort and/or excessive cooling bills in summer
  Page 50 - Install ceiling fans and whole-house fans
- 16. Attic with 3 to 5 inches of insulation
  Page 53 - Install R-19 insulation in partially insulated attic
- 17. Windows receive too much sunlight
  Page 54 - Build exterior solar shade screens
- 18. Windows receive too much sunlight (continued)
  Page 57 - Use awnings and/or interior roller blinds
- 19. Windows receive too much sunlight (continued)
  Page 58 - Apply reflective window film
- 20. Single-paned windows with substantial heat loss
  Page 59 - Put up storm windows
- 21. Attic has inadequate ventilation
  Page 62 - Increase attic ventilation

Priority: OPTIONAL ★
- 22. Attic has 5 or more inches of insulation
  Page 66 - Install R-11 in well-insulated attic
- 23. Attic temperature is excessive in summer
  Page 67 - Install radiant barrier in attic
- 24. Doors seem to lose excessive amounts of heat
  Page 68 - Put in storm doors (or a replacement insulated door - see Replacement Measure 3)
- 25. Double-paned windows have excessive heat loss in winter and heat gain in summer
  Page 69 - Build movable Insulation shutters

Priority: OPTIONAL ★
- 22. Attic has 5 or more inches of insulation
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- 25. Double-paned windows have excessive heat loss in winter and heat gain in summer
  Page 69 - Build movable Insulation shutters

ENERGY CONSERVATION REPLACEMENT MEASURES

- 1. Water heater leaking or needs replacing
  Page 71 - Replace water heater with high-efficiency model
- 2. Window unit broken, rotten, or very loose
  Page 73 - Repair or replace window
- 3. Exterior door broken, damaged, or loose
  Page 74 - Repair or replace door with insulated unit
- 4. House with space heaters
  Page 76 - Replace with central furnace, approved gas/propane space heaters, or electric space heaters
- 5. Furnace within heated area
  Page 77 - Provide exterior combustion air
- 6. Heating system needs replacing
  Page 78 - Install new high-efficiency system — either gas/propane with AFUE of at least .80 or heat pump with SEER of at least 10.0
- 7. Air conditioner needs replacing
  Page 81 - Replace air conditioner with high-efficiency unit — SEER of at least 10.0
CHAPTER 2
THE BASICS

This chapter describes how energy is used in homes, gives an estimated breakdown of annual energy bills, and suggests how to achieve the greatest energy savings. In addition, insulation, vapor barriers, infiltration, caulking, weatherstripping, shading, ventilation and other energy conservation practices are discussed.

THE IMPORTANCE OF ENERGY CONSERVATION

For many Arkansans, the costs of heating and cooling homes, providing hot water, and operating major appliances are difficult to afford; they can exceed mortgage payments. However, energy costs can be controlled through basic energy conservation measures.

Some of the most effective ways to conserve energy cost little or nothing. Simply cleaning the filters on your home’s furnace or air conditioner, setting back the thermostat at night, and proper scheduling of energy-consuming activities such as laundry, cooking, and dishwashing can save you energy and money.

Energy-saving improvements to your home, such as increasing insulation in the attic and floor, sealing off unwanted drafts, and buying energy-efficient models when replacing appliances may cost several hundred dollars. However, they pay for themselves in energy savings within a few years. Most of the energy conservation measures that save on heating bills will also keep your house cooler in summer. Conservation will make your home more comfortable by moderating temperature swings and eliminating drafts. Some measures will also reduce maintenance needs for your home and add to its value.

The energy costs for any home depend on many factors including local climate, size of the home, and lifestyle of the occupants. However, the most important factors are the design and construction of your home—the quantity of insulation in the ceiling, walls, and floor, the tightness of construction (how well it prevents drafts), and the efficiency of heating and cooling equipment and major appliances such as the water heater, refrigerator, and dishwasher. The following chart shows estimated energy costs of typical Arkansas homes.

Your home’s energy bills may vary from the estimates in the chart. Often, local utilities will be able to help you determine your specific energy use.

In considering energy conservation measures to reduce energy bills, think of your house as a bucket and the energy used to heat and cool it as water in the bucket. If there is a hole—no matter how small—the water will drain out.

If there is a hole in the insulation, weatherstripping, or caulking of a house, heat escapes in winter or leaks inside in summer. In an energy-efficient home, these leaks are minimized by insulating the ceiling, walls, and floor and by sealing air leaks.

Before investing in energy conservation, think about how energy is used in a home. Heating, cooling, and hot water are primary energy needs. Energy conservation can help the most in these areas.
The energy needed for heating and cooling is determined by the movement of heat into and out of your home. Heat travels by conduction, convection, and radiation and always moves from hot to cold. The speed at which heat moves is determined by the difference in temperature between the hotter area and the cooler—the larger the difference in temperature, the faster heat flows.

**Conduction** is the movement of heat through a solid object such as the ceiling, walls, and floor of a home. Insulation is used to stop the flow of heat by conduction and will reduce your heating and cooling costs.

**Convection** is the transfer of heat caused by the movement of air. As air is heated, it becomes lighter and rises. As air cools, it becomes heavier and falls. Convection causes air to circulate between warm areas and cool areas inside a home.

**Infiltration** is the convective flow of heat in and out of a home through air leaks. Weatherstripping, sealing holes, caulking cracks, and other infiltration control measures can reduce total heating and cooling bills over 30 percent.

**Radiation** is the movement of heat by long waves from a warm to a cold surface. For example, radiation heat flow occurs in the summer when sunlight strikes a roof and the roof radiates heat to the attic floor below. You can use reflective materials to block the flow of radiant heat.

In winter, your home loses heat by conduction through the building envelope—the walls, windows, ceilings, and floors that form the barrier between heated and unheated areas; by infiltration around the baseboard or sill plate, windows, doors, and wall penetrations for plumbing and wiring; and by radiation from people and warm interior surfaces to cold outer walls and windows.
Heat gain in the winter from sunlight and internal heat sources—the heat given off by appliances, lighting, and people—helps offset the losses from conduction, infiltration, and radiation. In homes designed to capture and store sunlight, called “passive solar” homes, heat gain from sunlight can provide over 50 percent of the total heat required.

In summer, unwanted heat enters your home primarily through conduction from the outside, through sunlight passing through windows, and from internal heat sources. Air leaks bring in outside humidity which causes moisture problems as well as higher bills. Radiation can be important in houses with little ceiling insulation.

**INSULATION MATERIALS**

Insulation blocks the flow of heat by forming thousands of pockets that trap air or other gases. These pockets, called dead air spaces, must be kept intact for the material to maintain its insulating value.

Many different insulation products are available. When choosing one, always consider the R-value, a measure of effectiveness (R means resistance to heat flow). The higher the R-value, the better the insulator. Labels on some products may list the U-value, which is simply the inverse of the R-value \((U=1/R)\). The U-value is on a scale from 0 to 1.0. The lower the U-value, the greater the resistance to heat flow.

Compare insulation materials by the cost per R-value. Some insulating materials have a high R-value per inch of thickness, but are more expensive per R-value than other products. For example, fiberglass batts have an R-value of about three per inch and cost around $0.023 per R-value per square foot. Rigid foam insulation boards have a higher R-value per inch but cost about $0.07 per R-value per square foot. If space is not a problem, such as when insulating a ceiling with an attic above, fiberglass is a better buy.

Careful installation of insulation and weatherstripping is critical. In a study conducted by the Naval Civil Engineering Laboratory, a 5 percent gap in the coverage of ceiling insulation reduced the overall R-value of the ceiling by over 40 percent. Similar findings were reported for gaps in the wall and floor insulation.

**VENTILATING AND CONTROLLING EXCESS MOISTURE**

Arkansas’ climate is considered “mixed-humid” because we are not as hot as our southern neighbors (but we’re still humid) and not as cold as our more northerly neighbors. The summer in Arkansas brings humid air into the house and when this is combined with excess moisture from cooking and bathing, it can create an excess buildup of water vapor which can not only cause mold and mildew, it can cause the building itself to rot.

The first defense against moisture problems is ventilation. The average family of four produces from 18 to 20 pints of water a day just performing routine household activities. Bathroom and kitchens should have vent fans that take moist air out of the house during cooking and showering. The fans should only be turned on for as long as needed.
because as they push humid air out of the house, that air is replaced with outside air that is pulled through the many small cracks in a home.

Attics and crawlspaces need to be ventilated. See Project 21, “Increase Attic Ventilation” on page 62. Don’t seal up an attic or crawlspace. While some heat loss may be prevented, considerable damage can result from the trapped moisture.

In our mixed humid climate the walls and roof need to be able to transfer moisture in both directions. This is why it is important to not restrict moisture from passing through walls and ceilings. It is still necessary to air seal walls and ceilings, the important point is to not prevent the passage of water vapor with what is commonly called a “vapor barrier.”

WEATHERSTRIPPPING AND CAULKING

Weatherstripping is a strip of metal, plastic, rubber, or fiber that blocks air leaks around doors, windows, and other openings in the building envelope. Caulking, which is a pliable material, or foam sealants are used to seal gaps. They are also used to seal the seam where different buildings materials meet, such as between the window jamb and siding.

When choosing weatherstripping and caulking products, consider cost and longevity. The caulk should have at least a 25-year life. Acceptable options include acrylic latex caulk with silicones, silicone caulk, and urethane caulk. See page 46 for more details on weatherstripping leaky windows and doors.

NATURAL COOLING AND HEATING

The same conservation measures that keep heat inside your home in winter will also help keep heat outside in summer. By relying on conservation and other natural cooling techniques, you should be able to minimize the need for air conditioning. To reduce the air conditioning load or reduce your cooling costs, natural cooling measures become even more important as they can keep the house comfortable for much of the summer.

The keys to staying comfortable inexpensively in Arkansas’ hot, humid summers are to keep windows shaded from direct sun, provide adequate ventilation in the house, avoid activities that produce heat or humidity, and use air conditioning as efficiently as possible.

Daily activities inside the home, such as cooking, washing dishes, laundry, and bathing, are a major source of heat and humidity in the summer. By minimizing these activities and scheduling them for cooler morning and evening hours, your home will stay more comfortable.

Shading—In winter, the south side of your house receives almost three times more sunlight than the east or west sides. However, in summer, the east and west windows receive the bulk of the sun’s rays—almost three times more than the south side. Therefore, summer shading of the east and west windows, and, to a lesser degree, the south windows, is of paramount importance. Use trees, shrubs and trellises to shade unshaded windows where practical.
Overhangs provide some shading for windows facing south. For most residences, they should be 2 feet wide and located at least 6 inches above the top of the window to allow the low winter sun full access to the south glass area. However, overhangs do not provide much shade for east and west windows because of the low summer sun angles in the morning and afternoon. Awnings that extend over the windows are better for these applications. While landscaping and overhangs offer some protection, additional shading for windows should be provided by exterior or interior treatments. Of course, it is better to block the sun before it enters the windows. Exterior shade screens, which block up to 70 percent of sunlight, accomplish this and serve as insect screens also. However, they do darken the view somewhat and should be removed in winter to let the sun help heat the home.

Interior treatments include roller blinds, light-colored drapes, venetian blinds, and shutters. They should have a reflective or glossy white exterior to bounce incoming sunlight back out of the window.

**Radiant Barriers**—If the attic is properly insulated and ventilated, little of the heat that is conducted through a solid roof enters the living area. However, some radiant heat from the hot roof does warm up the insulation, which increases heat gain into the house. A reflective foil or other reflective material located between the roof and insulation can obstruct this flow of radiant heat.

**Ventilation**—In addition to shading, ventilation is an effective strategy for helping maintain comfort indoors in summer with minimal use of air conditioning. Whenever the temperature outside is lower than that inside, open windows to ventilate the house. Place fans in windows or use whole-house fans to draw air into the house during cooler morning or evening hours.

As temperatures increase during the day, close windows and shades to block the heat, and use interior fans to circulate air. Keep room and ceiling fans on while the air conditioner is running, too. By moving the cooled air with fans, you will feel as comfortable with the air conditioner thermostat set at 80 degrees or 85 degrees as at 75 degrees with no air movement. For each degree that the thermostat is raised, air conditioning costs will be lowered 3 to 8 percent. Always close windows when the air conditioner is on.

The attic of the home should be fully ventilated. Air flow in the attic helps remove moisture throughout the year and keeps attic temperatures cooler in summer.
DOMESTIC WATER HEATING

Water heating is the third largest energy expense in your home. Typically it accounts for from 15% to 28% of your utility bills. However, several simple energy conservation measures can cut the cost of water heating by more than half.

Reducing the temperature setting on the water heater from high to low (160 degrees to 120 degrees) will save energy and still provide enough hot water. Electric water heaters usually have two thermostats which can be adjusted with a screwdriver. Make certain that the flow of electricity to the heater is disconnected before adjusting the thermostat. Gas water heaters usually have a temperature setting dial near the burner. This dial can easily be turned to set the temperature.

If you have to buy a new water heater, make certain it is an energy-efficient unit with foam insulation inside the metal shell. For your current water heater, installing an insulating tank jacket will quickly pay for itself in energy savings. In addition, insulate at least the first 3 feet of all pipes extending from the tank. If the water heater is located inside the living area, increasing the insulation levels will keep your home cooler in summer.

Low-flow showerheads, which release water at the rate of two to three gallons per minute instead of the usual five gallons, save energy and water. Well-designed fixtures will reduce only the quantity of water and not the force at which it is delivered. They can cut water use up to 60 percent.

Flushing sediment from the water heater helps to save energy as well as to extend its life. Drain a gallon of water from the bottom of the tank every few months to remove any sediment that has accumulated.

ENERGY-SAVING APPLIANCES

Energy-efficient appliances can also save you money on utility bills. Refrigerators, freezers, and dishwashers are the biggest energy users and together can cost several hundred dollars a year to operate. High efficiency models can save over 50 percent of these costs.

When selecting an appliance, consider purchasing a unit that is ENERGY STAR-rated, which are at least 30 percent more efficient than other models. Also consider an appliance’s estimated energy costs, which are provided on the EnergyGuide tag. This yellow tag is required by law to be attached to most major appliances and compares the energy use of a particular product to that for similar models. The Energy Guide also shows the estimated yearly cost of operating the appliance.

In addition to saving energy, efficient appliances give off less waste heat than standard models so they save on air conditioning costs, too. Their higher cost is usually recovered within a few years.
CHAPTER 3
GETTING THE JOB DONE CORRECTLY

This chapter considers the practical issues involved in working on your home:

- Should you hire a contractor to do the job?
- How should you decide what conservation measures to install with your limited time and money?
- In what order should the measures be applied?
- Do you have the skills necessary to do the work?
- What are the basic rules for using tools?
- What are effective safety guidelines?

SHOULD YOU DO IT YOURSELF?

The energy conservation measures described in this publication have a common goal—saving money on your home energy bills. Your skills will be perfectly suited for some tasks, while other tasks will require a contractor. Be sure to judge accurately your own capabilities before embarking on a project by yourself. Even when hiring a contractor, read the instructions in this book to ensure quality work.

QUESTIONS TO ANSWER ARE:

1. If I make a mistake, what would be the worst possible consequence? How much would the repair cost? How likely is the mistake? Can I really afford the risk?

2. Do I really have the skills to do an acceptable job on this project? Do I have the necessary tools? Can I rent the tools?

3. Do I really have enough time to do the project? If the project takes two times (three times, four times, etc.) longer than I anticipate, what would be the consequences? Will the house be without heating, cooling, hot water, any water, or electricity? Can I call in a contractor quickly enough to avoid a serious inconvenience for my household?

If, after reviewing the questions, you are still confident and ready to proceed, go ahead. But first, read the sections in this chapter that describe the basic things to consider when working on energy conservation measures. If you realize that you need to hire a contractor, read the next section.

HIRING A CONTRACTOR

Weatherization and renovation contractors vary widely in cost, skill level, knowledge, and quality. The guidelines listed below should be followed when dealing with any contractor:

1. Always check references for contractors and look at their previous jobs. Talk at length with former clients about the quality of the work.

2. Write a bid request that describes the project fully and includes drawings of unusual construction details.

3. Get bids from at least three contractors.

4. Write a contract with the contractor to help minimize costly misunderstandings for both parties. The contract should spell out all phases of the project in detail. For example, when hiring someone to insulate the floor, specifically write into the contract whether you want a plastic vapor barrier installed on the floor of the crawl space, pipes insulated, or dryer vents extended.

5. A contract for insulation work should specify what R-value you want installed. Always check to make sure the proper number of bags or batts were used.

6. Never pay the contractor until the job is completed. If necessary, you can work out a payment plan so that as parts of the job are completed, payment can be made.

7. If the contractor does not live up to the contract, make her/him correct the deficiencies. Be firm and straightforward when working with contractors.
SCHEDULING THE JOB

Often your bank balance will restrict you from implementing as many measures as you would like. Schedule the jobs wisely. Start with the highest priority (urgent priority) tasks first and work down to those having less importance. For example, do not do a lower priority job, such as installing storm windows, when a high priority task, such as insulating the attic, has yet to be done. See Chapter 1 for a list of conservation measures in priority order.

The detailed descriptions of the different measures in Chapters 4 and 5 include cost estimates. Determine your maximum budget and identify in priority order a set of jobs whose total costs will not exceed the budget.

SKILLS REQUIRED

For each conservation measure described in this book, the relative skill level needed by the do-it-yourselfer is indicated. The main categories used are:

- **Simple handiwork**—competent using basic hand tools, such as hammer, screwdriver, utility knife, tape rule, putty knife, and handsaw.
- **Basic carpentry**—comfortable working with both hand tools and power tools, such as circular saw, electric drill, reciprocating saw, and saber saw.
- **Skilled carpentry**—proficient with hand tools and power tools. Able to make difficult angled cuts and do finished carpentry. Knowledgeable about most elements of residential construction.

RULES FOR TOOLS

Tools are intended to make our work easier. Too often, experienced do-it-yourselfers use the wrong tools or poorly maintained tools and make simple jobs difficult. Some general guidelines for tool use are:

1. Use the right tool for the job.
2. Always keep tools in good condition – chisels and cutting blades sharp, paint brushes clean, etc.
3. Never muscle or rush your work.
4. If a job requires more than you have, there is probably a tool to make it easier. Often, expensive tools can be rented for reasonable prices.

Accompanying the conservation measures described in Chapter 4 of the book are lists of the tools needed for each project.
Safety should be a predominant concern of the occasional carpenter. When working sporadically, such as on weekends, you often forget to pay attention to basic safety rules in your rush to finish the job. A reasonable set of common sense safety measures follows:

- Don’t wear loose clothing; tie back long hair. Wear protective gear—earplugs, heavy shoes, hats, goggles, and gloves. Wear a dust mask when working around sawdust, insulation, etc.
- Provide plenty of light on all sides of the work. Clean up any mess around you. Clear your path before carrying lumber or other large or heavy objects. Remove all obstructions and distractions; even something far away can become surprisingly distracting once you have started the job.
- Before you switch on a power tool, STOP, THINK, AND CHECK! Where is everything? Are your hands clear? Are you well balanced? Is all of your body well out of the path of action? Is your support stable? Is the tool going to run into anything? Reconsider for a moment (this applies also to hand tool use).
- Switch ON a tool only when ready to use it immediately. Switch it OFF immediately after use—if you get accustomed to the sound you may forget the machine is active.
- Unplug power tools when changing blades.
- You are never so skilled that you can become casual around power tools; always observe basic safety rules.
- Maintain a respect for more “passive” tools. Keep fingers back from points of chisels, screwdrivers, awls, and hand saws. They can cause surprisingly large cuts.
- Use clamps to secure the work.
- Use only clean, dry, unfrayed extension cords. Beware of water puddles. Observe proper grounding practices.
- Never place tools on a step ladder, even for a moment. When you later move the ladder, tools can fall on your head!
- Follow common sense rules about tools (see previous section).
- When you are tired, stop. If confused, unclear, perplexed, or hungry, stop. A little time goes a long way in solving a problem—trying to rush a solution often causes mistakes.
- Provide adequate ventilation when working with paints, adhesives, and other materials with harmful fumes or vapors.
- Familiarize yourself with first aid practices. Know the location of the nearest telephone and hospital. Keep a first-aid kit nearby.
The key to reducing annual energy bills is not just thinking about all the possible energy conservation measures you can adopt, but actually getting down to work. This chapter includes 25 energy conservation projects that can reduce your energy bills up to 70 percent. It is organized into groups of projects having different priorities, as described at the beginning of Chapter 1.

Estimates of the cost of materials, the cost of hiring a contractor, and the approximate annual energy savings are shown for each measure. The do-it-yourselfer should approximate costs using just the materials figure. The contractor cost includes materials, labor, overhead, and profit. The cost and energy saving estimates can vary considerably and should be used only as a guideline. The total energy savings from installing several measures will most likely be less than the sum of the energy savings from each.
BASIC PROCEDURE

Many opportunities for saving energy are available at the tip of your finger—switching off lights, adjusting thermostats, switching on fans, etc. However, simple, no-cost measures are often overlooked. A checklist of these measures is shown below:

SAVING ON HEATING BILLS

• Set the thermostat back to 55 or below degrees at night. If you have a heat pump, setting your thermostat back may not save you money. Check with your local utility for recommendations for your home.

• Leave the thermostat at the maximum of 65 to 68 degrees during the day, if the house is not occupied.

• Keep the fireplace damper closed whenever fires are completely extinguished (if you do not have a damper, install a fireplace cover—Project 6).

• Use kitchen, bath, and other vent fans sparingly on cold days.

• Do not use the fireplace when the furnace is on unless the fireplace has glass doors.

• If the heating system is in use, never open a window in a room that is too hot; reduce the thermostat setting instead.

• Install a clean filter for the heating system every month or two during the winter.

• Wear a sweater—a light, long-sleeved sweater makes the room feel two degrees warmer, a heavy sweater makes it feel about four degrees warmer, and two lightweight sweaters make it feel five degrees warmer.

Dress for Winter
SAVING ON COOLING BILLS

- Set the air conditioner thermostat at 78 to 85 degrees and run ceiling or small fans to keep the room comfortable.
- Set the fan speed for a window air conditioner on high except in very humid weather. When it is humid, use the low fan speed setting.
- Keep air conditioner filters clean.
- Turn off the air conditioner when you leave for several hours.
- Keep shades and curtains drawn over windows to help block sunlight.
- Do cooking, dishwashing, and laundry in the early morning or late evening to decrease heat build-up during the hot part of the day.
- On mild days, open windows to cool the house instead of using the air conditioner.
- During the hot part of the day, close windows to keep the heat out.
- Dress for warmer temperatures—shorts or skirts, and light sleeveless blouses for women; shorts and short-sleeved shirts for men.
- Change the filter on your return air once a month.

SAVING ON WATER HEATING

- Repair leaky faucets promptly.
- Set the water heater thermostat down to 120 degrees (or to the low setting) unless you have a dishwasher that requires 140-degree water.
- Do not allow faucets to run continuously while rinsing dishes, shaving, or washing hands.
- Use cold water for rinsing the kitchen sink and for the food disposal. Grease goes down the drain better with cold water.

PROJECT 1
No-Cost, Low-Cost Measures

Turn up your thermostat in the summer for cool savings. Whether your thermostat is manual or automatic-setback, setting your thermostat to 78 degrees when home and 85 degrees or off when away will save energy. Savings are from 1% to 3% for each degree the thermostat is set above 72 degrees.

Cost per drop of a leaking hot water faucet:

<table>
<thead>
<tr>
<th>Drops Per second</th>
<th>Electric $/month</th>
<th>Gas $/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>$2</td>
<td>$1.15</td>
</tr>
<tr>
<td>1.0</td>
<td>$5</td>
<td>$2.50</td>
</tr>
<tr>
<td>1.5</td>
<td>$8</td>
<td>$4.10</td>
</tr>
<tr>
<td>2.0</td>
<td>$11</td>
<td>$5.60</td>
</tr>
</tbody>
</table>

Based on $0.10 per kWh (kilowatt-hour) of electricity and $1.00 per therm of natural gas.
PROJECT 1

No-Cost, Low-Cost Measures

- In the laundry room, clean the lint filter after every load.
- Make sure that the clothes drier vents to the outside and is not obstructed.
- Make sure that your refrigerator and freezer doors close tightly. Close the door on a dollar bill. If you can pull it out, you may need a new gasket.
- Once a year, clean the condenser coils (on the back or bottom of your refrigerator).
- If your freezer is a manual-defrost type; remove the frost after it becomes 1/4” thick.
- Check the temperatures in your refrigerator and freezer. Refrigerator temperatures should be from 37 to 40 degree F and the freezer’s temperature should be zero degrees F.
- Use ENERGY STAR qualified compact fluorescent bulbs wherever possible. Each bulb saves an average of $30 or more in energy costs over its lifetime.

Saving on Appliances

- Use toaster ovens, pressure cookers or other small appliances instead of the oven when possible.
- Do not use dishwashers, clothes washers, or dryers until you have a full load.
- Use energy conserving options, such as “air dry” on the dishwasher or “suds saver” on the clothes washer. Keep the dryer’s exhaust vent clean and make sure it runs outside.
- When buying appliances, look for the ENERGY STAR logo and read the Energy Guide labels to compare energy costs.

Saving on Indoor Lighting Energy Use

- Turn off lights in unused rooms.
- Use higher lighting levels in work areas.
- Reduce overall lighting levels for room illumination.
- Use ENERGY STAR qualified compact fluorescent bulbs wherever possible. Each bulb saves an average of $30 or more in energy costs over its lifetime.
- Keep all lamps and lighting fixtures clean.
✓ **SAFETY**

When working in the attic, be careful of what is below you—a ceiling that probably will not support your weight—and what is above you—a roof deck that likely has roofing nails pointing toward you. Walk only on the ceiling joists, attic floor, or walkboards placed on top of the joists. Be careful not to hit the roof above with your head; you should wear a construction helmet to ensure protection.

![Attic Work]

Insulating an attic is a messy job. The attic air will be full of particles from the insulation, so wear a dust mask and goggles. Also, put on gloves, a long-sleeved shirt, long pants, socks, and good shoes to protect your skin from potentially irritating insulation.

**MATERIALS**

In most of Arkansas, R-30 is recommended in the ceiling or attic. In the cooler northwest part of Arkansas, R-38 is recommended.

**Insulation**—See page 6 for insulating values of typical insulating products.

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**PROJECT 2**

**INSTALL R-30 INSULATION IN POORLY INSULATED ATTIC**

**Priority: URGENT ★★★★★**

✓ **CHECKLIST**

**Initial Requirements**

- Attic currently has 0 to 3 inches of insulation. If the attic does not have adequate ventilation (the net free vent area should equal 1/150 of the attic floor area), consider installing more attic ventilation—see Project 21 for details.

**Typical Costs and Savings**

**Materials:**

- $.35 to $.55/sq ft fiberglass/mineral wool roll
- 28 to $.35/sq ft blown cellulose
- $.28 to $.38/sq ft blown fiberglass/mineral wool

**Contractor (materials, labor, and overhead):**

- $.43 to $.77/sq ft fiberglass/mineral wool roll
- $.35 to $.60/sq ft blown cellulose
- $.35 to $.60/sq ft blown fiberglass/mineral wool

**Annual energy savings:**

- $.15 to $.31/sq ft of attic floor

**Average Time Required**

- 1/2 to 1 day/1,000 sq ft
PROJECT 2
INSTALL R-30 INSULATION IN POORLY INSULATED ATTIC

☑ CHECKLIST

Skills Required
• Simple handiwork for installing batt or roll insulation
• Blown insulation is often installed by a contractor, but a person who is handy can usually do the job

Tools
• Utility knife
• Heavy-duty shears
• Drop light and extension cord
• Tin snips
• Tape rule
• Heavy-duty stapler and staples
• Dust mask

BASIC PROCEDURE

Two approaches for installing attic insulation are addressed in this section: 1) installing your own batt or roll insulation; and 2) blowing in loose-fill insulation. Batt and rolls are relatively easy to install, and using them to insulate an attic is an ideal project for the occasional do-it-yourselfer.

Loose-fill insulation should always be installed with a mechanical insulation blower which mixes air in with the insulation and increases the R-value. Blowing insulation is a more complicated job than installing batts or rolls. It is appropriate for skilled do-it-yourselfers. However, sometimes the cost for a contractor to put in the insulation will be less than the materials cost for the insulation itself, whether it is in batt, roll, or loose-fill form. Therefore, call several contractors to get bids before deciding to install insulation yourself. Information on blowing your own attic insulation is covered later in this chapter.

INSTALLING ROLL OR BATT INSULATION

1. Install attic ventilation (see Project 21: Increase Attic Ventilation)
2. Check the attic and roof condition
   a. Are there roof leaks? Look for water stains on the under-side of the roof decking, on the existing insulation, or on the attic floor.
   b. Will the ceiling support insulation? If the interior plaster is beginning to pull away from the lath or the drywall or sheetrock is pulling away from nails, do not insulate unless the ceiling is reinforced, or insulate by laying rolls of insulation tightly together crosswise over the joists.
   c. Before insulating, note the location of all of the following items:
      • Recessed lights
      • Doorbell transformers
      • Masonry chimneys
      • Metal chimneys and vent pipes
      • Exhaust fans
      • Heat/light ventilators
      • Knob and tube wiring
      • Uncovered electric junction boxes
      • Whole house fans
      • Attic access doors

You will need to take care when insulating near these objects to reduce the danger of fire. See the exhibit on Attic Insulation Blocking Guidelines on Page 20.
3. Prepare the attic
   a. Run drop cords and lights into attic. Install 2" x 6" or 2" x 8" walkboards so nobody accidentally steps on the ceiling and ends up on the floor below.
   b. Move stored items downstairs; protect what is left by covering them with plastic.
   c. If possible, pull up the attic floor over any uninsulated areas.
   d. If the old insulation is damp and compressed, remove it. If the vapor barrier on old insulation faces upwards, remove it or flip the insulation so the vapor barrier is against the ceiling.

4. Seal penetrations through the attic with foam sealant or caulking
   Locate all wiring, plumbing, ductwork, and other penetrations through the ceiling and seal using 20-year caulk, spray foam sealant, or other suitable material. Pay special attention to large cracks or holes, such as those around lights, heating ducts, or electric boxes for ceiling lights.

5. Weatherstrip and insulate the attic access door
   Install weatherstripping all around the attic access door to reduce infiltration. See Project 13: Weatherstrip Leaky Windows and Doors for more information on weatherstripping.
   Attach a batt of insulation to the door. If the attic access is a fold-down stairway, build a lightweight, insulated box to go over the stairs. Such a box can be lowered easily over the stairs as they are closed. There are also commercial products designed to insulate over attic stairs.

6. Install blocking
   Block around potential danger areas with R-30 or R-19 roll or batt insulation as described in the exhibit on Attic Insulation Blocking Guidelines. See Project 2.

7. Install insulation
   Wear long pants, a long-sleeved shirt, work gloves, a dust mask, safety goggles, and a hat or helmet for this work. When insulating, pay attention to these key elements:
   Get total coverage—insulate under all portions of the attic floor, if present. Move boxes and stored items so you can insulate everywhere.
   Do not block air flow from soffit or eave vents—use cardboard, foam insulation, special foam baffles, or wood to keep insulation especially loose-fill, from blocking this vital air flow.
   Start near the eave area. Place insulation with the vapor barrier—if it has one—facing down. If there is some insulation already on the attic floor, use unfaced batts which do not have a vapor barrier. Do not install a vapor barrier sandwiched between layers of insulation. To install insulation under the attic floor, use a push rod as shown on the diagram. You may have to use thinner insulation in this area—if the floor boards are installed on top of 2" x 6" joists, use 6-inch (R-19) rolls. Of course, if the floor boards are loose or easy to pull up, remove them, install insulation and then replace them. If possible, floorboards should be elevated since compressing insulation reduces its R-value. When you encounter cross-bracing, cut and weave the insulation around the braces as shown in the diagram.
Attic Insulation Blocking Guidelines

Blocking refers to insulation rolls or batts spaced out from components of the attic that should not come in contact with insulation. Blocking is particularly important when blowing insulation. These guidelines should be used for all types of insulation:

Recessed Lights
Allow a 3-inch clearance on all sides, except for the newer insulated-ceiling (IC) fixtures which allow insulation on and around the light.

Masonry Chimney
The National Fire Protection Association prohibits insulation from being installed against masonry chimneys. Allow at least a 2-inch clearance. To prevent air leakage in the gap between the chimney and insulation, install sheet metal flush against the chimney and attach it to the ceiling joists.

Factory-Built, Insulated Metal Chimney
Allow a 2-inch clearance between the insulation and chimney. If the chimney is housed inside a metal support box that extends into the attic, allow a 2-inch clearance between the insulation and the metal box.

Attic Trap Door
Block around the trap door for the attic to keep insulation from falling when the door is opened.

Vent Pipes from Heat-Producing Appliances
Unless otherwise specified, allow a 9-inch clearance between vents for combustion appliances—such as gas or oil-fired furnaces and water heaters—and the insulation blocking.

Uncovered Electric Junction Boxes
If the wiring in an electric junction box in the attic is exposed, you may install a cover and insulate over it. If it is left uncovered, keep insulation 3 inches from the box.

Knob and Tube Wiring
Do not cover knob and tube wiring with any insulation. The best procedure is to block around the wiring with unfaced insulation batts so that no insulation touches the wiring. If the house has been rewired, hire an electrician to identify and remove the knob and tube wiring that no longer carries live current.

Doorbell Transformer
Do not cover; no clearance is required on the sides.
EXHAUST FAN FOR KITCHEN OR BATHROOM

If the fan exhausts into the attic with no ductwork to the outside, a minimum 3-inch clearance is needed at the mouth of the blower. Preferably, you should extend a flexible duct from the fan to outside air or to one of the attic vents. If you do not extend the duct outside, the attic vent area should be greater than the minimum—(1/150 of the attic floor area with a vapor barrier or 1/300 without). See Project 21 for details on attic ventilation.

HEAT/LIGHT/VENTILATOR

In the case of a heat/light/ventilator combination often used in a bathroom, allow a 3-inch clearance on all sides just as you would for a recessed light and do not insulate over the top.

WHOLE-HOUSE FANS

Install blocking up to the whole-house fan housing and allow a 3-inch clearance between the blocking and fan motor.

Consider the attic area

HOW TO ORDER ROLL OR BATT INSULATION

The floor area that needs R-30 is calculated below (the portion that already has 4 inches needs only R-19): 25 ft x 60 ft = 1,500 sq ft

Roll or batt insulation is made of fiberglass or mineral wool. To obtain R-30, you can either order R-30 rolls or batts, or buy R-19 to go between the ceiling joists and R-11 to go crosswise on top of the joists. To estimate how many square feet you need, multiply the floor area of the attic by .95 to account for space occupied by the joists. In the above example, you would need: .95 x 1,500 sq ft = 1,425 sq ft of insulation

After estimating the square footage, call the insulation supplier and specify the area and the spacing between the joists. He or she should be able to tell you how many rolls are needed. Make sure you purchase insulation that is sized to go between the joists in your attic. Most often, joists are either 14.5 inches or 22.5 inches apart.

If the attic currently has insulation, you should order unfaced rolls of insulation. Unfaced insulation has no asphalt-impregnated kraft paper or metal foil vapor barrier. If the attic has no insulation, order faced batts; the ones with the asphalt-impregnated kraft paper backing work fine. The backing, which should face down towards the heated space, acts as a vapor barrier to moisture flow from the rooms below.
To install loose-fill attic insulation, you should follow the steps listed on the next page. Remember to get bids from several insulation contractors to make sure you will be saving enough money to justify doing it yourself. Note that many blowing machines are designed to blow only cellulose insulation; make sure you get the right blower and insulation for the job.

When ordering loose-fill insulation, you will need to know the attic floor area, the spacing between the joists, and the desired R-value. The bag in which the insulation comes will have a chart that shows how many bags are needed to provide specific R-values for a given floor area.

Never judge R-value by the thickness of the insulation. The mechanical blowing machine used to install loose-fill insulation blows a mixture of air and insulation through a blower hose into the attic. If the mixture has an excess of air, the insulation will be “fluffed”—the thickness of the insulation will not reflect its true insulating value. Fluffed insulation settles over time and has a much lower R-value than its initial thickness indicates.

To avoid problems encountered with variable mixtures of air and insulation, never judge the insulating value of loose-fill insulation by its thickness. Instead, use the insulation chart on the bag the insulation comes in to determine how many bags to blow into your attic. See the sample insulation chart below.

### Typical Insulating Values of Cellulose Insulation

<table>
<thead>
<tr>
<th>R-value at 75 F</th>
<th>R-40</th>
<th>R-32</th>
<th>R-24</th>
<th>R-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum thickness in inches</td>
<td>10.8</td>
<td>8.6</td>
<td>6.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Minimum weight (lbs.) per sq ft</td>
<td>2.1</td>
<td>1.6</td>
<td>6.5</td>
<td>.67</td>
</tr>
<tr>
<td>2&quot; x 6&quot; Joists Spaced 24 inches on Center sq ft coverage per 25# bag</td>
<td>2.1</td>
<td>1.6</td>
<td>.98</td>
<td>.67</td>
</tr>
<tr>
<td>Bags per 1,000 sq ft</td>
<td>83</td>
<td>63</td>
<td>48</td>
<td>27</td>
</tr>
<tr>
<td>2&quot; x 6&quot; Joists Spaced 24 inches on Center sq ft coverage per 25# bag</td>
<td>13</td>
<td>1.8</td>
<td>23</td>
<td>41</td>
</tr>
<tr>
<td>Bags per 1,000 sq ft</td>
<td>77</td>
<td>56</td>
<td>43</td>
<td>24</td>
</tr>
</tbody>
</table>

For example, suppose your attic contains 1,500 square feet of area you wish to insulate to R-30. Assume the joists are spaced 24 inches on center. Since R-30 is not shown on the sample chart, use the sizing estimates for R-32 insulation. The chart shows that 63 bags are needed for 1,000 square feet; thus, for the 1,500 square foot insulation area:

63 bags × 1,500/1,000 = 94 bags for R-32 insulation are needed.
Therefore, order 94 bags and purchase one or two rolls of R-30 batt or roll insulation to be used as blocking material. Be prepared for storing the large number of bags you will be purchasing—they can take up an unexpectedly large volume.

**STEPS IN INSTALLING LOOSE-FILL INSULATION**

1. Store the loose-fill insulation near where you plan to locate the insulation blower.
2. Follow steps 1 through 6 listed in the previous section Installing Roll or Batt Insulation.
3. Set up the blowing machine (the place where you buy the insulation may loan or rent it to you). Unwind the hose and run it into the attic. The most convenient arrangement is often to keep the whole blowing operation out of the house by locating the blower outside on a covered porch or inside a cargo van, and then running the hose through an outside opening into the attic, such as a gable vent.
4. Organize your crew. It is best to have three people—one to be in the attic blowing insulation, another loading the blowing machine with insulation, and the third acting as a go-between. In the summer the attic will be hot, so start early and plan for the person blowing the attic insulation to have frequent relief. Set up a signal to tell the person loading the machine to quickly turn it off in case of problems in the attic. The go-between crew member is helpful here.
5. Plug in the blowing machine. Most machines have two plugs, one for the blower and another for an agitator that stirs up the insulation loaded in the hopper. It is best to connect the plugs to two separate circuits to prevent blowing fuses or breaker switches.
6. Turn on the agitator. The blades should turn around inside the hopper. Never place hands or objects other than loose-fill insulation in the hopper when the agitator is operating. Rip a bag of insulation open and dump it into the hopper. Be careful not to let any of the torn portions of the bag fall into the hopper, as they can stop up the blower hose.
7. When the person in the attic signals that he or she is ready, whoever is loading the blower can turn it on. As the insulation level in the hopper declines, add additional bags.
8. Once again, install all of the bags of insulation purchased for the job.
9. When all of the bags have been installed, let the blower run for a few minutes to clear itself of all insulation. Then clean up.

**PROJECT 2
INSTALL R-30 INSULATION IN POORLY INSULATED ATTIC**

**Cautionary Note on Insulation Contractors**

Some contractors have fluffed insulation as a matter of practice. While most contractors are reputable, make sure that whoever is installing your insulation knows ahead of time that you plan to check the insulation chart on the bag and make sure he or she has installed the recommended number of bags. Also, nail or staple thickness markers several places in the attic. This will make it easier to apply a uniform thickness throughout the attic.
PROJECT 2
INSTALL R-30 INSULATION IN POORLY INSULATED ATTIC

OTHER CONDITIONS

In many houses, attic areas may include heated rooms or attics may not even exist because of cathedral ceilings or flat roofs.

Heated rooms in the attic

Attic rooms are often uncomfortable because of improper air sealing and insulation. Remember, you want to insulate and seal the entire envelope of the house.

Cathedral ceilings and flat roofs

These areas present special problems for the home insulator. No access exists to the enclosed cavity so insulation cannot be added easily. The most common methods for adding insulation require considerable building skills that typically call for a carpenter or building contractor. Some options are described in the following paragraphs.

Have the contractor build a dropped ceiling and insulate over it. If removable panels (ceiling tiles) form the new ceiling, use roll insulation. Loose-fill insulation will drop between the tiles and make a mess every time you look into the space above. While insulating, add attic ventilation.

If you have an exposed beam ceiling, the contractor can insulate between the rafters and install a new interior finish of wood or drywall. If you want to preserve the look of the exposed beams, but still insulate, thinner pieces of insulation, such as 2 to 4 inches of rigid foam insulation board, can be installed and covered with an interior finish that fits in between the still exposed portions of the rafters as shown in the diagram. With rigid foam insulation, the contractor should use an interior finish with a 15-minute fire rating, such as 1/2-inch drywall. Attach 2” x 4” nailers to the sides of the rafters as nailing surfaces for the interior finish.

When the rafters for a cathedral ceiling or flat roof are enclosed within the interior finish, insulating becomes even more difficult. If the interior finish needs replacing, two approaches can be followed: 1) remove the existing finish, install insulation leaving an air space above for ventilation, install ridge and soffit vents, put in a vapor barrier, and apply the new interior finish; or 2) attach 2 inches of rigid insulation to the interior side of the old finish and screw the new finish into the rafters through the insulation and old finish.

If reroofing, your contractor can install rigid insulation board over the existing roof, nail 1” x 4” or 2” x 4” spacers through the insulation into the existing rafters, attach a new roof deck to these spacers, install the new roof, and put in ridge and soffit vents for ventilation.
**BASIC PROCEDURE**

Ducts and other components of your heating and cooling system should be airtight so that they do not waste energy or create health and safety problems. Poorly sealed ducts can cause 10 to 30 percent of your home’s total heating and cooling costs. Duct leaks can draw air that is laden with toxic chemicals, pollen, mold, excess humidity, dust, and other contaminants into your home from attics, crawl spaces, and basements.

In addition to being airtight, the ducts should be well insulated to reduce energy losses and prevent condensation. All surfaces of the ductwork should be insulated, including the boot connections to the floor or ceiling. Duct insulation does not form an airtight seal, so a contractor usually must remove it to seal ducts, then reinstall the insulation.

The best material to use to seal ducts is mastic, a thick paste which can be applied to all types of ductwork. Avoid using what is commonly called “duct tape” since this only provides a temporary seal. If tape is to be used, look for the Underwriters Laboratory label UL-181 for a specially made duct sealing tape.

**PROJECT 3**

**SEAL AND INSULATE DUCTWORK**

Priority: URGENT ★★★★

- **CHECKLIST**

**Initial Requirements**
- Leaky or uninsulated ductwork in unheated area (basement, crawl space, attic, garage, etc.)

**Typical Costs and Savings**

- **Materials:**
  - $15 to $20/gal of duct sealing mastic
  - $.50 to $1.00/foot for duct insulation

- **Contractor (materials, labor, and overhead):**
  - Cost varies according to the accessibility of the ductwork and size of the house. Average sized home with easy access may range from $500 to $750

- **Annual energy savings:**
  - 10% to 30% of central heating and cooling bills

- **Average Time Required**
  - Contractor can usually finish in 1 to 2 days

- **Skills Required**
  - You should hire a contractor for this job

- **Tools and materials**
  - Contractor will supply all tools and materials
Every seam in the ductwork should be airtight. For an existing home, reaching some leaks can be difficult. The following list prioritizes the most important sites to seal:

1. Disconnected components, including breaks in metal duct, tears in flexduct, and dislodged duct board connections.
2. All of the seams in the air handler (the cabinet that houses the fan). Be sure to check that seams in hard-to-reach areas have been sealed. Sealing these areas may require partial disassembly of the air handler.
3. The supply and return plenums which sit on top of or beside the air handler. These boxes should be completely airtight.
4. The main ducts, called the supply and return trunk lines. Seal the seams perpendicular to the flow of air and all connections for branch ducts.
5. Panned ducts. These ducts are formed by wood or other parts of the building and are usually responsible for significant duct leakage.
6. The connections where the ductwork turns to meet the floor or ceiling, called the boots and elbows. Sealing and insulating these areas is especially important to prevent condensation on building materials, which can lead to deterioration.
7. The joints between sections of the branch ductwork.

Insulating Ducts

After the ducts have been carefully sealed, insulate them if they are in the attic, in the crawlspace or in the garage. Ducts should be insulated with R-5.6 or greater duct insulation. If you find any moist duct insulation, remove it first.

Cut the insulation so it is long enough to wrap around the duct with a two-inch overlap. Wrap the insulation around the duct with the vapor barrier on the outside, faced away from the duct. Don’t pull it too tight because this will compress the insulation fibers and reduce its effectiveness. Tape all seams with metal tape to provide a continuous vapor barrier. It is important to keep humid summertime air from reaching the cold ducts where it can condense into water.

If both the ducts and water pipes are in the same location (typically a crawlspace) then insulate all the water pipes to keep them from freezing. See Pipe Insulation on page 28.

If a foil-faced radiant barrier duct wrap is available, it is an excellent alternative to traditional fiberglass duct insulation. This duct wrap technology will not absorb moisture that might condense on the ductwork in hot weather.

SAFETY

If you have old duct insulation or tape, it may contain asbestos, a potential carcinogen. Have an expert tell you what type it is. If it is asbestos, get recommendations on the best course of action.
**SAFETY**

Wear work gloves and a long-sleeved shirt—most water heater jackets contain fiberglass or mineral wool insulation which can be irritating to the skin.

Read the instructions on the water heater jacket carefully; gas, propane, or fuel oil water heaters should be insulated only on the sides—not the top. Never block the cover for the pilot light and burner, or the exhaust vent at the top of a gas or propane water heater. Also, do not block the pressure-temperature relief valve (also called the “pop-off” valve) for any type water heater. In addition, do not cover the drain valve at the bottom of the water heater.

**MATERIALS**

- Insulating jacket—use an insulating jacket large enough for your water heater.  
- Vinyl tape—to secure the jacket to the water heater; it often comes with the water heater jacket.  
- Pipe insulation—enough to wrap about 15 feet of pipe. Make sure it is the right size for your piping (usually 3/4-inch copper or galvanized).

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**PROJECT 4**

**INSTALL INSULATING JACKET ON WATER HEATER**

Priority: URGENT ★★★★★

✓ **CHECKLIST**

**Initial Requirements**

- Current water heater is standard rather than high efficiency. Some older, cabinet-type units that are usually located in the kitchen may be inappropriate to insulate.

**Typical Costs and Savings**

**Materials:**

- $10 to $20

**Contractor (materials, labor, and overhead):**

- $25 to $35

**Annual energy savings:**

- 4% to 9% of water-heating costs

**Average Time Required**

- 1/2 to 1 hour

**Skills Required**

- Simple handiwork

**Tools**

- Utility knife
- Heavy-duty shears
BASIC PROCEDURE

For an electric water heater:
1. Turn off electricity to water heater.
2. Remove the door covering the thermostat and set thermostat to low setting (120 degrees). If you have a dishwasher, use thermostat setting recommended for it. Replace the door when you finish. Many electric water heaters have two thermostats, both of which should be adjusted.
3. Wrap the insulating jacket around the sides, cut to size, and tape in place.
4. Cut a “window” through the insulation to provide access to the thermostat. Put the insulation you cut out back in the window so the water heater remains insulated.
5. Cut insulation for the top of the water heater. Cut holes in the top piece to allow the pipes and the pressure-temperature relief valve to protrude.
6. Install the insulated cover over the top and tape the seams.

For a gas, propane, or fuel oil water heater:
1. Reduce the thermostat to the low setting.
2. Wrap the insulating jacket or insulation rolls around the sides, cut to size, and tape in place.
3. Cut insulation away from the pressure-temperature relief valve, pilot light and burner area. Make sure insulation can not possibly drop in front of these areas. These actions are critical for your safety.
4. Do not install insulation on the top of a gas, propane or fuel oil water heater

Pipe Insulation
A great deal of energy and water is wasted while waiting for the hot water to reach the tap. Make sure that all hot water pipes that you can see and reach are insulated. Also, if your water pipes are in the crawlspace, make sure that both the hot and cold water pipes are freeze protected by insulating them with pipe insulation. Pipe insulation comes in flexible foam tubes (R-3 to R-5), rigid foam (R-7) and fiberglass wraps (R-2 to R-3).
BASIC PROCEDURE

1. Use caulk or spray foam sealant to seal cracks or holes smaller than a pencil width in the ceiling, floor, or exterior walls. Seal holes on both the inside and outside surfaces of walls.

2. For larger openings, use spray foam sealant or fill the crack with backing material and caulk the surface.

3. Use sheet materials, such as cardboard, insulation board, or plywood, to cover large holes. Seal the edges of the sheet materials with caulk or spray foam sealant. Be sure to seal openings between the attic and house, and between the crawl space or basement and house.

USING SPRAY FOAM SEALANTS

Spray foam sealants come in cans and are dispensed much like shaving cream. However, the sealant, made of polyurethane, is difficult to tool or shape when wet. Therefore, it comes with a straw-like tube for reaching into tight places.

The product oozes, rather than sprays, out of the straw. It will stick to anything it touches. When it dries, it can be trimmed easily with a sharp utility knife.

Fill larger cracks or holes in multiple passes. The foam expands considerably, so fill the crack 2/3 full, then come back in a while to finish it off.

Never plan to use a container of the sealant more than twice. Often, you will obtain only one use because the material will set and clog up the applicator and nozzle. Plan to seal as many holes and cracks at one time as possible.

Spray foam sealant must be protected from exposure to sunlight and is flammable, so it should not be used near a heat source such as a furnace flue.

PROJECT 5

SEAL HOLES, CRACKS, AND PENETRATIONS

Priority: URGENT

CHECKLIST

Initial Requirements
- Holes, cracks, or unsealed penetrations through walls, ceilings, and floors.

Typical Costs and Savings

Materials:
- $2 to $7/caulk tube
- $5 to $12/can of spray foam sealant
- $5 to $30 for sheet materials to seal large holes
- $2 to $5/package of backing material

Contractor (materials, labor, and overhead):
- Up to $500/house

Annual energy savings:
- $130 to $180/house

Average Time Required
- Varies widely

Skills Required
- Simple handiwork, perhaps some basic carpentry
PROJECT 5

SEAL HOLES, CRACKS, AND PENETRATIONS

☐ CHECKLIST

Tools

• Caulk gun
• Utility knife
• Optional Tools
  • Carpenter’s tool belt (see Rules for Tools section in Chapter 3)
• Saw

Safety

• No special measures

Materials

• One-part urethane caulk, acrylic latex caulk with silicones, paintable silicone caulk, or other caulk with at least a 20-year life
• Backing material—such as foam backer rod
• Spray foam sealant—e.g., Great Stuff Polycel 1® or Touch n’ Foam®
• Sheet materials such as insulation board, plywood, or cardboard to cover large holes

AIR SEAL BYPASSES

Air leaks cause high heating and cooling bills and can make your home uncomfortable. Air leaks bring in outside moisture, dust, pollen, radon, and other pollutants. Even though your home is well insulated, it can still have excessive air leaks. Standard loose-fill, batt, or roll insulation materials do not stop air leaks, and can lose their insulating values if air seeps through them. Be sure to seal all bypasses before you insulate.

☐ Attic stair sealed with weatherstripping and insulated box
☐ Gap sealed with sheet metal and high temperature caulk
☐ Dropped soffit sealed with insulation board and spray foam
☐ Plenum for ductwork sealed with insulation board and spray foam
☐ Whole house fan sealed with insulation board and Velcro®
**S A F E T Y**

Never install the fireplace cover before the fire is completely out. Red embers or other signs of fire should not be present. In other words, the fire should have been stone cold for several days.

**M A T E R I A L S**

- 3/4-inch rigid extruded polystyrene insulation board—Dow (Styrofoam blue board), U.S. Gypsum (Foamular), or Amoco (Amofoam)
  or
- 3/4-inch plywood
- Fabric or self-sticking wall paper to cover insulation board or plywood.

**B A S I C  P R O C E D U R E**

1. Check to determine which fireplaces do not have dampers; order glass doors for undampered fireplaces that are used often.

2. To make covers for those undampered fireplaces that are seldom used, first measure the size of the fireplace opening.

3. With a utility knife, cut the rigid insulation board at least 2 inches wider and 1 inch taller than the opening or use a circular saw to cut plywood similarly.

4. If you are covering the cut board with fabric, wrap it around the board and cut it 3/4 inch wider on the three sides with exposed edges. Then, either sew the edges to enclose the board, or glue the fabric in place.

5. If using adhesive wall paper, cover the insulation board or plywood neatly.

6. Set the cover in front of the fireplace and mark the exact outline of the fireplace opening on it. Cut thin pieces of the rigid insulation or plywood, and attach them to the cover so it fits inside fireplace opening. This inside edge provides a good seal between the cover and the fireplace and helps keep the cover in place.

**P R O J E C T  6**

**B U I L D  F I R E P L A C E  C O V E R S**

*Priority: URGENT ❔

**C H E C K L I S T**

**Initial Requirements**

- If house has undampered fireplaces that are seldom used, install fireplace covers or glass doors.
- If a fireplace that is often used has no dampers, install glass doors, a fireplace insert, or a woodstove. The fireplace cover discussed in this chapter should not be installed on a frequently used fireplace due to the danger of fire (see Safety section).

**Average Time Required**

- 1 to 3 hours/fireplace cover
- Contractor usually can install glass doors, fireplace insert, or wood stove in a day’s time

**Skills Required**

- Simple handiwork for fireplace cover

**Tools**

- Tape rule
- Fabric shears
- 4-foot straightedge (yard stick, metal bar, or thin lumber that is not warped)

**Optional Tools**

- Circular saw
PROJECT 6
BUILD FIREPLACE COVERS

• Fireplace dampers only slow down the flow of air. When not in use, make sure that the damper is closed—hang a ribbon from the damper lever as a reminder. An open damper is like leaving a four-foot window wide open.

• When not in use cover and seal the front of the fireplace with some solid material as in the example to the right.

• A fireplace is not an efficient heating source. In fact, a fireplace can rob the home of conditioned air that it uses for combustion. As the heated air escapes up the chimney, cold outside air is pulled into the home through small cracks around windows and doors.

• Glass doors on fireplaces will reduce room air from escaping up the chimney. The glass does partially block the direct radiant heat you feel from the fire.

• If you do use the fireplace for supplemental heating then lower the house thermostat to 50° F, close all doors and warm air ducts to the room where the fireplace is located, and slightly open (about 1”) an outside window located near the fireplace.

• Sealed combustion fireplaces are specially made to pull in outside air for combustion. Also, when not in use, there is no air leakage

TYPICAL COSTS AND SAVINGS

Fireplace cover
Materials:
• $20 to $50/cover
Contractor (materials, labor, and overhead):
• $40 to $100/cover
Annual energy savings:
• $20 to $50/cover

Glass doors
Materials:
• Vary widely according to style
Contractor (materials, labor, and overhead):
• $100 to $300 for standard designs
Annual energy savings:
• Vary widely—up to $150

Fireplace inserts
Materials:
• $300 to $1,000 for standard designs
Contractor (materials, labor, and overhead):
• $400 to $1,500
Annual energy savings:
• Vary widely—up to $400

Wood stoves
Materials:
• $400 to $1,000 for standard designs
Contractor (materials, labor, and overhead):
• $500 to $1,500
Annual energy savings:
• Vary widely—up to $400
SAFETY
Be careful when working with glass to avoid cuts, particularly when removing pieces of a broken window pane. Use work gloves when removing glass.

MATERIALS
- Glazing compound that contains linseed oil—for sealing windows in place; do not use caulk.
- Quick-drying primer, linseed oil, or wood sealer—if glazing compound has no linseed oil. Sealing unpainted wood will make glazing compound last longer.
- Glazier’s points—to hold panes in place during installation
- Window panes—measure the size of the opening for broken panes and cut the glass 1/8 inch smaller along both dimensions. When buying the glass, take a piece of the broken window pane with you to match the type of glass.
- Exterior paint to match window trim
- Paint thinner—for cleanup

BASIC PROCEDURE
Replacing broken window panes
(If the window does not use glazing compound, see Replacing panes sealed in place with gaskets).

1. Measure opening for broken panes and order new panes 1/8 inch smaller in height and width.
2. Remove old pane carefully—use work gloves and work from the top down to prevent glass from dropping on your hands. Wiggle glass back and forth (like loosening a child’s tooth) to help pull it out. Also, remove all of the old glazing compound.

3. If using a glazing compound that does not contain linseed oil, seal the unpainted wood mullions with quick-drying primer, linseed oil, or wood sealer.

4. After the sealant dries (read directions on the can for an estimate of how long drying takes), use a putty knife to spread a 1/8-inch layer of compound evenly around the frame in which the glass will rest.

PROJECT 7
REPAIR AND REGLAZE WINDOWS

Priority: URGENT ★★★★★

☑ CHECKLIST

Initial Requirements
- Some windows are broken or have cracked or missing glazing compound

Typical Costs and Savings
Repair
Materials:
- $1 to $3/sq ft
Contractor (materials, labor, and overhead):
- $5 to $10/sq ft
Annual energy savings:
- Vary widely
Reglazing
Materials:
- Minimal
Contractor (materials, labor, and overhead):
- $3 to $6/sq ft
Annual energy savings:
- Vary widely

Average Time Required
- Repair: 1/4 to 1 hour/window pane
- Reglazing: 1/4 to 1 hour/window
PROJECT 7
REPAIR AND
REGLAZE
WINDOWS

☑️ CHECKLIST

Skills Required
• Basic carpentry

Tools
• Putty knife
• Tape rule
• Paint brush
• Hammer
• Gloves

5. Set the new pane in the frame and push in two glazier’s points along each side of the window with the putty knife or hammer.

6. Apply a sealing bead of putty at an angle as shown in the diagram. Press firmly for a good seal, and trim the excess putty as you work. Dip the putty knife in the linseed oil to help smooth out the putty.

7. After the putty has dried (usually seven to ten days after installation), paint the putty to match the window. The paint should extend 1/16 inch onto the pane to ensure a good seal.

Reglazing windows

1. Scrape all loose or cracked glazing compound out of the mullion frame. Make sure that only firmly attached glazing compound remains.

2. If using a glazing compound that does not contain linseed oil, seal the unpainted wood with quick drying primer, linseed oil, or wood sealer.

3. After the sealant dries, follow steps 6 and 7 from the previous procedure for replacing broken panes.

Replacing panes sealed in place with gaskets

Most metal windows and some wood units use rubber gaskets, rather than putty, to seal the glass in place. If the frame is held together by screws, you may be able to replace broken panes yourself.

Some metal windows, especially sliding windows, are built of single-section, molded sashes which cannot be disassembled by a do-it-yourselfer. The glass is held in place by a neoprene rubber gasket. These need to be reglazed by professionals.

To replace panes in frames held together by screws, first remove all large pieces of glass. If screws hold the frame together (and hold the broken glass in place) take them out. The rubber seals should remain attached to the sash. Be careful as you loosen the frame because the remaining broken glass will fall. Buy a matching pane 1/8 inch smaller than the frame and lay it in the disassembled sash. Screw the two halves of the sash together and mount it back in its frame.
MATERIALS

- Shower flow controls for each shower include a completely new energy-conserving showerhead. Right behind heating and cooling, heating water is the third largest energy user in the home. Newly designed low-flow showerheads reduce water use by 50% or more while providing a forceful spray of water. These showerheads reduce water consumption from six gallons per minute down to one to three gallons per minute. A flow restrictor, while less expensive is not recommended because, while it may reduce the forcefulness of the spray, it will not provide a satisfactory shower. When replacing older showerheads, it is best to remove them and take them to the hardware store to ensure the new product you buy will fit.

- Teflon tape—wrap this tape around the threads of the shower pipe to prevent leakage.

BASIC PROCEDURE

1. Remove the existing showerhead with an adjustable wrench.
2. Take the showerhead to the hardware store or building supply and purchase an appropriate shower flow control.
3. Wrap teflon tape around the threads of the shower pipe. Start at the end of the pipe and wrap clockwise one or two layers thick.
4. Tighten the new energy-conserving showerhead onto the taped pipe threads using the adjustable wrench.

OTHER CONDITIONS

If the old showerhead is locked on because of corroded pipes, you should reassess the job carefully before proceeding. Do not use brute force and damage the house’s plumbing because the job can then become expensive, and may leave your household without water until repairs are made. Of course, if the corrosion is severe, the flow may already be restricted.
PROJECT 9

INSULATE FLOORS

Priority: ★★★★☆

☑ Checklist

Initial Requirements

- The floor is presently uninsulated. An accessible crawl space (at least 18 inches of headroom) or unheated basement is under the floor. R-19 insulation is recommended.

Typical Costs and Savings

**R-19 Floor Insulation**

Materials:
- $.24 to $.38/sq ft of floor to be insulated
- $.37 to $.60/sq ft of floor (up to $.05/sq ft more for a low crawl space)

Contractor (materials, labor, and overhead):
- $.24 to $.38/sq ft of floor

Annual energy savings:
- $.06 to $.10/sq ft of floor

**R-11 Floor Insulation**

Materials:
- @ $.12 to $.18/sq ft of floor

Contractor (materials, labor, and overhead):
- $.22 to $.40/sq ft of floor (up to $.05/sq ft more for a low crawl space)

Annual energy savings:
- $.05 to .07/sq ft of floor

Average Time Required
- 1 to 2 days/1,000 sq ft

---

**SAFETY**

Wear hard-soled shoes, dust mask, safety glasses or goggles, long-sleeved shirt, hat, and work gloves for full protection—you will be working with fiberglass or mineral wool insulation.

**MATERIALS**

- Staples for heavy-duty stapler
- Insulation—Order R-19 rolls of insulation with a vapor barrier on one side for the specific spacing between joists (usually 14-1/2 or 22-1/2 inches). See exhibit on Floor Insulation Sizing for more information.
- Tiger claws or other rigid wire supports designed to hold insulation between the floor joists firmly against the subfloor—order for the specific spacing between joists. You will need about 50 to 55 supports per 100 square feet in floors with joists spaced 14-1/2 inches apart, or 35 to 40 per 100 square feet in floors with joists spaced 22-1/2 inches apart.
- 6 to 10 mil polyethylene plastic—only for houses with crawl spaces or basements over bare earth.
- Pipe insulation for hot and cold water pipes
  - Baling wire and U-nails to hold insulation in place (see Special conditions)

**FLOOR INSULATION SIZING**

Floor insulation can be sized either by determining the area of the floor to be insulated, or by finding the total length of joist spaces in which insulation will be installed. For example, consider a floor that has 1,600 square feet with joists spaced on 22 1/2-inch centers. Allowing 5 percent for framing, the insulation area should be 95 percent of the floor area:

\[
\text{Insulation area} = .95 \times 1,600 = 1,520 \text{ sq ft}
\]

Specify 1,520 square feet of R-19 insulation that is 22 1/2 inches wide. Also order 35 to 40 tiger claws per 100 square feet of floor—about 600 total tiger claws.

You could also have measured the length of the joist spaces and counted their number. If the above floor had 40 joist spaces 20 feet long, you would need: 40 x 20 = 800 linear feet of 22 1/2-inch R-19 insulation.
**BASIC PROCEDURE**

1. Set insulation, tiger claws, and tools in a protected place (e.g., on boards in crawl space) near the area of use so they will not get lost or dirty.

2. Before installing the insulation, caulk and seal all holes in the floor (electrical, plumbing, air-conditioning).

3. Install insulation as follows:
   a. Begin in the corner of the crawl space or basement farthest from the entry. Start with short lengths of insulation and build up to longer ones. Lay the first piece on the ground with the vapor barrier facing down. Note that you will be flipping the insulation over as you install it so that the vapor barrier will face up.
   b. Press the insulation against the band or ribbon joist of the exterior walls as shown and roll it up against the subfloor above. Make sure the vapor barrier of insulation faces up against the subfloor. Push a tiger claw against the insulation so that it fits snugly but does not compress the insulation.
   c. Push the next 2 to 3 feet of insulation in place. Install another tiger claw no more than 18 inches from the first one.
   d. Continue pressing this first piece of insulation in place; space the tiger claws about 18 inches apart.
   e. Install the next piece of insulation. Press the different sections of insulation together tightly so that no gaps result.
   f. Continue until you have insulated the entire floor. Note the special conditions at the end of this section.

4. Insulate exposed water pipes—now that you have insulated under the floor, the house will not be losing heat to the crawl space. Unfortunately, the crawl space will now be colder in the winter; therefore, plumbing pipes located under the house will be more likely to freeze. To help prevent freezing, you should insulate both hot and cold water pipes under the floor.

5. If the crawl space or basement has an earth floor, install a plastic ground cover. Find a friend who can help stretch out the plastic. Remove all stored materials from the crawl space. Roll out the polyethylene plastic and overlap the pieces about 2 feet. Hold the plastic in place with bricks or stones. Lap the plastic about 2 feet up the side walls.

**PROJECT 9**

**INSULATE FLOORS**

**☑ CHECKLIST**

**Skills Required**
- Simple handiwork

**Tools**
- Utility knife
- Heavy-duty shears
- Drop light and extension cord
- Tin snips
- Tape rule
**PROJECT 9**

**INSULATE FLOORS**

**SPECIAL CONDITIONS**

**JOIST SPACING TOO WIDE FOR INSULATION**

Measure the total width of joist spacing and subtract the width of roll insulation (14-1/2 or 22-1/2 inches) to find out how wide the extra piece needs to be to provide total coverage. For example, if you are using 22-1/2-inch insulation and encounter a 35-inch space, the extra piece will need to be:

\[
35 - 22-1/2 = 12-1/2 \text{ inches wide}
\]

Cut as much insulation of this width as is needed. Make sure you conserve insulation. Cut several widths out of the same piece of insulation if possible.

Hammer U-nails into both sides of the joists 5-1/2 inches below the subfloor (3-1/2 inches if using R-11 insulation). Space the U-nails every 20 inches and stagger them as shown.

To insulate this wide space, press the regular-width insulation against one side of the joist and staple the exposed tab of the vapor barrier every foot. You will have to compress the insulation a little to allow the stapler access to the vapor barrier. Continue stapling for the length of this piece. Install the narrower section beside the one just installed using the same technique. Now lace the metal wire back and forth between joists through the U-nails, pushing the insulation snugly in place as you go.

**JOIST SPACING TOO NARROW FOR INSULATION**

Using shears or the utility knife, cut the insulation the width of the joist space plus 1 inch (to allow a snug fit). Cut the tiger claws the same length with tin snips or with a steel or masonry cold chisel and a mallet or heavy hammer. Once the insulation is cut, follow the regular sequence for installing floor insulation (step 2 above).
**SAFETY**

Although the risk of an electric shock from low-voltage thermostat wires is minimal, always be careful around electricity. Never touch bare wire; handle it by the insulation. Always disconnect the electrical service by removing the fuse or turning off the breaker for the heating or cooling system.

**MATERIALS**

- Programmable thermostat (or clock thermostat)

- **Important:** If your house has a central heat pump, it requires a special programmable thermostat that is designed for your particular brand system. Call the local distributor or manufacturer for recommendations on the best product to buy.

**BASIC PROCEDURE**

1. Read the directions for installation and operation of the programmable thermostat.

2. Disconnect the fuse or turn off the breaker switch for the heating and cooling system in the service entrance panel.

3. Remove the old thermostat by taking off the cover and unscrewing the unit from the wall. Make sure the wires do not fall back inside the wall. Caulk the hole through which the wires extend.

4. Follow the directions that come with the thermostat to connect it to the wiring from the heating and cooling system.

5. Attach the thermostat to the wall or other location.

6. Reconnect electrical service to the heating and cooling system; program the thermostat and monitor its performance to make sure it is working properly.

---

**PROJECT 10**

**CONNECT PROGRAMMABLE THERMOSTAT**

Priority: ESSENTIAL ★★★

✔️ **CHECKLIST**

**Initial Requirements**

- You are willing to let the temperature of your house drop in winter at night and when no one is home. Also, you are willing to increase the temperature when no one is home during the summer.

**Typical Costs and Savings**

- **Materials:**
  - $50 to $150

- **Contractor (materials, labor and overhead):**
  - $80 to $200

- **Annual energy savings:**
  - $65 to $90

**Average Time Required**

- 1/2 hour to install

**Skills Required**

- Simple handiwork

**Tools**

- Screwdriver
- Needle-nosed pliers
PROJECT 11
INSTALL GASKETS ON ELECTRICAL OUTLETS

Priority: ESSENTIAL ★★★

☑️ CHECKLIST

Initial Requirements
• No gaskets on electrical outlets

Typical Costs and Savings

Materials:
• $5 to $15/house (about $2 for 8 gaskets)

Contractor (labor, materials, and overhead):
• $15 to $40/house

Annual energy savings:
• 1% to 2%

Average Time Required
• 1 1/2 to 3 hours

Skills Required
• Simple handiwork

Tools
• Flat head screwdriver sized for electrical switchplate covers

SAFETY

This task can be extremely dangerous as you will be working around 120-volt electricity. Always disconnect the fuse or turn off the breaker switch to the different outlets and switch boxes as you proceed.

Be careful when removing coverplates from electrical outlets and switches. Even when you have made every effort possible to turn off the current to the box being worked on, there is a chance it may still be live. Never insert any object, especially fingers and metal tools, inside the electrical box.

MATERIALS

• Gaskets for both switches and outlets—enough to cover the switches and outlets for the house. Gaskets are available for double switches and outlets as well. Also, get plastic safety plugs for those outlets that are seldom used. Although switches and outlets on exterior walls have priority, gaskets should be installed under all cover plates. Cold air leaks from the attic, basement, and crawl space into interior walls.

BASIC PROCEDURE

1. Disconnect the fuse or turn off the breaker switch to the outlet or switch being worked on (use a loud radio plugged into the outlet or light controlled by the switch to tell which fuse shuts off the circuit).

2. Unscrew the coverplate—do not lose the screw.

3. Install the gasket carefully—there may be live wires inside the box. For best results, caulk the gasket to the wall finish material.

4. Replace the coverplate.

5. Continue for the whole house.
**PROJECT 12**

**CAULK WINDOW AND DOOR FRAMES**

**Priority: ESSENTIAL ★★★**

**CHECKLIST**

**Initial Requirements**
- Missing or cracked caulk between the window or door frame and the exterior or interior wall finish

**Typical Costs and Savings**

- **Materials:**
  - $2 to $7/tube of durable caulk
  - $2 to $5/package of backing material

- **Contractor (materials, labor, and overhead):**
  - $8 to $20/unit

- **Annual energy savings:**
  - Vary widely

**Average Time Required**
- About 1/4 hour/window or door

**Skills Required**
- Simple handiwork

**Tools**
- Caulk gun
- Putty knife

**Safety**
- No special measures

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**MATERIALS**

- Acrylic latex caulk with silicones, silicone caulk, 1-part urethane, or other durable caulk
- Backing material, such as foam backer rod

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**BASIC PROCEDURE**

1. Clean old, dried caulk out of the crack between the wall and window or door frame.
2. Apply caulk to the crack. If the crack is wider than 1/4”, use backing material to fill the gap, then cover with caulk.
PROJECT 13
WEATHERSTRIP
LEAKY
WINDOWS AND
DOORS

Priority: ESSENTIAL ★ ★ ★

☑ CHECKLIST

Initial Requirements
• Air flows readily around windows and doors into the house; weatherstripping is missing or ineffective; doors need energy-conserving thresholds.

Typical Costs and Savings
Materials:
• $5 to $10/window or door for weatherstripping;
• $6 to $15/door for energy-conserving threshold

Contractor (materials, labor, and overhead):
• $36 to $50/window; $40 to $60/door

Annual energy savings:
• Vary widely

Average Time Required
• Weatherstripping—1/2 to 2 hours/opening
• Threshold—1/2 to 1-1/2 hours/door

Skills Required
• Weatherstripping—Simple handiwork
• Threshold—Basic carpentry

MATERIALS
• Sash locks where missing or damaged—these locks pull together the upper and lower sashes on double-hung windows and reduce air infiltration.
• Weatherstripping for windows and doors that have none—weatherstripping comes in either long rolls or in sections appropriate for single doors or windows. If you are buying a longer roll, allow an average of 17 feet per door or window. For example, a 50-foot roll would seal about three openings (3 x 17 = 51 ft). See exhibit on Infiltration Control Products.
• Energy-conserving thresholds or door sweeps for leaky door bottoms. See exhibit on Infiltration Control Products.
• Fasteners to nail, screw or otherwise attach weatherstripping if not included in the package.
• 20-year caulk for sealing under energy-conserving thresholds.
INFLTRATION CONTROL PRODUCTS

TYPES OF WEATHERSTRIPPING:

1. Thin spring metal—comes in rolls and is nailed or screwed in place. It is the most durable and can be used in a variety of applications.
2. Rolled vinyl gasket—comes in rolls and can be obtained with a metal backing. It is durable and has many different applications.
3. Adhesive-backed vinyl V-strip—works well for sealing doors and hinged windows, and between the two sashes in double-hung windows.
4. Adhesive-backed foam strip—recommended only for short-term situations, such as helping a leaky window make it through a winter. Use closed cell foam which lasts longer—the surface is smooth and the individual pores in the foam do not show—unlike the open-cell foam which wears out very quickly.
5. Foam rubber with wood backing—easy to install but not very durable.

TYPES OF WEATHERSTRIPPING:

1. Plain door sweep—can simply be screwed onto the bottom of the door and adjusted vertically so that it seals the crack between the closed door and the threshold. It is easy to install, somewhat durable, and fairly inexpensive, ranging in cost from $5 to $10. Door sweeps are most useful for flat thresholds. Flip sweeps are similar products that swing out to avoid interference with carpeting or rugs.
2. Door shoe—durable option that is somewhat difficult to install. It is especially useful when the existing threshold is not worn. As with the door sweep, you can adjust the shoe to form a solid seal for a door bottom that is not parallel to its threshold. Door shoes are more expensive than plain sweeps, ranging in price from $7 to $20.
3. Vinyl gasket threshold—usually comes as an aluminum threshold with a vinyl gasket inserted in a middle track. The door bottom seals against the vinyl gasket. Due to foot traffic, the gasket will wear out over time, but can be replaced. A vinyl gasket for a door parallel to the floor usually ranges in price from $5 to $8. An adjustable threshold of this type for a door that is not parallel to the floor is more difficult to install and costs $12 to $20.
4. Interlocking metal threshold—very durable and provides an excellent seal. However, it is difficult to install.

PROJECT 13
WEATHERSTRIP LEAKY WINDOWS AND DOORS

✓ CHECKLIST

Tools
Weatherstripping
• Tape rule
• Screwdriver
• Hammer
• Utility knife
Threshold
• Above tools plus:
• Hack saw
• Drill
Safety
• No special measures

Types of thresholds
PROJECT 13
WEATHERSTRIP LEAKY WINDOWS AND DOORS

BASIC PROCEDURE
DOUBLE-HUNG WINDOWS—USING SPRING METAL WEATHERSTRIPPING

For some window units, the metal weatherstripping can be inserted between the sashes and window jamb without disassembling the window.

1. Open the lower sash fully and slide the metal weatherstripping between the jamb and sash on one side. Mark where the weatherstripping meets the window seat. Repeat for the other side.

2. Cut weatherstripping to length and tack into place between the jamb and lower sash. Close the lower sash.

3. Open the upper sash fully and follow the same procedure to weatherstrip it as for the lower sash.

4. Install a piece of weatherstripping along the bottom edge of the lower sash and top edge of the upper sash to seal the units when closed. Also weatherstrip the meeting rail (where the two sashes meet when closed).

If the weatherstripping cannot be inserted between the sash and jamb, then the window may have to be disassembled for proper installation, as described in the following steps.

1. Remove the window stops carefully—it may be difficult to find replacement stops that match, particularly in an older home.

2. Pull the sashes out of the jamb and install spring metal weatherstripping against the jamb. Also, install weatherstripping on the outer surface of the lower sash’s top rail so that the two sashes will seal together tightly.

3. Replace the sashes and install the window stop so that the window fits snugly, but can easily be opened and closed.

4. If the window does not lock tightly, replace or adjust the sash lock.

5. Install weatherstripping along the bottom edge of the lower sash and top edge of the upper sash to seal the units when closed.
Double hung window—using vinyl weatherstripping

1. If you do not have to remove the stops and sashes, seal the sides of the window with rolled vinyl gaskets. Note that these weatherstripping materials may be visible.

2. Also, seal the meeting rail with rolled vinyl gaskets. Seal the bottom rail with vinyl V-strip or rolled vinyl gasket weatherstripping.
PROJECT 13
WEATHERSTRIP LEAKY WINDOWS AND DOORS

- Clean all surfaces of dirt, loose paint and other debris before caulking.
- Apply caulk during dry weather when the temperature is above 45 F.
- Use a backer rod (looks like a rope made of foam) on gaps that are over \( \frac{1}{2} \) or more, then cover with caulk.
- Replace cracked and peeling caulk around windows, doors and siding to eliminate drafts.
- If your windows are in need of major repair, consider new ENERGY STAR windows. Improved window technologies keep more of the heat inside during the winter and keep less of the sunlight streaming through in the summer.

CASEMENT WINDOWS
Install spring metal or vinyl V-strip weatherstripping around the jamb just beside the window stops.

METAL WINDOWS
Although not recommended for other windows, use closed-cell, adhesive-backed foam to seal the bottom rail and meeting rails of these windows. You may have to replace this weatherstripping annually, but it is inexpensive and easy to install.

CONVENTIONAL SWinging DOORS
Use spring metal, vinyl V-strip, or rolled vinyl weatherstripping around the top and sides of the door frame.

SWinging DOOR BOTTOMS
If the door bottom is not square with the threshold, attach a door shoe or plain sweep; adjust it vertically to provide a good seal. If the door has no threshold, install an adjustable threshold with a vinyl gasket instead.

If the door is square and needs a threshold, install a simple (nonadjustable) threshold with a vinyl gasket. If it is square and already has a threshold, install a door boot or plain sweep. See the exhibit on Checking for Square in Project 24: Put In Storm Doors.

SLIDING GLASS DOORS
Many units are already weatherstripped with a replaceable brush-like “pile” weatherstripping or with a neoprene gasket. If not weatherstripped, a skilled carpenter can screw rolled vinyl weatherstripping with a metal backing into the frame using sheet metal screws.
SAFETY

Exceptional care is needed to avoid damaging electrical wires and plumbing inside the walls. The electrical circuits for the wires running through the walls that are being insulated should be turned off.

Blowing wall insulation can be a delicate operation. The insulation blowing machine pressurizes the wall with its high air flow. Under certain conditions, the interior wall finish can be strained and potentially loosened from its support. An observer should be stationed inside the house watching the wall. If the interior wall is shaking or billowing considerably, the observer can tell the installer to turn off the blowing machine.

MATERIALS

- Loose-fill insulation—When filled with insulation, the insulating value of most wall cavities increases by about R-13. A 25-pound bag of insulation will fill about three wall cavities—about 25 square feet of coverage per bag.
- Siding or other materials to replace damaged areas
- If holes are to be drilled, one to two-inch wall plugs to cover holes
- 20-year paintable caulk to seal plugs in place
- Paint may be required

PROJECT 14
INSTALL WALL INSULATION

Priority: IMPORTANT ★ ★

CHECKLIST

Initial Requirements
- Existing walls are uninsulated.

Typical Costs and Savings
Materials:
- $.20 to $.35/sq ft of wall
Contractor (materials, labor, and overhead):
- $.55 to $1.00/sq ft of wall for blowing through interior wall or exterior wood siding
- $.80 to $1.75/sq ft of wall for blowing through exterior brick veneer

Annual energy savings:
- $.33 to $.50/sq ft

Average Time Required
- Contractor can often finish an average size home in one full day

Skills Required
- In most cases, a contractor should be hired for this job

Tools
- Insulation blowing machine 10-ft, 1-1/2” diameter flexible plastic tube
- Ladders
- Power tools, such as saws, drills as required
- Carpenter’s tool belt (See Rules for Tools section in Chapter 3)


**PROJECT 14**

**INSTALL WALL INSULATION**

**BASIC PROCEDURE**

If the walls in your home do not have insulation, blowing in loose-fill insulation can both insulate and air seal wall cavities. Cellulose insulation usually provides the best job of sealing air leaks and adds about R-13 to the wall.

To gain access to the stud cavities, you can either drill holes into the wall from outside or inside, or remove a piece of exterior siding. If the house does not have sheathing under the siding, you may only need to pry the siding up a few inches in order to get the hose for the insulation blower into the wall. If you have to drill holes, you will need to patch them. Patching holes in the plaster or sheetrock on the inside is relatively easy to do, but the patch and wall will need to be painted. Holes drilled on the outside have to be patched as well. Wood or plastic plugs can be used to fill these holes. The plugs must be caulked and painted carefully to match the exterior finish.

Blowing the insulation into the wall through a flexible tube compacts the insulation, and can dramatically reduce air leaks. Known as dense pack wall insulation, this method packs about three times more insulation material into the wall and so seals air leaks while insulating. At the density typically applied without using the dense pack method, wall insulation does not significantly reduce air leakage.

Most exterior walls have electrical wires, plumbing and other materials that can be life threatening or damaging to the building if improperly handled. Be certain that whoever is insulating the walls is knowledgeable about performing this work safely and efficiently. Never work on walls that have live electrical current or faulty wiring. Be sure to know where cutoff valves are located for water lines.

**THE BASIC STEPS IN DENSE PACK WALL INSULATION FOR A HOUSE WITH SIDING ARE:**

1. Pry the lower course of siding away from the wall about two inches, being careful not to crack the siding, and to keep its top edge nailed to the wall so it can be easily renailed. If the house has sheathing beneath the siding, remove the siding and drill a 2-inch diameter hole in the sheathing at an upwards angle to allow the tube to be shunted to the top of the wall without a sharp bend.
2. Pry or remove siding as required for horizontal blocking in the wall, above window and door framing, and for diagonal corner bracing.

3. Adjust the insulation blower so that it will blow insulation at a sufficient pressure to compact the loose-fill cellulose to a density of about 3 pounds per cubic foot of wall area. The insulation should be compressed tightly such that poking it with your finger feels like poking a kitchen sponge. BE CAREFUL THAT THE PRESSURE IS NOT SO GREAT THAT THE INTERIOR WALL SURFACE BOWS OR CRACKS.

4. Blow insulation into each stud bay by shunting the tube to 1 foot from the top of the wall. As the bay begins to fill with insulation and the insulation compacts around the end of the tube, pull the tube down in 1 foot increments allowing the insulation to become tightly packed. Dense packing the entire stud bay for an 8-foot high wall should take 3-5 minutes. If filling a stud bay is taking longer, stop and check to ensure that the insulation is not flowing inside, or into the attic or crawl space.

5. Be sure to insulate the entire exterior wall — above windows and doors, where porch roofs or balconies attach to walls, and where there are uninsulated floors above garages or open areas. Dense pack cellulose insulation is also effective at sealing air leaks between floor joists for attic bonus rooms. Many of these areas will require insulating from above while standing on a ladder. Follow strict safety guidelines as the blower can become clogged or drills obstructed and jerk against the installer.

6. After the stud bay is insulated, close the wall by re-nailing the siding. Plug any drill holes in the wall sheathing with pieces of fiberglass insulation, and then re-nail the siding. Repair and paint pieces of siding if necessary.

PROJECT 14

INSTALL WALL INSULATION

Installing wall insulation is a difficult job for the do-it-yourselfer. Consider hiring a professional installer to do this work.

- An excellent opportunity for installing wall insulation is when you add or replace siding. The holes that are drilled in the wall will not have to be plugged and painted. Many siding companies add a thin amount of foam insulation and this will help a little, but insulating that 3½-inch cavity between the studs with R-13 insulation will save the most energy.
**PROJECT 15**

**INSTALL CEILING FANS AND WHOLE HOUSE FANS**

**Priority: IMPORTANT ★ ★**

**✓ CHECKLIST**

**Initial Requirements**
- You need a full attic with adequate ventilation to install a whole house fan.

**Typical Costs and Savings**

**Ceiling fan**
- **Materials:**
  - $50 to $2000

- **Contractor (materials, labor, and overhead):**
  - $100 to $300

- **Annual energy savings:**
  - Up to 40% on cooling costs and up to 10% on heating costs (using several fans)

**Whole house fan**
- **Materials:**
  - 150 to $350

- **Contractor (materials, labor, and overhead):**
  - $300 to $500

- **Annual energy savings:**
  - Up to 2/3 of cooling bill

**SAFETY**

Installing fans requires substantial electrical work — do not attempt it unless you are very sure of your abilities. Assume all wires are live until tested. Turn off the breaker switch or disconnect the fuse for the circuit on which you will be working or cut off the main breaker for the house. Always connect a temperature-sensitive switch, called a firestat, in the attic when installing a whole house fan. Firestats will shut off the fan in case of fire.

**MATERIALS**

**CEILING FAN**
- Multi-speed ceiling fan — use a multi-speed model sized according to the room. An ENERGY STAR rated fan will use less energy and provide better air flow.

- To determine which size of ceiling fan you need, measure the room where the ceiling fan will be installed. If the room is 75 sq. ft. or less use a fan size from 29 to 36 inches in diameter, rooms 76-144 sq. ft. use a 36 to 42 inch fan, rooms 144-225 sq. ft. use a 44 inch fan and rooms 225 to 400 sq. ft. use a 50 to 54 inch fan.

- Cable clamps — these screw into the electric box and clamp the incoming wire in place. Buy six to ten.

- Electric box to which ceiling fan is connected — the box should connect directly to the ceiling joist.

- Switch box, multi-speed switch, and switch cover-plate for fan — if needed (many are operated by a pull switch that hangs from the fan.)

**EXTRA MATERIALS FOR WHOLE HOUSE FAN**
- Multi-speed whole house fan — size based on the volume of the area you wish to cool. For example, a house with 2,000 square feet of area to cool and 8-foot ceilings would have a volume of 16,000 cubic feet. The fan should deliver 1/2 to 1 air change per minute; that is, every 1 to 2 minutes the volume of air in the house should be replaced. In the example, you need a fan that produces 8,000 to 16,000 cubic feet of air flow per minute, or 8,000 to 16,000 cfm. The cfm rating should be printed on the box.

- In addition to the wiring materials listed for a ceiling fan, you will need the following for a whole house fan:
  - Extra wire nuts and cable clamps
  - Temperature-sensitive safety switch (firestat) — to keep fan from running if a fire occurs in house
  - Timer switch — keeps you from having to get out of bed in the middle of the night to turn off the fan
  - 2” x 8” or 2” x 6” lumber — for framing the opening where the fan will be mounted. The lumber should be the same size as the ceiling joists
  - Nails for framing opening
  - Inner tube or other rubber material (optional) — gasket for the whole house fan
BASIC PROCEDURE
INSTALLING CEILING FAN

1. Read installation instructions before you leave the store to make sure the fan is appropriate for your house.

2. Determine where you want the fan installed (e.g., center of the ceiling, over dining table, over bed, etc.) Also, determine the position of the switch to control the fan if necessary. Many fans are controlled by a pull cord just like that for a closet light.

3. Determine the path for electric wiring. If substituting the fan for an existing overhead light, you can probably use the wiring inside the electric box for the light. Otherwise, the wire can extend to the main service panel or it may be connected to an outlet box in a seldom used circuit.

4. If a new electric box is necessary, attach it to a joist in the attic.

5. Run wiring to the box.

6. Keep the circuit off and follow the instructions to hang the fan and connect the wiring into the electric box.

PROJECT 15
INSTALL CEILING FANS AND WHOLE HOUSE FANS

☑ CHECKLIST

Average Time Required
Ceiling fan — 1 to 3 hours
Whole house fan — 8 to 16 hours

Skills Required
Ceiling fan — basic electrical wiring

Whole house fan — basic carpentry and basic electrical wiring

Never do your own wiring unless you have prior experience and total confidence in your abilities.

Tools
Ceiling fan
- Wiring inside electric box
- Voltage meter or circuit tester
- Utility knife
- Wire stripper
- Needle-nose pliers
- Carpenter’s tool belt (see Rules for Tools section in Chapter 3)
- Ladder

Whole house fan
- Above tools, plus:
- Circular saw or reciprocating saw
- Framing square
INSTALLING WHOLE HOUSE FAN

1. Read the printed instructions that come with the fan. Determine the path for the electric wire. Because you must connect the temperature-sensitive switch and timer switch, the wiring is usually more complex than for a ceiling fan.

2. You will need to start by framing a structure on which the fan will sit. Use the printed instructions and follow steps 3 through 7 below.

3. Use a framing square as a guide to draw lines on the ceiling for the location of the fan. Try to locate the fan between two ceiling joists — plan the location so as to cut at most, one joist. After checking to make sure you will not cut any wires or other objects in the attic, carefully use a keyhole saw, circular saw, or reciprocating saw to cut the opening.

4. Remove the ceiling within the opening to expose the attic. Be sure not to damage any of the interior finish outside the dimensions of the fan.

5. Cut any joists that extend over the fan opening. Cut 2” x 8” or 2” x 6” framing the hole in between the joists.

6. Install framing.

7. Install the fan on top of the framing; consider inserting a rubber gasket, such as a piece of inner tube, between the framing and the joists to reduce vibration and noise.

8. Run wiring using the wiring diagram that comes with the fan.

9. Test the fan.

10. Install the louvered cover over the fan.

11. Use insulation board or other material to seal the louvered cover in winter to reduce infiltration, or build an insulation box to fit over the fan during the winter. There are some commercial whole house fan covers available.
MATERIALS

Same procedure as Project 2: Also refer to Determining Quantity of Loose-Fill Insulation on bottom of this page. Exception: In northwest Arkansas, add R-27 to R-30 on top of the existing R-11 for a total of R-38 or greater.

BASIC PROCEDURE

1. Either have a contractor blow in R-19 loose-fill insulation, blow it in yourself, or install R-19 unfaced batt or roll insulation.
2. See Project 2: Install R-30 Insulation in Poorly Insulated Attic.

DETERMINING QUANTITY OF LOOSE-FILL INSULATION

Typical specifications for loose-fill insulation, which should appear on the bag, are shown in the chart on page 22. To obtain R-19 for a 1,500-square foot attic, first determine how many bags you will need. Assuming 2” x 6” joists on 24-inch centers, the chart shows you would need 27 bags per 1,000 square feet. To calculate the amount of insulation needed in the 1,500-square foot attic, multiply:

27 bags x 1,500 sq ft/1,000 sq ft = 40.5 bags

You or your contractor should order and install 41 bags.

PROJECT 16
ADD R-19 INSULATION IN PARTIALLY INSULATED ATTIC

Priority: IMPORTANT ★ ★

☑ CHECKLIST

Initial Requirements

- Attic now has 3 to 5 inches of insulation

Typical Costs and Savings

Materials:

- $.24 to $.38/sq ft of fiberglass/mineral wool roll
- $.20 to $.28/sq ft of blown cellulose
- $.20 to $.28/sq ft of blown fiberglass/mineral wool

Contractor (materials, labor, and overhead):

- $.32 to $.57/sq ft of fiberglass/mineral wool roll
- $.26 to $.35/sq ft of blown cellulose
- $.28 to $.36/sq ft of blown fiberglass/mineral wool

Annual energy savings:
- $.14 to $.29/sq ft of attic floor

Average Time Required
- 5 to 9 hours/1,000 sq ft

Skills Required

Simple handiwork, perhaps some basic carpentry

Tools and Safety

See Project 2: Install R-30 Insulation in Poorly Insulated Attic.
PROJECT 17
BUILD EXTERIOR SOLAR SHADE SCREENS

Priority: IMPORTANT ★★
According to the U.S. Department of Housing and Urban Development, stopping the sun’s heat before it penetrates windows and sliding glass doors is up to seven times more effective than using interior blinds or curtains.

CHECKLIST
Initial Requirements
- Unshaded windows facing east, southeast, south, southwest, or west.
  (See also Projects 18 and 19.)

Typical Costs and Savings
Materials:
- $.80 to $3.00/sq ft
Contractor (materials, labor, and overhead):
- $3.25 to $5.00/sq ft
Annual energy savings:
- $.27 to $.44/sq ft

Average Time Required
- 1/4 to 1 hour to fabricate and install each screen
- Shade screen on metal frame

MATERIALS
SHADE SCREEN ON WOOD FRAME:
- Solar shade screen — rated to block 60 to 80 percent of sunlight and sized at least 1 to 2 inches larger than the screen frame
- Heavy-duty 1/4-inch staples for staple gun to attach the screen to frame
- 3/4-inch or 1-inch brads to attach the screen molding to frame
- Corrugated metal fasteners — to hold together new frame
- 1” x 2” lumber long enough for the frame
- Construction adhesive or glue
- Screen molding (if needed) to extend all around the frame
- Exterior wood primer
- Exterior paint to match window trim
- Hardware to attach the screen over the window

SHADE SCREEN ON METAL FRAME:
- Solar shade screen — rated to block 60 to 80 percent of sunlight and sized at least 1 to 2 inches larger than screen frame
- Rubber spline to hold the screen in the metal frame
- Hardware to attach the over the window
**BASIC PROCEDURE**

**REPLACING AN INSECT SCREEN ON A WOOD FRAME WITH A SOLAR SHADE SCREEN**

1. Remove the screen molding from the old screen. Be careful if you want to reuse the molding — it breaks easily.
2. Remove old brads and staples with a screwdriver, hammer and pry bar.
3. Clean flaking paint on the frame with a paint scraper or steel wire brush.
4. Cut the shade screen 1/4 inch larger than the outside dimensions of the old screen and lay it in place on the wooden frame.
5. Staple the solar shade screen to the top of the frame — be careful to keep the screen’s thick weave straight across the frame. Then, stretch the screen evenly toward the bottom and staple.
6. Staple one side down; then, stretch the other side and staple it down.
7. Trim the excess screen with a utility knife.
8. If you are reusing old screen molding, tack it in place with 3/4-inch or 1-inch brads.
9. If you are replacing the screen molding, use a mitre box to cut molding with 45-degree corners.
10. Mount the screen in the window.
11. Make sure you remove the shade screen in winter.

**INSTALLING A SHADE SCREEN ON A NEW WOOD FRAME**

1. Measure the outside frame of the window. Be accurate — the frames of older windows may have shifted and the corners will no longer be at right angles. (see the exhibit on Checking for Square under Project 24: Put in Storm Doors)
2. Using a mitre box, cut pieces for the window frame out of 1” x 2” lumber at a 45-degree angle. Lay the pieces on a flat surface to check the dimensions and ensure the mitred edges fit tightly.
3. Glue the frame together and use the corrugated fasteners to assemble it. Drive two 1-1/2-inch brads through the edge into each corner joint to ensure a solid connection.
4. Follow steps 4 through 10 in the previous section (replacing an insect screen on a wood frame with a shade screen).
5. Make sure you remove the shade screen in winter.

**PROJECT 17**

**BUILD EXTERIOR SOLAR SHADE SCREENS**

**CHECKLIST**

**Skills Required**
- Basic carpentry

**Tools**

- Screen spline roller
- Scissors
- Carpenter’s tool belt (see Rules for Tools section in Chapter 3)

**Shade screen on wood frame:**
- Pry bar (for installing on old frame)
- Mitre box with backsaw (if installing on new frame or replacing screen molding on old frame)
- Paint scraper or steel wire brush (for installing on old frame)
- Heavy-duty stapler

**Shade screen on metal frame:**
- Electric drill and drill bits (if installing on new frame)
- Mitre box and backsaw (if installing on new frame)

**Safety**
- Common-sense measures
REPLACING AN INSECT SCREEN ON A METAL FRAME WITH A SOLAR SHADE SCREEN

1. Remove the old screen from the metal frame by gently pulling out the rubber or plastic spline — be careful if you plan to reuse the spline.
2. Cut a piece of the shade screen 1 to 2 inches larger than the outside dimensions of the old screen.
3. Place the shade screen over the frame. Starting at the top left-hand corner, lay the rubber spline on top of the screen directly over the groove in the frame.
4. Roll the spline roller in a clockwise direction to press the spline and the screen firmly into the groove. Continue around the frame until you reach the starting point. As you proceed, keep the weave even in the frame.
5. Trim any excess screen from the spline using the utility knife.
6. Install the shade screen frame in the window.
7. Make sure you remove the shade screen in winter.

INSTALLING A SHADE SCREEN ON A NEW METAL FRAME

1. Measure the outside frame of the window.
2. Cut four pieces of aluminum frame stock to form the top, bottom, and sides of the frame. For larger screens, you may also need a center support bar and clips for attaching it to the frame.
3. Slide the frame pieces onto the metal corner brackets. Set the completed frame into the window to check the fit. Make any needed adjustments.
4. Follow steps 2 through 6 for the previous procedure in this section (replacing an insect screen on a metal frame with a solar shade screen).
5. Make sure you remove the shade screen in winter.
**Materials**

- White roller blinds sized for the window — the white color is important to reflect incoming summer sunlight back out the window.

- Awnings — preferably should be wider than the window, should extend over it in summer, and should be retractable to allow full sunlight in winter. Also, the awning should have vent holes where it attaches to the house to keep from trapping hot air under the awning.

**Basic Procedure**

Follow instructions that come with the products.

**Skills Required**

*Roller blind* — simple handiwork

*Awnings* — basic carpentry

**Tools**

*Roller blind*:
- Screwdriver
- Hammer
- Tape rule

*Awning*:
- Electric drill with bits
- Carpenter’s tool belt
- (See Rules for Tools section in Chapter 3)
- Level

**Safety**

- Common-sense rules in Safety First section of Chapter 3

**Project 18**

**Use Awnings and/or Interior Roller Blinds**

**Priority: IMPORTANT ★ ★**

✓ **Checklist**

**Initial Requirements**

- Unshaded windows face east southeast, south, southwest, or west; owners prefer blinds or awnings to shade screens or reflective window film (Projects 17 and 19.)

**Typical Costs and Savings**

**White Roller Blind**

**Materials:**
- $5 to $25/window

**Contractor (materials, labor, and overhead):**
- $10 to $30/window

**Annual energy savings:**
- $10% to 15% of cooling costs

**Awning**

**Materials:**
- $45 to $300/window

**Contractor (materials, labor, and overhead):**
- $60 to $400/window

**Annual energy savings:**
- Up to 25% of cooling costs

**Average Time Required**
- 1/4 to 1/2 hour/roller blind
- 1/2 to 2 hours/awning
PROJECT 19
APPLY REFLECTIVE WINDOW FILM

Priority: IMPORTANT ★★

✓ CHECKLIST

Initial Requirements
• Unshaded windows face east, southeast, south, southwest or west, and sunlight is not needed during winter months (See also Projects 17 and 18.)

Typical Costs and Savings
Materials:
• $4 to $10/window
Contractor (materials, labor, and overhead):
• $10 to $16/window
Annual energy savings:
• $4 to $8/window

Average Time Required
• 1/4 to 1/2 hour/window

Skills Required
• Simple but careful handiwork

Tools
• Depends on type of product; see manufacturer’s instructions

Safety
• Common-sense rules in Safety First section of Chapter 3

MATERIALS
Reflective window film sized for the window. Because the film cannot be removed intact once installed, it is not recommended for windows in rooms where winter sunlight is important.

BASIC PROCEDURE
The film should be installed according to the manufacturer’s instructions.
SAFETY

Installing exterior storm windows usually requires use of ladders, so be careful and follow common-sense tips in the Safety section of Chapter 3. Also, storm windows are usually built of glass, so handle them with care.

When planning storm windows, make sure each room will include an easy way of escape in case of fire. For example, if all the windows in a room have fixed exterior storm windows over them, escaping will be difficult — use at least one operable storm window.

PROJECT 20
PUT UP STORM WINDOWS

Priority: IMPORTANT ★★

✓ CHECKLIST

Initial Requirements

• Existing single-paned windows are in good repair with full weatherstripping, intact glazing compound, and caulked frames.

Typical Costs and Savings
Materials:
• $5 to $10/sq ft
Contractor (materials, labor, and overhead):
• $8 to $20/sq ft
Annual energy savings:
• $.55 to $.56/sq ft

Average Time Required
• 1/2 to 1 1/2 hours/window

MATERIALS

• Exterior storm windows for double-hung, sliding, or fixed windows (see exhibit on Selecting Storm Windows), or
• Interior storm windows for casement, awning and other windows that open outwards (see exhibit on Selecting Storm Windows)
• Acrylic latex caulk with silicones, silicone caulk, or other 20-year caulk (for exterior storm windows)
• 1/2-inch x 1/2-inch molding strip to form bottom mounting edge — may be needed if none exists for interior storm windows
• Primer and paint to match the interior window frame (for interior storm windows that need the bottom moulding strip)
PROJECT 20
PUT UP STORM WINDOWS

✓ CHECKLIST

Skills Required
• Simple handiwork; perhaps some basic carpentry

Tools
• Caulk gun
• Screwdriver
• Extension ladder
• Paint brush (for interior storm windows)
• Pliers
• Square or level
• Utility knife

Optional Tools
• Saber saw or reciprocating saw with metal cutting blade — needed for adjusting a storm window that is too large.

SELECTING STORM WINDOWS

EXTERIOR STORM WINDOWS

Exterior storm windows work best over double-hung windows that slide up and down, horizontal sliding windows, or fixed windows. Storm windows that fit over operable windows should have two or three tracks to allow ventilation in spring, summer, and fall. Double-track windows have an inner track for the operable bottom sash.

The insect screen and upper sash fit in the outer sash. In triple-track storm windows, the bottom sash, upper sash, and insect screen each have their own track. Fixed windows need only a single, fixed-sash storm window.

In order to reduce costs, use standard-sized storm windows instead of custom-ordered windows. You can often trim the metal flanges of standard storm windows to adjust for a nonstandard window. Quality products will be rated by the American Architectural Manufacturers Association (AAMA).

INTERIOR STORM WINDOWS

These single-sheet storm windows are usually made of acrylic plastic and attach to the existing window trim with magnetic strips or Velcro®. They are ideal for hinged windows that open out, such as casement or awning units, where exterior storm windows would be impractical since they would not allow the window to open. Some interior storm windows have a sliding sash system to allow ventilation like regular operable windows.

They should be sized to fit on the inside surface of the window casing. In some cases, you will have to remove the handle for an operable window in order to install the storm window.

It is possible to make your own interior storm windows. Several kits are available for do-it-yourselfers. You can order sheets of plastic cut to fit from a plastic glazing supplier. Velcro® is available from fabric stores. Be sure and obtain a high-quality, durable cement to attach the Velcro® to both the storm window and the window frame. The window should have an inside handle or ledge for easy removal.
**BASIC PROCEDURE**

1. Determine which type of storm window to install: exterior (fixed, double-track, or triple-track) or interior.

2. Measure the window opening for storm windows and purchase or order the windows.

3. If installing exterior storm windows, set up a ladder and have a friend inside help to hold the unit. Then:
   a. Set the storm window in position to make sure it fits. With the window in place, mark the locations of the weep holes, which provide an outlet for moisture.
   b. If the window does not fit, adjust it by scoring the cutting lines on the flange and using pliers to bend and break off the excess. You can use a saber saw for this step, but it may be more difficult than using pliers.
   c. Caulk the portion of the window frame against which the storm window will attach. Leave gaps at the bottom where the weep holes are.
   d. Set the storm window in position and screw it into place. Make sure the window sashes slide easily and fit squarely at the top and bottom. Clean caulk out of the weep holes.

4. If installing interior storm windows, proceed as follows:
   a. Set the storm window against the window frame and mark the perimeter with a pencil.
   b. If the storm window needs a bottom molding strip and the window does not have one, attach 1/2-inch x 1/2-inch molding even with the window frame along the bottom of the window. The bottom of the storm window will attach to this. Make sure it does not block the ordinary operation of the primary window. Prime and paint it the color of the window frame.
   c. Attach the magnetic strip or Velcro® strip to the window frame so that it fits just inside the mark showing the perimeter of the storm window. Use a high-quality, durable glue. Magnetic strips may also be screwed into place. Make sure the screw is countersunk so it does not interfere with the seal between the magnetic strip and the window.
   d. Attach the storm window to the sealing strip.
PROJECT 21
INCREASE ATTIC VENTILATION

Priority: IMPORTANT ★★

CHECKLIST

Initial Requirements
• Attic net free vent area is less than 1/150 of the attic area (see exhibit on Selecting and Sizing Attic Vents.)

Typical Costs and Savings

Materials:
• Gable vents — $20 to $70 each
• Roof louver vents — $15 to $90 each
• Turbine vents — $20 to $45 each
• Ridge vents — $1 to $3/linear foot
• Soffit vents — $1 to $5 each

Contractor (materials, labor, and overhead):
• Gable vents — $30 to $50 each
• Roof louver vents — $35 to $55 each
• Turbine vents — $55 to $85 each
• Ridge vents — $5 to $9/linear foot
• Soffit vents — $8 to $12 each

Annual energy savings:
• Range widely, but attic ventilation is needed for reasons other than energy conservation. It helps remove moisture from the attic throughout the year. In summer, it keeps the attic cooler and may increase the life of the roof.

SAFETY
Be careful when working on the roof. Always have someone close by in case of an accident. Work during a cool part of the day, as roof temperatures can exceed 150 degrees on hot, sunny days.

MATERIALS
• Attic vents — install as many as are required to achieve the desired net free vent area (see exhibit entitled Selecting and Sizing Attic Vents.)
• Flashing — choose a product that is durable and matches the other flashing materials on the roof. Some vents come with built-in flashing.
• Roofing cement — follow the recommendations of the manufacturer about which type of material to use to provide a waterproof seal.
• Roofing nails
SELECTING AND SIZING ATTIC VENTS

Attic ventilation is necessary to remove condensation from the attic. Condensation can occur when water vapor from the interior of the house rises through the ceiling into the attic. Given a high concentration of water vapor and sufficiently cool temperatures, the vapor can condense into water and potentially damage the insulation, as well as the ceiling material itself.

Attic vents should be positioned both as high and as low as possible. The best strategy is a combination of high vents spread along the ridge and low vents near the soffit area (on the underside of the roof overhang.) In addition, the vents should be spread over the entire roof area to ensure that all of the attic is properly ventilated.

Outside air enters the attic through the soffit vents and is exhausted out through the high vents. For most homes, this natural convective flow of heated air and moisture out of the attic is sufficient. Generally, electrically powered attic ventilators are not necessary.

The type and placement of attic vents will be determined largely by the roof design. Continuous ridge and soffit vents usually provide the most effective ventilation.

Attic vents are sized in terms of square feet of net free vent area — the size of the actual opening through which air flows. You may have a rectangular gable vent that is 2-feet tall and 3-feet wide; however, if that opening is covered by a wood louver, the actual area through which air flows will be substantially less than the size of the opening. The chart shows factors for determining the net free vent area for different vent coverings.

For example, the area of the opening for the 2-foot by 3-foot gable vent is:

\[ 2 \text{ ft} \times 3 \text{ ft} = 6 \text{ sq ft} \]

The vent is covered by a wood louver. From the chart, the ratio of opening area to net free vent area is 2.25. The net free vent area of the gable vent is then:

\[ 6 \text{ sq ft}/2.25 = 2.7 \text{ sq ft} \]

The chart shows factors for determining the net free vent area for different vent coverings.

<table>
<thead>
<tr>
<th>Type of cover</th>
<th>Reduction Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire mesh or chicken wire</td>
<td>$1.00</td>
</tr>
<tr>
<td>Insect screen</td>
<td>2.00</td>
</tr>
<tr>
<td>Metal louvers</td>
<td>1.50</td>
</tr>
<tr>
<td>Metal louvers with insect screen</td>
<td>2.00</td>
</tr>
<tr>
<td>Wood louvers</td>
<td>2.25</td>
</tr>
<tr>
<td>Wood louvers with insect screen</td>
<td>3.00</td>
</tr>
</tbody>
</table>

PROJECT 21
INCREASE ATTIC VENTILATION

✓ Checklist

Average Time Required
- 6 to 12 hours to install several vents

Skills Required
- Skilled carpentry. Be sure you have the experience needed for this job. Improperly installed attic vents can cause roof leaks. If you are in doubt, hire a contractor.

Tools
- Carpenter’s tool belt
  (See Rules for Tools section in Chapter 3)
- Circular saw, reciprocating saw, or jig saw
- Electric drill with bits
- Ladder
In Arkansas, the heat in the attic can be over 140 degrees. It is important to allow this heat to escape.

Attics need to vent moisture and heat through ridge vents or other devices or vents high on the roof and replace this air with soffit vents or vents placed low in the attic.

Vent openings in attics and crawl spaces must be placed so that there is cross-ventilation where air can flow in one opening, over the insulation, and out the other opening. In attics, a combination of eaves and ridge or high gable vents is best for cross-ventilation, because this takes advantage of natural convection.

**Basic Procedure**

**Soffit Vents**

1. Determine if the eave area has sufficient room for soffit vents. Generally, the vents are installed on the underside of the eave — called the soffit. If the roof does not have an eave, the vents may be placed in the fascia framing between the rafters.

2. Follow the manufacturer’s instructions for cutting holes for the vents. Holes for both continuous and rectangular soffit vents can usually be cut with a power saw. Using a power saw overhead requires considerable skill and strength. Be certain that you have the experience necessary to do this job safely.

3. After the opening is cut, position the vent and secure with weather-resistant nails or screws.

4. If the vent does not have insect screening, install it before positioning the vent in the opening.

5. Make certain that soffit vents are not blocked by insulation.

**General Vent-Sizing Rules**

- If your ceiling insulation has a vapor barrier, the net free attic vent area should be 1/300 of attic floor area.
- If the insulation has no vapor barrier, the net free vent area should be 1/150 of attic floor area.
- Use the Reduction Factor Chart to determine the total net free vent area that your attic should have.
- For example, assume the floor area of an attic is 1,000 square feet. The attic has gable vents with 3 square feet of net free vent area. The insulation has no vapor barrier. With no vapor barrier, you need the attic vents to equal 1/150 times the attic floor area.
- Vent area needed = 1,000 sq ft × 1/150 = 6.7 sq ft of net free vent area.
- You have 3.0 square feet of net free vent area; therefore, you need 3.7 square feet more net free vent area.
- Most quality vents will indicate the net free vent area on the sales literature. Usually, the area is given in square inches. To convert this to square feet, divide by 144. Typical net free vent areas for different vents are shown in the accompanying chart.

**Typical Vent Requirements in Attics without Vapor Barrier**

<table>
<thead>
<tr>
<th>Type of Vent</th>
<th>Approximate net free Vent area per unit</th>
<th>Number of vents for 1,000 sq ft attic with soffit</th>
<th>Number of vents for 1,000 sq ft attic without soffit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Vents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbine (12” diameter)</td>
<td>105 sq in/vent</td>
<td>5 vents</td>
<td>9 vents</td>
</tr>
<tr>
<td>Gable (25” x 120”)</td>
<td>60 sq in/vent</td>
<td>9 vents</td>
<td>17 vents</td>
</tr>
<tr>
<td>Roof louver, static or mush- room (81/2” opening)</td>
<td>50 sq in/lin ft</td>
<td>10 vents</td>
<td>19 vents</td>
</tr>
<tr>
<td>Ridge</td>
<td>18 sq in/lin ft</td>
<td>28 lin ft</td>
<td>53 lin ft</td>
</tr>
<tr>
<td><strong>No high vent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Soffit vents</strong></td>
<td>12 sq in/lin ft</td>
<td>80 lin ft</td>
<td>49 lin ft</td>
</tr>
<tr>
<td><strong>Power ventilators</strong></td>
<td>Recommended only in attics that cannot be insulated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Ridge Vents**

1. Follow the manufacturer’s instructions in marking the placement of the ridge vent on the roof ridge. Generally, installing the vent will require removing the cap shingles and cutting through the roof deck.

2. Remove the cap shingles in the area where the ridge vent will be installed.

3. Follow the manufacturer’s recommendations on how wide of a gap to allow along the ridge for the ridge vent. For most vents, a cut will be required 1 to 2 inches on each side of the ridge. Mark a line showing where to cut and remove any nails that may be in the way of the saw.

4. Cut through the shingles and decking using a circular saw with a carbide-tip blade.

5. Remove the loose shingles and decking material.

6. Secure the ridge vent in place according to the manufacturer’s instructions.

7. Be careful not to damage the vent during installation or clean-up.

**Roof Louver or Turbine Vents**

1. Choose a location between two roof rafters as close to the roof ridge as possible.

2. Follow the manufacturer’s instructions for cutting a hole in the shingles and roof decking for the vent.

3. Install the vent according to the manufacturer’s instructions. Be certain to follow guidelines for flashing to prevent roof leaks.

4. Repair or replace any shingles that may have been damaged during the work. Also check to make certain that the vent was not damaged during installation.

**Gable Vents**

1. Generally, gable end walls are constructed of studs. Choose a gable vent that will fit between two studs rather than a vent that requires cutting the studs. If the vent does require cutting through the studs on the gable end, then consult with a knowledgeable professional to ensure that no structural damage occurs.

2. Most gable vents mount over the exterior wall finish and are held in place by a flange. Follow the manufacturer’s instructions for positioning the gable vent and marking the area on the exterior wall finish to be cut for the vent.

3. Use a power or hand saw to cut through the exterior wall finish. Remove the cut materials.

4. Insert the gable vent and secure according to the manufacturer’s instructions.
PROJECT 22
ADD R-11 INSULATION IN WELL-INSULATED ATTIC

Priority: OPTIONAL ★

✓ CHECKLIST

Initial Requirements
- Attic now has 5 to 7 inches of insulation (See also Project 2: Install R-30 Insulation in Poorly Insulated Attic and Project 16: Add R-19 Insulation in Partially Insulated Attic)

Typical Costs and Savings
- (Assumes you are installing R-11 insulation)

Materials:
- $.15 to $.22/sq ft of fiberglass/mineral wool roll
- $.10 to $.16/sq ft of blown cellulose
- $.10 to $.17/sq ft of blown fiberglass/mineral wool

Contractor (materials, labor, and overhead):
- $.29 to $.42/sq ft of fiberglass/mineral wool roll
- $.19 to $.42/sq ft of blown cellulose
- $.20 to $.47/sq ft of blown fiberglass/mineral wool

Annual energy savings:
- $.01 to $.03/sq ft of attic floor

Average Time Required
- 3 to 7 hours/1,000 sq ft

MATERIALS

Same procedure as Project 2. In northwest Arkansas add R-19 to obtain a total of R-38. Typical specifications for loose-fill insulation appear in a chart on the bag. In many cases, values as low as R-11 will not be shown. Check with the manufacturer or distributor for help in determining how many bags are needed.

BASIC PROCEDURE

See Project 2: Install R-30 Insulation in Poorly Insulated Attic. Be certain not to install roll or batt insulation with a vapor barrier facing over existing insulation. Use unfaced or loose-fill insulation.

Skills Required
- Simple handiwork, perhaps some basic carpentry

Tools
- See Project 2: Install R-30 Insulation in Poorly Insulated Attic

Safety
- See Project 2: Install R-30 Insulation in Poorly Insulated Attic
SAFETY
Always follow common-sense safety measures when working in the attic. Use walkboards as walking surfaces.

MATERIALS
- 1/4-inch staples for stapler
- An aluminum foil designed to be used as a radiant barrier. Any product should resist tearing and be fire resistant. One or both surfaces should reflect at least 95 percent of incoming radiant heat. Purchase enough to fit on the underside of all of the attic rafters.

BASIC PROCEDURE
1. Set up the extension cord, lights, and walkboards in the attic.
2. Most radiant barrier products come in a roll from 4 to 6 feet wide. Staple the foil either across the rafters or parallel to them, as specified by the manufacturer. The shiny side should face downward so it does not gather dust over time. As long as the surface remains shiny, it will block radiant heat whether facing upward or downward. Of course, it is best to have a reflective surface on both sides.
3. Repeat step 2 for all sections of the attic.

Tools
- Carpenter’s tool belt (See Rules for Tools section in Chapter 3)
- Heavy-duty stapler
- Heavy-duty shears
- Drop lights and extension cords
- Tape rule

PROJECT 23
INSTALL RADIANT BARRIER IN ATTIC

Priority: OPTIONAL ★

CHECKLIST

Initial Requirements
The roof receives direct sunlight in summer and has a full attic underneath. The roof should have a ridge vent for ventilating hot air produced between itself and the radiant barrier. The attic should already have at least R-19 insulation. Radiant heat barriers are never a substitute for insulation.

Typical Costs and Savings
- $100 to $300/1,000 sq ft Contractor (materials, labor, and overhead):
- $200 to $1,000/1,000 sq ft Annual energy savings:
- Research has shown radiant heat barriers can reduce annual cooling bills around 10 percent if the attic has less than R-30 insulation.

Average Time Required
- 4 to 8 hours/1,000 sq ft

Skills Required
- Simple handiwork
PROJECT 24
PUT IN STORM DOORS

Priority: OPTIONAL ★

☑️ CHECKLIST

Initial Requirements
• Need a screen door for summer months; current door is leaky in winter.

Typical Costs and Savings
Materials:
• $75 to $250/door
Contractor (materials, labor, and overhead):
• $150 to $400/door

Annual energy savings:
• Up to 2% heating and cooling costs

Average Time Required
• 4 to 12 hours depending on whether the door frame is square

Skills Required
• Basic carpentry

Tools
• Carpenter’s tool belt (see Rules for Tools section in Chapter 3)

Safety
• Common-sense measures in Safety First section in Chapter 3

MATERIALS
• Weatherstripped, pre-hung storm door
• 20-year caulk

BASIC PROCEDURE
1. Before purchasing storm door, make sure existing door frame is square using exhibit on Checking for Square.
2. Purchase a weatherstripped, pre-hung unit that is designed for the size of the door opening you have.
3. Place the storm door over your regular door frame and mark its position on the frame.
4. Caulk around the door frame where the storm door will be mounted.
5. Adjust the bottom of the storm door to the proper height.
6. Screw the storm door in place.
7. Install an automatic closer (if it comes with the storm door).

CHECKING FOR SQUARE

When installing storm windows and doors or replacement units, you will need to determine whether the frame is square. The term “square” means the corners of the frame are all right (90 degrees) angles.

To check for square, all you need is a tape measure. Hold the tape at one of the bottom corners and measure the distance to the opposite top corner. Write down this distance. Then place the tape measure in the same position in the other bottom corner and measure to its opposite top corner. These distances — all the diagonals — will be equal if the frame is square. Most storm doors and windows can be installed over a frame that is slightly out of square.
MATERIALS

- 1 1/2-inch rigid extruded polystyrene insulation (you can use three 1/2-inch pieces)
- 2" x 2" fir lumber
- Masonite
- Construction adhesive
- Corrugated fasteners
- Weatherstripping
- Handles
- 3/4-inch drywall screws
- Latches and hinges (for hinged shutter)
- Exterior white paint
- Paint thinner for clean up

BASIC PROCEDURE

POP-IN SHUTTERS

1. Measure the height and the width of the interior window frame.
2. Cut 2" x 2" lumber for the frame as shown.
3. Assemble the frame, keeping all corners at right angles and using corrugated fasteners.
4. Cut the masonite to fit over the top and the bottom of the frame.
5. Cut the insulation to fit inside the frame.
6. Apply glue to the bottom side of the frame and nail one piece of masonite in place.
7. Set insulation in the frame and attach the top piece of masonite.
8. If you wish, apply the decorative fabric or adhesive paper to the interior surface of the shutter.
9. Paint the outside of the shutter white.
10. Install handles for easy removal.
11. Install weatherstripping all around the shutter so that it fits tightly in the window.

HINGED INSULATED SHUTTERS

1. Measure the dimensions of the window frame and cut 2" x 2" lumber for the frame as shown.
2. Follow steps 3 through 9 for pop-in shutters to assemble the shutter.
3. Attach hinges and a latch to the shutter and the window as shown.
4. Install weatherstripping all around so no air can leak around the shutter when latched.

PROJECT 25
INSTALL MOVABLE INSULATION

Priority: OPTIONAL ★

☑ CHECKLIST

Initial Requirements
- Windows already are well sealed and homeowner is willing to operate shutters.

Typical Costs and Savings

Materials:
- $.20 to $.57/sq ft of window
Contractor (materials, labor, and overhead):
- $6 to $10/sq ft of window
Annual energy savings:
- $.19 to $.32/sq ft of window

Average Time Required
- 1 to 5 hours/window

Skills Required
- Basic carpentry for pop-in shutters
- Skilled carpentry for hinged shutters

Tools
- Utility knife
- Cloth shears
- Carpenter’s square
- Paint brush
- Electric drill
- Carpenter’s tool belt (see Rules for Tools section in Chapter 3)

Optional:
- Mitre saw or circular saw

Safety
- Common-sense measures
Many components of your house might not be energy efficient, but it may not be cost effective to replace them unless they require repair. For example, it is not usually worthwhile to replace your current water heater with a new energy-efficient model until the old one wears out. If the water heater is over 10 years old, do some shopping for a replacement before it breaks down. Then, when the time comes, you will be an informed consumer.

This section gives guidelines for replacing house components including windows, doors, water heaters, space heating systems, and air conditioners with energy-efficient alternatives.

In general, the replacement measures require a greater level of skill than the conservation measures described in Chapter 4. Usually a contractor should be hired to implement them unless you are a skilled carpenter. In many cases, a licensed plumber or heating and air conditioning contractor will be required. Discussions in this chapter concentrate on the available options rather than on specific installation procedures. Information is also included on how to evaluate the job done by a contractor.
**Water Heater**

The cost of heating water is based on the cost of energy, the demand for hot water, the temperature of the water and the efficiency of the water heater. The energy cost can be reduced by choosing a high efficiency model. A yellow EnergyGuide label is helpful because it provides an estimated annual energy cost for each and every model. This label is required by law to be attached to all water heaters.

Energy-efficient gas and electric water heaters have increased insulation levels between the outer jacket and inside tank to reduce heat loss. The average extra cost ranges from $50 to $100.

In addition, some gas models have a special design for the burner, flue, or electronic ignition that requires no pilot light. These features further increase savings; they cost an average of $75 to $300 more than standard models.

**Water Heating Alternatives**

If your house does not have a supply of natural gas, an efficient alternative is a heat pump water heater, which operates at twice the efficiency of a typical electric unit. The heat pump water heater has an excellent payback.

Heat pump water heaters must not be subjected to freezing conditions. They work best in partially heated areas, such as enclosed basements or garages. If installed inside the home, they do not save as much energy because in winter they extract some of the house’s heat to heat water. However, they do have the added benefit of providing some cooling during warm weather.

A heat recovery device, also called a desuperheater, heats water with the waste heat from an air conditioner or heat pump. The device captures extra heat from the refrigerant as it circulates between the compressor and condenser. When used year-round on a heat pump, these units can cut water heating costs up to one-half and with an air conditioner up to 40 percent.

**Replacement Measure 1**

**Water Heater**

**Initial Requirements**

- Current water heater is leaking or no longer functioning. If water heater does not leak and is operating, then it is probably best to continue using it and follow the steps outlined in Project 4: Install Insulating Jacket on Water Heater. If an electric water heater is not producing hot water, the heating elements may need replacing.

- The Energy Factor (EF) accounts for the efficiency of heat transfer and the loss of heat during standby. For gas look for an EF of 0.64 or greater, for electric look for an EF of 0.93 or greater.

- Consider a demand or point-of-use water heater. These heaters do not have a tank that keeps water hot all day—they only heat the water just before it is being used. Gas-fired demand water heaters perform well because they heat up faster; however both gas and electric units might need larger gas or electric utility service.

- Evaluate the option to install a solar water heater. This technology is well developed and reasonably cost-effective.
REPLACEMENT MEASURE 1
WATER HEATER

- Solar water heating is the most cost-effective solar technology in the marketplace. A well-designed system can easily cut water heating bills in half.
- In Arkansas, the best choices for a solar water heater are either an indirect circulation or drain-back system. Both of these can tolerate freezing temperatures.
- The indirect circulation system is shown in the top right graphic. A pump moves a glycol-water antifreeze mixture through the solar collector where it gets heated. This heat is transferred to a hot water storage tank that sits next to the conventional hot water heater. As hot water is pulled from the “back-up” or conventional water heater it is replaced with solar heated water from this storage tank.
- The batch solar water heater option, shown in the bottom graphic, reduces the chance of freezing because the collectors maintain a significant amount of water in them.
- How big should my solar water heater be? For a family of two, a 20 square feet collector is enough. For larger families, add 12 to 14 square feet for each additional person.

ACTIVE SOLAR WATER HEATER

For homes that use a large amount of hot water and that receive full, unobstructed, south facing solar exposure, a solar water heater may be economical. All types of solar water heaters work as preheat systems assisting a conventional water heater.

There are many options for using the sun’s energy to heat water. In active solar water heaters, glass-covered panels absorb solar energy and transfer the heat it produces to water. Pumps move the solar-heated water to an insulated storage tank where the heat is stored.

BATCH SOLAR WATER HEATER

Batch water heaters are more simple but less efficient because the glass-covered collectors include the storage tank. The sun heats the water directly, and the batch heaters have no pumps or control systems. Materials for a do-it-yourself batch water heater cost between $200 and $700 and many energy-related publications and organizations have plans.

Solar water heaters installed by professional contractors cost $2,000 to $5,000. They save 25 percent to 70 percent of the water heating bills for a typical four-person family — from $75 to $300 each year.
**Option A: Sash Replacement Kit**

Some window manufacturers offer a special replacement system in which only the window sashes and stops, rather than the entire frame, need replacement. The kit includes airtight plastic jambs (which attach to the old jambs), two sashes with double-paned windows, and good weatherstripping.

To use this system, your window frame must be in good condition and square (all the corners must be at right angles see exhibit on Checking for Square in **Project 24: Put in Storm Doors**). If not square, the entire window will need to be replaced by a new unit.

The installer should follow installation instructions that come with the replacement unit.

**Option B: New Window Unit**

New windows vary greatly in price and quality. The key components of a durable, energy-efficient window are:

1. Two sealed panes of glass with a 1/2- to 3/4-inch air space between panes.
2. Weatherstripping all around window sashes. A double layer of weatherstripping gives extra protection against infiltration.
3. A tight fit when closed and locked. If windows wiggle or shift when pulled, the winter wind will find a path inside.

Order replacement windows the same size or slightly larger than the old window. If the new window is smaller than the old one, new interior and exterior wall finishes will have to be pieced in place to fill the gaps.

If the new window is larger than the old, the contractor will have to tear out some of the old wall studs and reframe the wall slightly to create a large enough rough opening for the new window. It may be less expensive to order a custom-built window identical in size to the one being replaced.

Make sure the carpenter uses spray foam sealant in the gap between the window unit and the rough opening.

**Replacement Measure 2**

**Initial Requirements**

- House has window frames or sashes that are damaged and need repair, or it has leaky jalousie-style windows.

**Look for Energy Star compliant windows for the best investment providing the most comfort and energy savings. See Links and Resources on last page.**

- Low-solar windows have a Solar Heat Gain Coefficient (SHGC) that is less than 0.4. Use this technology on west and east facing windows to reduce solar heat gain and reduce cooling costs.

- Low-emissivity (low-e) windows reflect heat back into the home. This is valuable in the wintertime.

- Inert gas filled windows replace air with a gas that reduces the heat loss.

- The window frame also needs to be efficient. Vinyl, fiberglass or wood are good choices.
REPLACE WITH INSULATED DOOR

Quality metal doors are filled with foam insulation and have insulating values of about R-7 to as high as R-15 compared to R-2.2 for conventional solid wood doors. They come in a variety of styles and can be attractive. Metal doors last longer than wood doors, do not warp easily, and provide greater security. Often, they cost no more than solid wood exterior doors.

You may also consider a fiberglass replacement door. These provide energy efficiency and durability comparable to a metal door and have a wood grain appearance.

The major drawback of metal and fiberglass doors is their inflexibility. They cannot be easily trimmed, so if the door frame is not square, it may have to be rebuilt.

Make sure the installer reads the directions that come with the door before beginning. Some adjustments can be made after the door is installed, but they will require extra time. A properly installed insulated door will seal tightly for years.

Initial Requirements

- Door rotten, badly warped or otherwise in poor condition.
- To remove the original door, open it and place a wedge under the outer corner, taking the weight off the hinges.
- Most doors are hung on loose-pin hinges. To remove the pin, tap it up, and then pull it out completely. Start at the bottom hinge and repeat this procedure at the center and top hinges. Now you can remove the door from its frame.
- In some vintage homes, the hinges may not be the loose-pin type, or the hinge pin may be "frozen" in place, perhaps by several coats of paint. In such cases, remove the door by unscrewing the hinges (bottom hinge first, then middle, then top) from the door frame.
- Set the new door in place and insert the hinge pins, working top to bottom.

Metal Door Surface

- Foam Insulation
- Wood for Structure and to Reduce Heat Loss
HOW COMBUSTION APPLIANCES WORK

Combustion appliances such as gas or propane furnaces, water heaters, ranges or cooktops, and fireplaces and wood stoves work by burning fuel. For burning, or combustion, to occur, oxygen must be present. The air we breathe is the source of the oxygen.

When air burns, by-products such as carbon monoxide, carbon dioxide, nitrogen oxides, and water vapor result. An important consideration in energy-efficient homes is the source of the oxygen, or combustion air, and the destination of the byproducts of combustion, or the exhaust gases.

Unvented appliances, such as many space heaters, use heated air inside the room as their source of combustion air. These appliances also exhaust the byproduct gases to the room itself. Even low level concentrations of these gases can be harmful. Higher levels can be life threatening. Older homes may be so leaky that dangerous concentrations of pollutants do not occur. However, homes that have been insulated and sealed using the techniques described in this book can restrict infiltration to such an extent that the concentration of gases reaches dangerous levels.

Vented space heaters, wood fireplaces, and central furnaces exhaust by-product gases to the outside and are safer than unvented units. However, standard models use room air to vent combustion gases. The room air is replaced by outside air leaking inside your home. This infiltrating air reduces the efficiency of these appliances and can make your home too dry in winter.

Many new space heaters and fireplace inserts have sealed combustion chambers that use outside air as the source of oxygen and for exhausting combustion gases. These appliances eliminate the reductions in efficiency and comfort encountered by those that burn indoor air and exhaust it outside, and they minimize potential indoor air pollution problems as well.

Since central furnaces and water heaters usually have no provisions for outside combustion air, they are best located in unheated areas such as a basement or utility room. Insulating and sealing a house that has an interior combustion appliance requiring outside combustion air can present problems. The infiltration may be reduced so much that insufficient combustion air leaks in. With an inadequate oxygen supply, the appliance’s burner will operate inefficiently. Replacement Measure 5: Provide Outside Air Supply for Central Furnace in Heated Area describes techniques for dealing with interior furnaces. The same techniques work for water heaters.

REPLACEMENT MEASURE 4
FUEL-FIRED SPACE HEATERS

Initial Requirements

- House has unvented space heaters using gas, propane, or kerosene for the major share of its heating needs. The exhaust gases given off by these unvented heaters are toxic and can reach dangerous levels inside the home, especially if air leaks in the home are minimized by basic conservation measures.

- Unvented gas, propane or kerosene space heaters should be replaced with one of the options described in this section.
Replacement Measure 4
Fuel-Fired Space Heaters

- Avoid using an unvented space heater for prolonged periods.
- Any type of fuel combustion (oil, natural gas, propane, kerosene) produces two unwanted byproducts: excessive water vapor and carbon monoxide (CO).
- Carbon monoxide (CO) has no smell and is dangerous. If you feel sick, dizzy or weak, go outside right away and get some fresh air—if you think you have the flue, but get better when you leave the house, CO may be the cause. If CO symptoms are serious, get immediate medical attention.
- When in operation, open a nearby window to allow fresh air to come in and “used” air to exit.
- Make sure that the heater is maintained and that the color of the flame is blue. Incomplete combustion (an orange flame) will produce undesirable gasses.

The following options help prevent degrading indoor air quality with unvented, fuel-fired space heaters:
- Unvented Space Heaters Using Oxygen Depletion Sensors
- Vented Fuel-Fired Space Heaters
- Air-to-Air Heat Exchangers
- Central Furnaces

Unvented Space Heaters Using Oxygen Depletion Sensors

New unvented fuel-fired space heaters should be equipped with oxygen depletion sensors (ODS). An ODS detects when oxygen levels in the house have dropped—meaning levels of the by-product gases may be reaching dangerously high levels. When these potentially harmful levels occur, the ODS shuts off the flow of fuel to the burner which extinguishes the flame so that no additional exhaust gases can enter the house.

Most local building codes bar the use of unvented space heaters in bedrooms and bathrooms. Always hire a licensed heating contractor to install new units.

Vented Fuel-Fired Space Heaters

Vented, fuel-fired space heaters reduce the health risk of unvented models and can also increase energy efficiency if the new units draw combustion air directly from outside the home. Models that use indoor air for combustion may have net efficiencies lower than 50 percent. Higher-quality vented space heaters with sealed combustion chambers are recommended instead of those using interior air for combustion. The higher efficiency units are usually mounted onto an exterior wall; they draw combustion air from outside and exhaust the by-product gases outside as well.

The sealed-combustion models have options such as blowers, pilotless electronic ignitions, and programmable thermostats. Unfortunately, this sophistication translates into higher prices. Simple, wall-mounted units with sealed combustion chambers cost $375 to $550. The units with more features can cost up to $750. A professional should always install a fuel-fired appliance.

Electric Space Heaters

Portable electric space heaters can heat rooms up to about 150 sq. ft. Some electric space heaters rely on convection (circulating air in a room) and others provide radiant heating that directly heats up objects and people that are within a line of sight. Radiant heaters are an efficient choice when you will be in a room for only a few hours and if you can remain within the line of sight of the heater. They can be more efficient when in a room for a short period because they avoid the energy needed to heat the entire room by instead directly heating the occupant. Make sure that a unit has an overheating cut-off sensor and a tip-over safety switch which automatically shuts off the heater if the unit is tipped over.

Avoid using an unvented space heater for prolonged periods.
- Any type of fuel combustion (oil, natural gas, propane, kerosene) produces two unwanted byproducts: excessive water vapor and carbon monoxide (CO).
- Carbon monoxide (CO) has no smell and is dangerous. If you feel sick, dizzy or weak, go outside right away and get some fresh air—if you think you have the flue, but get better when you leave the house, CO may be the cause. If CO symptoms are serious, get immediate medical attention.
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GUIDELINES FOR SUPPLYING OUTSIDE AIR

Bringing outside air into a furnace room that is part of the heated area of the house requires sizing ducts properly to supply the necessary air and complying with local building codes. The discussion in this section describes just one possible solution to the problem. Check with local code officials or heating professionals to ensure this measure is undertaken properly.

If the central furnace is in an enclosed chamber, such as a closet or mechanical room, it often draws indoor air for combustion through a louvered door. The best approach is often to supply outside air for the burner by running air intakes from the furnace room into a well-ventilated attic or crawlspace. Then, install and weatherstrip a solid door in place of the louvered door. You may also be able to insulate the walls of the furnace closet to further reduce energy losses.

The ducting that supplies combustion air should be designed by a knowledgeable, licensed heating contractor or mechanical engineer. It should be installed by a professional. If you have carpentry skills, you can install and weatherstrip the replacement door.

The cost for building a sealed combustion chamber for a furnace in a heated area as described above ranges from $100 to $500. Annual energy savings range from $50 to $125. Plus, once you have a guaranteed source of combustion air, you can safely continue with air sealing measures that will save even more money.

REPLACEMENT MEASURE 4
PROVIDE OUTSIDE AIR SUPPLY FOR CENTRAL FURNACE IN HEATED AREA

Initial Requirements
- Central furnace is in a heated area and uses indoor air as its source of oxygen (see exhibit on How Combustion Appliances Work on Page 75.)
REPLACEMENT MEASURE 6

CENTRAL HEATING SYSTEM

Initial Requirements

- Current heating system is broken, is inefficient and costly to operate, does not provide sufficient heat, requires frequent maintenance, or is otherwise unsatisfactory.
- If your furnace is ten to fifteen years old or has a serious problem that will cost several hundred dollars to fix, it is wise to replace it now rather than to repair it or wait until it fails.
- Choose the most efficient equipment that you can afford.
- Heat pumps, like refrigerators, transfer heat from one place to another. An air-source heat pump should have an HSPF efficiency of 8.5 or higher. A ground source or geothermal heat pump should have a COP efficiency of 3.2 or higher.
- Make sure that your ductwork is well sealed and insulated. See page 25.

GUIDELINES FOR REPLACING CENTRAL HEATING SYSTEMS

1. SIZE THE SYSTEM PROPERLY

   An oversized system will not run efficiently, it will not be comfortable, and it will cost more to purchase and operate than a properly sized unit. Bigger is not better! Require your licensed heating and A/C contractor to use Manual J when sizing the system for your home and Manual D to design an efficient duct system.

2. SELECT THE APPROPRIATE TYPE OF UNIT

   In deciding whether to buy a fuel-fired furnace or heat pump, it is important to consider the relative comfort levels, lifetimes, installed cost, and annual energy costs of the different options. Talk about comfort and reliability to people who have different types of units in their homes.

   If you wish to install central air conditioning at the same time you are putting in the new heating system, the installed and operating costs of a heat pump, which provide both heating and cooling, may be in the same range as those for a gas furnace combined with a central air conditioner. Have your heating contractor or an engineer compare the installed cost and annual energy bills for each option before making a decision. Be sure to get several bids.

   If you do not have access to natural gas, you may choose propane, electricity, heat pumps, geothermal or other options for heating.
3. Fuel-fired furnaces
A near revolution has occurred in the efficiency of heating and cooling systems over the past decade. A standard fuel-fired furnace has an Annual Fuel Utilization Efficiency (AFUE) of 78 percent. A mid-efficiency combustion furnace has an AFUE of 80 to 85 percent. These units usually add only a few hundred dollars to the initial cost and pay back the extra investment very quickly.

The high efficiency units have an AFUE from 90 to 97 percent. These systems are able to extract latent heat from the water vapor in the exhaust gases. They are more expensive and may add up to $1,200 to the cost of a standard furnace. Many homeowners can easily justify the added cost because of long-term energy savings.

4. Heat pumps
For years, conventional electric resistance heating systems have used resistance coils, which grow hot when electric current runs through them. The system’s blower distributes this heat throughout the house. Although resistance heating systems operate near 100 percent efficiency, they are more costly to operate.

Heat pumps use an arrangement of compressors, condensers, expansion valves, and other components to extract heat from outside air in winter. They also provide cooling, just like an air conditioner, by reversing the process and dumping heat from inside your home to the outside. On the average, heat pumps cost 40 to 65 percent less to operate than electric resistance units.

At lower outside temperatures—typically below 30 degrees—heat pumps can no longer extract sufficient heat from outside air. In these circumstances, a separate electric resistance unit, called a strip heater, comes on to provide backup heating. Fortunately, the time during which the strip heater must operate in winter is relatively limited in Arkansas because of its usually mild weather.

Heat pumps are rated in terms of their summer Seasonal Energy Efficiency Ratio (SEER) and their winter Coefficient of Performance (COP) or Heating Season Performance Factor (HSPF). You should select a unit with a SEER greater than 13, a high-temperature (47 degrees) COP over 2.9, a low temperature (17 degrees) COP greater than 2.0, and an HSPF over 7.7.

5. Zoned heating and cooling systems
In larger homes, entire areas may not be used during different parts of the day. By shutting off the flow of heated and cooled air to these rooms—a practice called zoned heating and cooling—considerable energy savings can be realized.

Typically, independent heating and cooling systems are installed for separate sections of the house. Multiple systems provide good comfort and closer control over the temperature in individual rooms. However, they are expensive and are usually justified only for houses having over 2,500 square feet of floor area which can be divided into separate areas with distinctive lifestyle patterns.
REPLACEMENT MEASURE 6
CENTRAL HEATING SYSTEM

- Check the connection between your duct supply registers (where the air comes out) and the hole cut in the drywall or floor through which they pass. A gap between the register and the hole allows conditioned air to escape. Fill the gap with caulking or cover the gap with foil tape or duct mastic.

- Set back your thermostat when you’re asleep or away. When used correctly, a programmable thermostat with 4-temperature and time settings can save you $100 each year on energy costs.

- Use the programmable thermostat to set your furnace/air conditioner to come on 30 minutes before you arrive at home.

You can also zone a house by closing operable floor or wall dampers that control the air supply coming from the heating or cooling system. The only problem with this measure is that the system’s blower is sized to move a certain volume of air through all of the ductwork. If several dampers are closed, the blower will try to push the same volume of air through fewer ducts and will experience increased pressure working against it. By forcing the blower to work harder, you may shorten its life.

Some heating contractors can install a dampering system that effectively zones a house with only one heating and cooling system and alleviates the increased load on the blower. These dampering systems will shut off the flow of heated air to a given area of the house, but will allow the air to flow into the return system and minimize stress on the blower.

6. SEAL AND INSULATE DUCTWORK

Make sure the heating contractor seals the joints between all ducts with mastic or UL-181 duct sealing tape before installing duct insulation. Duct insulation should be used in all unconditioned areas.

7. INSTALL PROGRAMMABLE THERMOSTAT

A programmable or clock thermostat can reduce heating energy use up to 40 percent. If you have a heat pump, make sure you buy a thermostat rated for your heating system. Otherwise, the heat pump may use considerable electricity because a conventional programmable thermostat may cause the strip heaters, not the heat pump itself, to warm the house in the early morning. For more information, see Project 10: Connect Programmable Thermostat.

8. CAREFULLY EVALUATE OTHER HEATING SYSTEM CONTROLS

If considering the purchase of duty cyclers or similar energy-monitoring and control devices, carefully evaluate their cost-effectiveness by consulting with a heating contractor or your local utility.

Some energy products that control the manner in which heating or cooling systems save energy have been marketed heavily in Arkansas. For example, inflated claims have been made about savings achieved by duty cyclers. Recently, similar devices with different names have surfaced in the marketplace. If you are considering buying this type of device, check it out first with your heating contractor or local utility.

In general, never believe persons who promise a magical solution to your energy problems. If the deal offered sounds too good to be true, it probably is. The only control device for your heating and cooling system that can really lower heating bills drastically is a programmable thermostat. The options for increasing the efficiency of a properly installed heating and cooling system are limited.
GUIDELINES FOR REPLACING AIR CONDITIONERS

1. SIZE THE AIR CONDITIONER PROPERLY
   When installing a central unit, have a licensed heating and air conditioning contractor, mechanical engineer, or your local utility estimate the cooling requirements and size the unit. An oversized system will run inefficiently and cost more than a properly sized unit. A professional should install the system.

   A room air conditioner can be sized using general guidelines provided by the manufacturer. Use the technical data in the sales literature to ensure the unit is matched to your cooling needs.

2. SELECT AN ENERGY-EFFICIENT UNIT
   The air conditioner should have a Seasonal Energy Efficient Ratio (SEER) of at least 13.0.

3. FOLLOW WISE PRACTICES
   (Guidelines 5, 6, and 8 in Replacement Measure 6: Central Heating System.)

4. USE NATURAL COOLING MEASURES
   Use shading and ventilation to minimize air conditioning bills and increase comfort levels in the home. See Projects 15, 17 and 18 for more information.

5. SHADE YOUR AIR CONDITIONER
   Keep the outside portion of your air conditioner in the shade. By keeping it cooler, it will run more efficiently and save you money. However, be certain to allow easy air flow to the outside equipment and to keep it clear of debris.

Initial Requirements

- Existing air conditioner is broken, is costly to operate, provides insufficient cooling, needs frequent maintenance, or is otherwise unsatisfactory.
- ENERGY STAR qualified central air conditioners have a higher Seasonal Energy Efficiency Ratio (SEER) than standard models, which makes them about 14% more efficient than standard models.
- 13 SEER is the minimum that manufacturers can now make.
- An oversized system will not run efficiently, it will not be comfortable, and it will cost more to purchase and operate than a properly sized unit. Require your licensed heating and A/C contractor to use Manual J when sizing the system for your home and Manual D to design an efficient duct system.
- Make sure that your ductwork is well sealed and insulated. Use mastic or UL-181 approved duct sealing tape. See page 25.
- Make sure that your new system uses the R-410-A refrigerant instead of the older R-22.
Construction terminology is used throughout this book, so it is important for the reader to have a guide to the jargon of the trade. The parts of a house often have several different names. The drawings on this page illustrate the terms used in this book.
Arkansas Energy Office  www.arkansasenergy.org
The Arkansas Energy Office has an extensive web site offering cost effective energy efficiency measures, resource materials, including state and local contacts. The “Consumer’s Guide to Lower Energy Bills” has several helpful publications in the Home Series.

Alliance to Save Energy  www.ase.org
The Alliance to Save Energy offers consumers information they need to save money, increase comfort, and even reduce pollution through energy efficiency. Visit the Alliance's new consumer web site at http://www.ase.org/consumers.

EPA's Energy Star Program  www.energystar.gov
The Environmental Protection Agency has developed the ENERGY STAR program to promote energy-efficient products including heating and cooling systems, lighting and other small appliances. Now there is also an Energy Star for Homes program.

Efficient Windows Collaborative  www.efficientwindows.org
The Efficient Windows Collaborative sponsors this web site with support from the U.S. Department of Energy's Windows and Glazings Program with the participation of industry members. This web site provides unbiased information on the benefits of energy-efficient windows, descriptions of how they work, and recommendations for their selection and use.

Here you can learn how to use the energy in your home more efficiently. You can also learn how to use renewable energy to provide your home with electricity, heating, cooling, and water heating.

Lawrence Berkeley National Laboratory  http://hes.lbl.gov/hes/makingithappen
LBNL's Environmental Energy Technologies Division conducts research leading to better energy-efficient technologies that reduce environmental impacts. The site includes an interactive tool for improving home energy efficiency (the Home Energy Saver—link above), as well as newsletters, research reports, and a directory of links to other energy efficiency resources.

DOE’s mission is to advance the national, economic, and energy security of the United States. This portal offers information on the many programs supported by DOE.

American Council for an Energy Efficient Economy  www.aceee.org/
ACEEE's Consumer Guide to Home Energy Savings provides numerous tips on low-cost ways to save energy in all areas of your home. The current edition of this consumer-friendly resource is now available at bookstores everywhere and online at www.aceee.org/consumer.