

HEATING AND COOLING SYSTEMS:

Saving Energy and Keeping Safe

This chapter helps you identify possible problems with your home heating system, duct system, and the house envelope (foundation, floors, walls, ceilings, and roof). By keeping your system in proper order, you can avoid unhealthy situations, reduce energy bills, increase your comfort level, and prevent structural damage.

This chapter covers:

1. Combustion Heating Appliance Ventilation Safety
2. Energy Consumption
3. Energy Efficiency (heating/cooling systems, air-sealing and insulation, and domestic hot water)

What do you expect from your house?

Your house should be a safe, comfortable place that is affordable and durable. How a home is constructed, insulated, and heated and cooled directly affects how it meets these objectives. A house is affordable only when costs for heating and cooling are reasonable. Energy bills are lowest if a home is tightly air-sealed and properly insulated and if all mechanical systems are operating efficiently. (Before extensively air-sealing your home, it is critical to ensure that doing so will not cause health or moisture problems. See Part 3b, which begins on page 101, for more information.) Above all else, your home must be a healthy place to live.

PART 1—Combustion Heating Appliance Ventilation Safety

If your furnace, wood stove, boiler, or water heater burns gas, oil, wood, or coal, it is important that the venting system, which carries combustion gases out of the house, is properly functioning. (This also applies to a gas clothes dryer.) Part 1 explains how venting systems work and what will keep them safe. At the end of Part 1, fill out the assessment table to identify potential risks with your system.

Are your combustion appliances safe?

When fuel (gas, oil, coal, or wood) is burned, carbon dioxide and water vapor are produced. If the burner is not functioning perfectly, carbon

monoxide and other harmful pollutants are also produced (see Chapter 9, Indoor Air Quality, for more information about combustion by-products). Most combustion appliances are vented to remove combustion by-products from the home. However, improper maintenance can lead to problems such as blocked or disconnected vents (Where did that bird put its nest?) and cracked flues. Vents or flues should be checked annually to make sure they are in good working order.

The three types of venting systems are natural-draft, power-vented, and sealed-combustion. Natural-draft or atmospheric-vent systems rely on the natural tendency of warm gases to rise. Natural-draft appliances always vent into a vertical flue (either masonry or metal) and have a draft hood, which draws extra indoor air into the flue. Natural-draft appliances are particularly susceptible to backdrafting. This problem occurs when exhaust equipment such as a clothes dryer, central vacuum, or exhaust fan draws air out of a house, creating a negative pressure within the house. This can cause combustion by-products to backdraft, or be pulled into the house instead of going out the vent (Figure 10.1).

A simple test for backdrafting is to turn on all exhaust devices in the home such as bathroom and kitchen vents and clothes dryer. Then start the furnace and water heater by turning up the thermostat and water heater temperature. After about two minutes, hold a burning stick of incense or spent match near the flue opening. The smoke should be drawn into the flue. If the smoke is pushed away from the flue, the device is backdrafting. Recheck after a few minutes.

With power-vented systems, a small blower exhausts combustion by-products from the house. Flue gases from power-vented appliances rarely backdraft. The newest furnaces and water heaters use sealed-combustion systems. With this type of system, air needed for combustion is brought in from outside through an intake pipe. Flue gases are vented outside through a second pipe. No chimney is needed. These systems are completely isolated from inside air, and as long as the intake and vent pipes are not blocked or damaged, sealed-combustion appliances are immune to backdrafting.

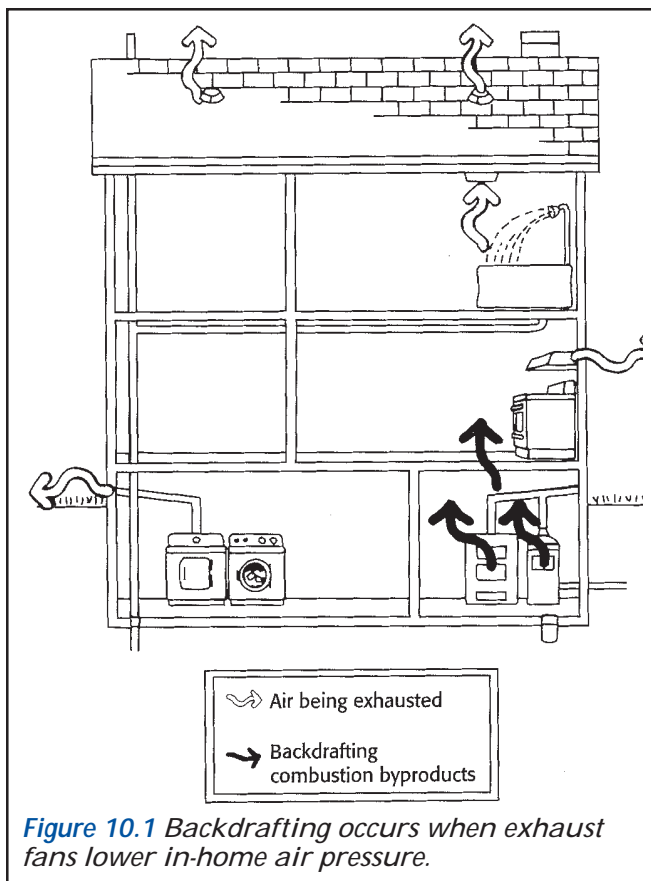


Figure 10.1 Backdrafting occurs when exhaust fans lower in-home air pressure.

Most modern water heaters are natural draft appliances; however, a few manufactures offer power-vented appliances.

Unvented appliances, including gas fireplace logs, should only be used in well-ventilated areas. If you must use unvented appliances, open a window in the room at least 1 inch.

Do your appliances get enough air?

For safe operation, it is critical that combustion appliances have enough air to work properly. The National Fire Protection Association (NFPA) codes (or more stringent local codes) must be followed to ensure safe installation and operation of combustion equipment.

Sealed-combustion units draw air directly from outside the home. However, natural-draft and power-vented units draw air from the indoor space in which they are located. If you have combustion equipment in a closet or other confined space, make sure the appliance gets enough air. This is often accomplished with louvered doors or combustion-air vents to the outside. Do not place anything inside or outside of the confined space that might block air flow.

Furnace or water heaters, located in basements that have been “finished” by the owner may have inadequate combustion air. Have a professional verify adequate sources of combustion and dilution air.

Is your fuel piping safe?

Homes served with natural gas should have fuel piping made from either black or galvanized piping. Copper should not be used for permanent piping or for the flexible connector between the appliance and the permanent piping. The connector should be Underwriter Laboratory (UL) approved. A stainless steel band on one end of the connector will show the UL seal.

Homes served with propane can use copper piping. However, a UL approved flexible connector should still be used.

Flexible connectors should not be routed through walls, floors, or partitions. There should be a shut-off valve separating the permanent piping from the connector.

Assessment 1—Combustion heating appliance ventilation safety

If you have a combustion appliance, complete the table on page 99. For each question, indicate your risk in the right-hand column. Some choices may not correspond exactly to your situation, so choose the response that best fits. Refer to Part 1 if you need more information.

Responding to risks

Your goal is to lower your risks. Turn to the Action Checklist on page 106 and write down the high and medium risks you identified. Refer to the information in Part 1 to help make plans to reduce your risks.

PART 2—Energy Consumption

The amount of energy consumed in your home depends on many factors, including how well the home is insulated, efficiency of appliances and equipment, local weather and climate, and your lifestyle.

Does your house use too much energy?

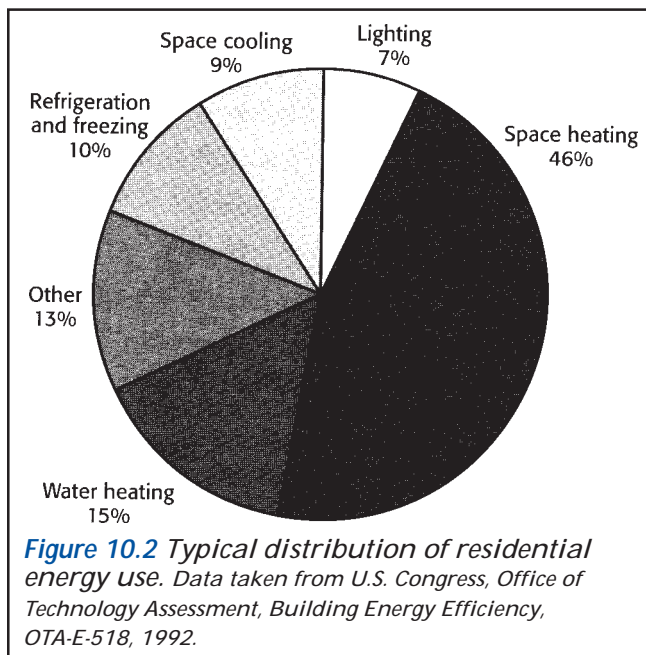
Figure 10.2 shows how energy is used in the typical American home. Your family’s lifestyle will affect how energy is consumed in your home. The best and most accurate way to determine the energy efficiency of your home is to have a home energy audit done by a service professional. Without an audit, it is not easy to know if your energy consumption is too much.

One simple measure is to compare your home’s energy use to another home of similar size and age with a similar family. You can compare gas and electric. If your home or the home you are comparing it to has upgraded the heating and cooling equipment, this will give you an indication of the benefit possible.

ASSESSMENT 1—Combustion Heating Appliance Ventilation Safety

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Vent system for combustion appliances	All combustion appliances have sealed-combustion venting systems.		Unvented space heaters or gas logs are used. —OR— Vent pipes are showing signs of damage. —OR— Rust or carbon is present on top of an appliance or below the draft hood.	<input type="checkbox"/> Low <input type="checkbox"/> High
Condition of chimney or flue	The chimney or flue is inspected annually.	The chimney or flue has been inspected only once in the past five years.	The chimney or flue has not been inspected, or the inspection record is unknown.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Air for combustion (does not apply to sealed-combustion appliances)	Combustion equipment has been tested and drafts properly when operating.		Combustion equipment has not been tested or does not draft properly when tested.	<input type="checkbox"/> Low <input type="checkbox"/> High

There are three key strategies to increase energy efficiency: air-sealing (leak-proofing) your home, adding insulation and efficient windows, and using more efficient appliances and equipment. Each is covered in Part 3.



PART 3—Energy Efficiency

The average home in the United States wastes 30 to 50 percent of the energy it uses. If every home installed energy-efficient equipment and was well-insulated, individual homeowners and the national economy would reap tremendous savings while reducing air emissions associated with fossil fuel combustion. The following sections will help you identify where energy is being lost and how you can prevent future losses. Complete the assessment tables at the end of each section to see where improvements can be made.

Part 3a—Improving Heating and Cooling Systems

The single greatest energy consumer in your home is the heating/cooling system (furnace, boiler, heat pump, wood stove, or air conditioner). This system has three parts: (1) heating/cooling unit(s), such as furnaces and air conditioners; (2) ducts or other distribution mechanism; and (3) a thermostat to control output. You can save energy in all three areas.

How old are the parts of your system?

If your primary heating/cooling unit is over fifteen to twenty-five years old, it is probably not very energy efficient. Even if it still works, you may benefit by replacing it with a new energy-efficient

model. A new device can pay for itself in fuel savings in only a few years. Or, if you find long-term financing for the new equipment, the dollar value of the monthly energy savings may exceed the monthly payment for the equipment, which would result in a positive cash flow.

Is your system getting proper maintenance?

All machines work more efficiently—and more safely—if they are inspected and maintained. Your furnace, air conditioner, and other heating/cooling equipment should be checked and serviced every year by a qualified professional. Have your combustion venting systems inspected at the same time. Monthly maintenance, such as inspecting and changing air filters, is recommended during the heating or cooling season. A forced-air system includes an air filter, which removes dust and debris before it reaches the air blower and heat-exchange coils. Dirt on the coils reduces efficiency, so you should change or clean your air filter on a regular basis.

Are you using your thermostat to save energy?

One of the easiest ways to save energy is to set thermostats at a lower temperature in winter and a higher temperature in summer so that the heating/cooling system runs less often. If a house is caulked and weather-stripped to prevent cold drafts, most people—when dressed appropriately—will be comfortable at 68 degrees Fahrenheit during winter. To save more energy, temperatures can be turned down to 50 or 60 degrees while you are sleeping or when the house is empty. During the summer, a thermostat setting of 72 degrees or higher is recommended. During times when the house is unoccupied, a summer thermostat setting of 80 to 85 degrees is recommended.

Energy saved by setting back your thermostat more than makes up for the energy used to reheat or re-cool your home. If you are using a heat pump, it is important to use a setback thermostat designed for heat pump applications.

Digital or clock thermostats (also called automatic set-back thermostats) can be programmed to adjust the temperature in your house automatically (Figure 10.3). For example, they can turn the heat down every night at 11 P.M. and bring the temperature back up by 6 A.M. before you get out of bed. The newest kind of residential thermostat, a home energy manager, allows many temperature settings throughout the week. Depending on your lifestyle, these set-back thermostats can pay for themselves in energy savings in as little as one or two years.

Is your distribution system working well?

Unless there is a heating/cooling unit in each room, you probably have a system to distribute hot or cool air from a central heater or air conditioner. More than 90 percent of central heating systems

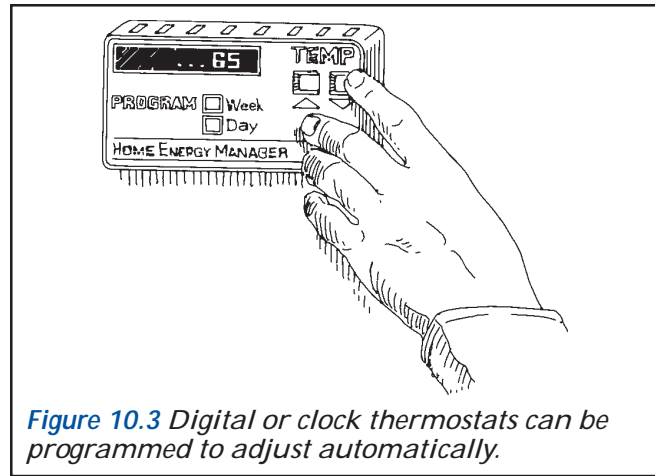


Figure 10.3 Digital or clock thermostats can be programmed to adjust automatically.

and virtually 100 percent of central residential cooling systems in America have forced-air distribution systems that use air ducts to move warm (or cold) air to the rooms of the house. If the duct system leaks, it can waste large amounts of energy.

Any ductwork located in an unheated space (such as an attic or crawl space) has a high potential for heat loss. Ducts in such spaces should be insulated. Also, all joints in the duct system, everywhere in the house, should be properly sealed to make sure all the warm or cool air gets where you want it to go. Duct tape provides a short-term seal for leaky ducts. Special mastics and fiberglass reinforcing tape provide long-term seals. Contact a local low-income home weatherization agency or Engineering Extension for more details.

Besides providing supply registers in each room to deliver heated/cooled air, there must be a return duct to allow air to get back to the heating/cooling unit. Many homes do not have a return register in every room, but rely on the space under a closed door to allow supply air to return to a centrally located return. If you have a room that is uncomfortable (hard to heat or cool) when the door is shut but is fine when the door is open, you probably have an air distribution problem. You can increase the cut under the door or call a heating and cooling specialist to add a return duct to the room. Leaky return ductwork are problematic and require sealing too.

The second most common heat distribution system uses hot water that is distributed through pipes to radiators or convectors. Pipes carrying hot water should be insulated everywhere—from boiler to radiator. Use a quality insulation material. Cheap materials degrade over time.

Assessment 3a—Improving heating/cooling systems

Use the table on the following page to identify areas where energy can be saved. Indicate your potential energy-loss level in the right-hand column. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to the sections above if you need more information to complete the table.

Responding to your energy-loss potential

Your goal is to reduce the amount of energy that is wasted. Turn to the Action Checklist on page 106 to record the high- and medium-loss potentials identified in the table. Use the recommendations in Part 3a to help identify ways to increase energy efficiency.

Part 3b—Preventing loss of heated (or cooled) air

Once you have reached a comfortable temperature indoors, your aim is to keep it that way. Preventing unwanted air leaks and blocking heat transfer are two important approaches to making your home even more energy efficient.

Have you air-sealed your home?

Every house has openings through which outside air can enter. Some openings, such as open windows and doors, are obvious pathways for air entry. Others, such as cracks around window frames, are unintended pathways for leaks (Figure 10.4). This uncontrolled leakage of air, known as infiltration, can account for a large portion of the total heat loss in a home—typically about 30 percent of the total heating bill. Stopping infiltration by sealing these leakage paths is called air sealing.

Cracks around windows and doors are perceived as major sources of infiltration. Openings high in the home, in the attic floor, and low in the home, in the basement, are the most significant leakage paths.

Cold (or warm) air entering a home must be heated (or cooled) if the home is to remain comfortable. Sealing your home against air leakage is not difficult, but it does require detailed information to be done right. For details on how to reduce air leaks, contact Engineering Extension at K-State or the U.S. Department of Energy's Energy Efficiency and Renewable Energy Clearinghouse (EREC). (See "For More Information" on page 105.)

Does your home need more insulation?

Even if you air-seal your house, you still need to prevent transfer of heat or cold air through walls, floors, or ceilings. Insulation acts like a blanket to retain the heat or cool air your system produces. Insulation materials are assigned an R-value, which is a measure of how well they "Resist" the flow of heat energy into or out of your home. The larger the R-value, the more heat (or cool air) is kept where you want it.

The recommended amount of insulation for a home varies with geographic location. If you have extreme temperatures in your area, you will need more insulation. The publication *Tips for Purchasing an Energy-Efficient Home* provides recommended insulation values for Kansas. It is available from your county Extension Office or K-State Engineering Extension. The EREC publication *Insulation Materials and Strategies?* describes various

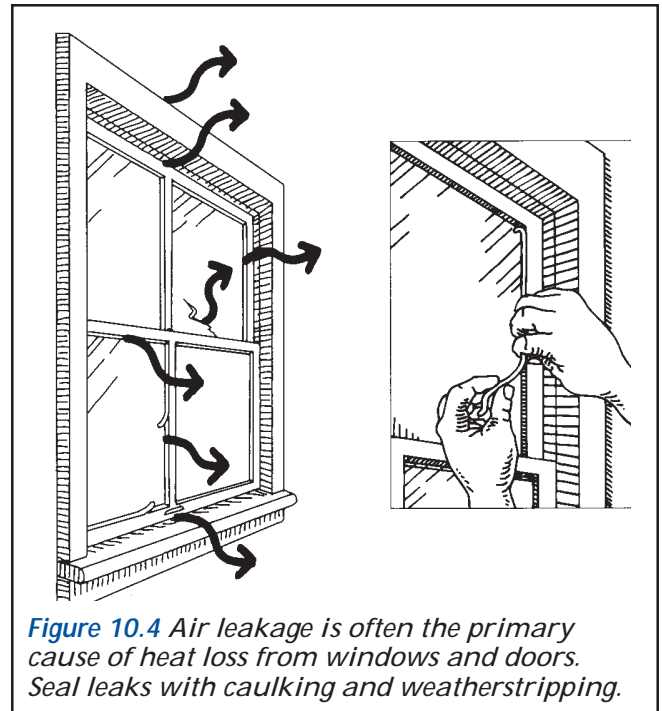


Figure 10.4 Air leakage is often the primary cause of heat loss from windows and doors. Seal leaks with caulking and weatherstripping.

insulation products available and provides insulation recommendations for all areas of the United States by zip code. It also helps you decide if you should attempt the job yourself or have it done professionally. (See "For More Information" on page 105 for information on how to contact EREC.)

Assessment 3b—Preventing loss of heated (or cooled) air

As before, indicate your potential energy-loss level in the right-hand column in the table on page 104. Although some choices may not correspond exactly to your situation, choose the response that best fits. Refer to the sections above if you need more information to complete the table.

Responding to your energy-loss potential

Your goal is to reduce the amount of energy you use. On the Action Checklist (see page 106), record the high and medium loss potentials you identified above. Use the recommendations in Part 3b to help find ways to increase energy efficiency.

Part 3c—Increasing efficiency of domestic hot water systems

After heating and cooling your home, heating water for domestic consumption is the next largest energy user. There are several ways to reduce the amount of energy you use to heat water.

The simplest thing you can do to save energy used for water heating is to turn down the water heater temperature. Each 10-degree reduction in water heater temperature will save you 3 to 5 percent on your annual water heating bill. Lowering the water temperature will also increase the lifetime of your water heater and reduce the risk of someone

ASSESSMENT 3a—Improving Heating and Cooling Systems

	LOW-ENERGY LOSS	MEDIUM-ENERGY LOSS	HIGH-ENERGY LOSS	YOUR LOSS POTENTIAL
Age of heating/ cooling equipment	Equipment is less than 5 years old.	Equipment is 5 to 15 years old.	Equipment is older than 15 years.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Maintenance of heating/ cooling equipment	Air filters are changed every month during use, and equipment is serviced at least every 2 years.	Filters are changed occasionally, and the system is maintained on an irregular basis.	Filters are not changed or rarely changed, and the system is not maintained.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Air-temperature thermostat	A modern thermostat with automatic temperature set-back is installed. It is routinely used to minimize energy consumption.	A newer thermostat is installed and is used occasionally to regulate temperatures at night or when the house is empty.	An older thermostat is in use. It is set to maintain a constant temperature.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Duct location	All duct work is located in heated/ cooled space.	Some duct work is located in unheated space.	All duct work is located in unheated space.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Ductwork in unheated space (if applicable)	All ductwork in unheated space is insulated.	Some ductwork in unheated space is insulated.	There is no insulation on ducts.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Return duct	There are air-return ducts in every room, or bedroom doors are left open.	There is one "central" air return. Bedroom doors are shut at night but there is a 2-inch or greater space under the doors.	There is one "central" air return. Bedroom doors are shut at night, and there is little space between the bottom of the doors and the floor.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Air-sealing ducts and registers	Seams in the duct system are sealed, especially where air registers enter rooms.	There are no visible gaps in the duct system.	Gaps are visible in the duct system or around room air registers.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Air intake or air handler	The intake/handler is located in heated space.	The intake/handler is located in unheated space (for example, a crawl space or attic).	The air intake/handler is located in a garage.*	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High

***SAFETY NOTE:** Regardless of where your furnace is, NEVER leave your car running in the garage. The air handler can pick up car exhaust fumes and distribute them to the house through the duct system.

ASSESSMENT 3b—Preventing Loss of Heated (or Cooled) Air

	LOW-ENERGY LOSS	MEDIUM-ENERGY LOSS	HIGH-ENERGY LOSS	YOUR LOSS POTENTIAL
Attic	All potential leak points are sealed or weather-stripped.	Only some potential leak points are sealed.	Most potential leak points are not sealed.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Windows and doors	All windows and doors are sealed with caulk and weather-stripping and tested for leaks. Newer, well-sealed, double-paned windows are installed.	Only some windows and doors are caulked and weather-stripped. Older or leaky storm windows are used. Some windows are sealed in winter with plastic sheets.	Windows are older and not sealed. Storm windows may be absent.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Basement or crawl space	Sill plates, service entrances, windows, and wall cracks are sealed with caulk or foam.	Leaks have been detected but are not fully sealed.	No sealing has been attempted.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Attic insulation	Insulation is equal to or greater than levels recommended for my region. All penetrations through the attic from wiring, plumbing, and other openings such as plumbing chases are air sealed.		Insulation is well below the recommended levels. –OR– Attic is not insulated. Attic is not air-sealed.	<input type="checkbox"/> Low <input type="checkbox"/> High
Insulation in walls (above-ground)	Wall cavities are insulated with loose fill or 3-inch to 5-inch bats.		There is no insulation in wall cavities.	<input type="checkbox"/> Low <input type="checkbox"/> High
Insulation in walls (heated basements)	Walls are insulated with rigid foam or bats, according to regional recommendations.		Walls are not insulated.	<input type="checkbox"/> Low <input type="checkbox"/> High

being burned by the hot water. Children and the elderly are most at risk of being scalded from water that is too hot.

Most water heaters are factory set around 140 degrees Fahrenheit. For most household uses, that is higher than necessary. Usually, 120-degree water is adequate unless you have an automatic dishwasher without a temperature booster. In this case, you may need to keep the temperature set at 140 degrees for optimal dishwashing performance.

Wrapping your water heater with insulation can reduce water heating energy use by 4 to 9 percent. Except for some new water heaters that come with high levels of foam insulation and do not need any more, the addition of insulation usually pays for itself in less than one year. Water heater insulation blankets are widely available at hardware stores and come in standard sizes to fit 40-, 60-, and 80-gallon water heaters. Be sure to follow the manufacturer's instructions for installation.

Reducing hot water consumption will reduce the amount of energy needed. Fix any leaking faucets and install low-flow shower heads. Washing laundry in cold rather than hot water will also save energy. Air-drying laundry in warm weather reduces energy use from the dryer and gives the clothes a fresh smell.

Hot water pipes should be insulated wherever they are accessible. Either preformed foam insulation or wraparound fiberglass insulation can be used.

Assessment 3c—Increasing efficiency of domestic hot water systems

In the table on page 105, indicate your potential energy-loss level in the right-hand column. Refer to the sections above if you need more information to complete the table.

Responding to your energy-loss potential

Your goal is to reduce the amount of energy you use. On the Action Checklist (see page 106), record the high- and medium-loss potentials you identified above. Use the recommendations in Part 3c to help find ways to increase energy efficiency.

ACTION CHECKLIST

Go back over the assessment tables and make sure that you have recorded all high and medium risks and energy-loss potentials. Next, list the improvements you plan to make. You can use recommendations from this chapter or from other sources to help pick actions you are likely to take. Write down a date to keep you on schedule. You do not have to do everything at once, but try to eliminate the most serious problems as soon as you can. Often it helps to tackle the inexpensive actions first.

SAFETY NOTE

Proceed with caution. As stated before, your home must be a healthy place to live. Air-sealing may save energy, but it can also trap deadly pollutants. Air-sealing can cause a dangerous situation by reducing the air available for combustion appliances. Do not attempt to air-seal your home until you have done the following:

- Unvented gas or kerosene heaters or unvented gas fireplaces/logs must be removed or vented outdoors.
- Gas cook stoves are not vented and are not to be used for space heating.
- If you have a high level of radon in your home, properly air-sealing can help reduce the problem. However, you should monitor radon levels carefully and contact a professional if the problem is not fixed. (See Chapter 9, "Indoor Air Quality," for more information about radon.)
- If you have natural-draft appliances, do not extensively air-seal your home without seeking the advice of an energy services professional.

For More Information

Engineering Extension at Kansas State University

Engineering Extension can provide information on energy-efficient building practices, indoor air quality, and provide general information on home energy use. Contact them at 133 Ward Hall, Kansas State University, Manhattan, KS 66506–2508; (785) 532-6026.

Energy Efficiency and Renewable Energy Clearinghouse (EREC)

The U.S. Department of Energy provides energy information through the Energy Efficiency and Renewable Energy Clearinghouse (EREC). EREC will send detailed information on the topics in this assessment, and much more. Call them toll-free at (800) DOE-EREC/(800)-363-3732, Monday–Friday, 9A.M.–7P.M., Eastern Standard Time.

American Council for an Energy Efficient Economy

The American Council for an Energy Efficient Economy can provide information on energy-efficient appliances. Contact them at 2140 Shattuck Avenue, Suite 202, Berkeley, CA 94704; (510) 549-9914. Ask for a current list of publications.

ASSESSMENT 3c—Increasing Efficiency of Domestic Hot Water Systems

	LOW-ENERGY LOSS	MEDIUM-ENERGY LOSS	HIGH-ENERGY LOSS	YOUR LOSS POTENTIAL
Thermostat setting	Thermostat is set at 120°F.	Thermostat is set at 130°F.	Thermostat is set at 140°F or higher.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Insulation	A new, highly insulated water heater or water heater blanket is installed.		An older water heater with no added blanket is in use.	<input type="checkbox"/> Low <input type="checkbox"/> High
Water conservation	Low-flow shower heads are installed, and there are no leaking faucets. A conscious effort is made to conserve hot water.	There are no leaking faucets. Some effort is made to minimize hot water use.	There are leaking faucets, and no low-flow fixtures are installed.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High
Pipe insulation	All accessible hot water pipes are insulated.	Some accessible hot water pipes are insulated.	There is no insulation.	<input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High

Publications

Heede, Richard. *Homemade Money: How to Save Energy and Dollars in Your Home*. Amherst, New Hampshire: Brick House Publishing, 1995. This publication is 260 pages long and is available for \$14.95 per copy from the Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, CO 81654–9199.

Nisson, Ned and Alex Wilson. *The Virginia Energy Savers Handbook: A Guide to Saving Energy, Money, and the Environment*. Virginia Department of Mines, Minerals, and Energy, 1993. This 120-page guide is available from the Virginia Department of Mines, Minerals, and Energy, Division of Energy, 202 North Ninth Street, 8th Floor, Richmond, VA 23219; (804) 692-3218.

Kansas Home*A*Syst Helps Ensure Your Safety

This *Kansas Home*A*Syst* handbook covers a variety of topics to help homeowners examine and address their most important environmental concerns. See the complete list of chapters in the table of contents at the beginning of this handbook. The end of each chapter lists resources and other useful information. For more information about topics covered in *Kansas Home*A*Syst*, or for information about laws and regulations specific to your area, contact your county or K-State Research and Extension office.

Contact the Kansas Farm*A*Syst/Home*A*Syst office at Biological and Agricultural Engineering, Seaton Hall, Manhattan, KS 66506–2917; phone: (785) 532-5418. Web page: www.engg.ksu.edu/enggext/ppi/homeasyst; or the National Farm*A*Syst/Home*A*Syst Office at: B142 Steenbock Library, 550 Babcock Drive, Madison, WI 53706–1293; phone: (608) 262-0024; e-mail: <HOMEASYST@MACC.WISC.EDU>.

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Figures 10.1, 10.3, and 10.4 were adapted from Ned Nisson and Alex Wilson, *The Virginia Energy Savers Handbook: A Guide to Saving Energy, Money, and the Environment*, 1993.

This chapter was based on original material written by Lori S. Marsh, Associate Professor and Extension Engineer, Department of Biological Systems Engineering, Virginia Polytechnic Institute and State University.

Action Checklist

Heating and Cooling Systems: Saving Energy and Keeping Safe

Write all high- and medium-risks and energy loss potentials below.	What can you do to reduce the risk or energy-loss potential?	Set a target date for action
Sample: Water heater is not insulated	Buy ready-made insulation blanket at the hardware store.	One week from today: March 8

*Kansas Home*A*Syst*, an environmental risk-assessment guide for the home, is a cooperative project of the Pollution Prevention Institute, K-State Research and Extension Service, Kansas Department of Health and Environment, U.S. Environmental Protection Agency, and the Environmental Department, Conservation District, and Natural Resources Conservation Service of Johnson County, Kansas, and Johnson County/K-State Research and Extension Office.

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