INTERNATIONAL ASSOCIATION OF CERTIFIED HOME INSPECTORS

HOME ENERGY INSPECTION

Energy-Efficient Heating and Cooling:

A Homeowner's Guide

Change the World,
and Start with a Home Energy Inspection

The average household spends more than $2,200 a year on energy bills, with nearly half of that amount going to heating and cooling costs. Following the recommendations provided to you by your InterNACHI-Certified Home Energy Inspector can help you make smart decisions about your home's heating, ventilating, and air-conditioning (HVAC) system that can help you save on energy costs, improve your overall comfort at home, and help fight global warming.

Did you know the energy used in the average house is responsible for twice as much greenhouse gas emissions as the average car?

When power plants burn fossil fuels to make electricity, they release greenhouse gases. By using less energy at home, you help reduce the emissions that contribute to global warming.

An InterNACHI Home Energy Inspector can help you save money and protect our environment by recommending energy-efficient products and practices.

Whether you're looking for guidance about purchasing energy-efficient equipment, getting a quality installation, performing HVAC maintenance, or learning about ways to make your heating and cooling system operate more efficiently, an InterNACHI Home Energy Inspector can help.

Why Read this Guide?

Use this guide to help you:

- Learn how to properly maintain your heating and cooling equipment.
- Take simple measures in your home to improve the efficiency of your HVAC system.
- Decide when it's time to replace your old heating and cooling equipment with more energy-efficient equipment that has earned the EPA's ENERGY STAR.

Consider Making a Change if Any of the Following Statements Apply

Some of your rooms are too hot or cold. Inadequate air sealing or insufficient insulation could be the cause. No matter how efficient your heating and cooling system is, if your home is not properly sealed and insulated, you will not be as comfortable and your system will have to work harder.

Your home has humidity problems, excessive dust, or rooms that never seem to get comfortable. Leaky or poorly insulated ductwork might be the cause.

Your equipment needs frequent repairs and your energy bills are going up. In addition to the rise in energy costs, the age and condition of your heating and cooling equipment may have caused it to become less efficient.

Your heating and cooling equipment is more than 10 years old. Consider replacing it with newer, more efficient equipment. And remember, high efficiency levels begin with ENERGY STAR.

You leave your thermostat set at one constant temperature. You could be missing a great energy-saving opportunity. You can set a programmable thermostat to adjust your home's temperature at times when you're regularly away or sleeping.

You hired an InterNACHI Home Energy Inspector and your report shows that your home costs more than $2,200 to operate. That means you're using and paying for more energy at home than most Americans. Read your InterNACHI Home Energy Report to discover recommendations for home improvement projects that will increase your score by improving your home's energy efficiency and comfort.

Maintain Your Equipment

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Dirt and neglect are the top causes of heating and cooling system inefficiency and failure. To ensure your system's efficient operation, it's important to perform routine maintenance. Here are some tips.

Change your air filter regularly. A clean filter will prevent dust and dirt from building up in the system, which can lead to expensive maintenance and/or early system failure. Check your filter every month, especially during winter and summer months when use tends to be heavier. Change your filter if it's dirty or at least every three months.

Tune up your HVAC equipment. Proper maintenance by a qualified technician is one of the most important steps you can take to prevent future problems. Contractors get busy during summer and winter months, so it's best to check the cooling system in the spring and the heating system in the fall. Plan the check-ups around the beginning and end of Daylight Saving Time each spring and fall.

Overall System Maintenance Checklist

Your contractor should perform the following tasks each spring and fall:

- **Check thermostat settings** to ensure that the heating and cooling system turns on and off at the programmed temperatures.

- **Tighten all electrical connections, and measure voltage and current on motors.** Faulty electrical connections can cause your system to operate unsafely and reduce the life of major components.

- **Lubricate moving parts.** Parts that lack lubrication cause friction in motors and increase the amount of electricity you use. Lack of lubrication can also cause equipment to wear out more quickly, requiring more frequent repairs or replacements.

- **Check the condensate drain in your central air conditioner, furnace and/or heat pump (when in cooling mode).** If the drain is plugged, it can cause water damage in the house, affect indoor humidity levels, and breed bacteria and mold.

- **Check the system controls to ensure their proper and safe operation.** Check the starting cycle of the equipment to assure that the system starts, operates and shuts off properly.

- **Inspect and clean or change the air filter** in your central air conditioner, furnace and/or heat pump. Your contractor can show you how to do this. Depending on your system, the filter may be located in the duct system instead of in the heating and cooling equipment, and your contractor can verify its location.

Additional System-Specific Maintenance Activities

For Heating Systems:

- **Inspect the flue piping** for rusting and any disconnections or evidence of back-drafting.

- **Check all gas (or oil) connections, gas pressure, burner combustion, and heat exchanger.** Improper burner operation can be caused by a dirty burner or a cracked heat exchanger, and either can cause the equipment to operate less safely and efficiently. Leaking gas (or oil) connections are also a fire hazard and can contribute to long-term health problems.

For Cooling Systems:

- **Clean indoor and outdoor coils** before warm weather starts. A dirty coil reduces the system's ability to cool your home and causes the system to run longer, increasing your energy costs and shortening the life of your equipment.

- **Check your central air conditioner's refrigerant charge** and adjust it, if necessary, to make sure it meets the manufacturer's specifications. Too much or too little refrigerant charge can damage the compressor, reducing the life of your equipment and increasing energy costs.

- **Clean and adjust the blower components** to provide proper system air flow. Adequate air flow over the indoor coil is necessary for the equipment's efficient operation and reliability.

Use a Programmable Thermostat

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A programmable thermostat is ideal for people who are away from home during set periods of time throughout the week. Through proper use of pre-programmed settings, a programmable thermostat can save you about $180 every year in energy costs.

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How do you choose the right one?

To decide which model is right for your home, think about your schedule and how often you're away from home for regular periods of time—work, school, other activities—and then decide which of the following three different models is the best fit for your lifestyle:

The **7-day model** is best if your daily schedule tends to change, such as when children are at home earlier on some days. These models give you the most flexibility and let you set different programs for different days—usually, with four possible temperature periods per day.

The **5+2-day model** uses the same schedule every weekday and another for weekends.

The **5-1-1 model** is best if you tend to keep one schedule during the work week and different schedules on Saturdays and Sundays.

Programmable Thermostat Settings

You can use the following table as a starting point for setting energy-saving temperatures, and then adjust the settings to fit your family's schedule and stay comfortable.

Setting	Time	Setpoint Temperature (Heating)	Setpoint Temperature (Cooling)
Wake	6:00 a.m.	<70º F	>78º F
Day	8:00 a.m.	Set back at least 8º	Set forward at least 7º
Evening	6:00 p.m.	<70º F	>78º F
Sleep	10:00 p.m.	Set back at least 8º	Set forward at least 4º

Get the Greatest Benefit from Your Programmable Thermostat

- Install your thermostat away from heating and cooling registers, appliances, lighting, doorways, fireplaces, skylights and windows, and other areas that receive direct sunlight and are prone to drafts. Interior walls are best.

- Keep the thermostat set at energy-saving temperatures for long periods of time, such as during the day when no one is home and at bedtime.

- Set the "hold" button at a constant energy-saving temperature when you're going away for the weekend or on vacation.

- Resist the urge to over-ride the pre-programmed settings. Every time you do, you use more energy, and you may end up paying more for your energy bills.

- Use a programmable thermostat for each zone of your house if you have multiple heating and cooling zones. This will help you maximize comfort, convenience and energy savings throughout the house.

- If your programmable thermostat runs on batteries, change them each year. Some units signal when the batteries must be changed.

If you have a heat pump, you may require a special programmable thermostat to maximize your energy savings year-round. Talk to your retailer or contractor for details before selecting your thermostat.

If you have a manual thermostat, you can adjust the temperatures daily before you leave the house and when you go to sleep at night. Typically, adjusting the temperature 5° to 8° (down in winter, up in summer) can help save energy if you're going to be away from home for several hours.

Seal Your Heating and Cooling Ducts

Ducts are used to distribute conditioned air throughout houses that have forced-air heating and cooling systems. In typical houses, about 20% of the air that moves through the duct system is lost due to leaks, holes, and poorly connected ducts. The result is an inefficient HVAC system, high utility bills, and difficulty keeping the house comfortable, no matter how the thermostat is set.

Simple Steps to Improve Duct Performance

Because ducts are often concealed in walls, ceilings, attics and basements, repairing them can be difficult. But there are things that you can do to improve duct performance in your house.

Start by sealing any leaks using mastic sealant or metal (foil) tape and insulating all the ducts that you can access, such as those in the attic, crawlspace, basement and garage. Don't use duct tape for this, as it's only a temporary fix for emergencies and not long-lasting.

Also, make sure that the connections at vents and registers are well-sealed where they meet the floors, walls and ceilings. These are common locations where you'll find leaks and disconnected ductwork.

Working with a Contractor

Many homeowners choose to hire a professional contractor for duct improvement projects. Most heating and cooling contractors also repair ductwork.

Look for a contractor who will:

- inspect the whole duct system, including the attic, basement and crawlspace (if you have these);

- evaluate the system's supply-air and return-air balance. Many systems have return-air ducts that are too small;

- repair or replace damaged, disconnected and undersized ducts, and straighten out flexible ducts that are tangled or crushed;

- seal leaks and connections with mastic, metal tape, or an aerosol-based sealant;

- seal gaps behind registers and grilles where the duct meets the floor, wall or ceiling;

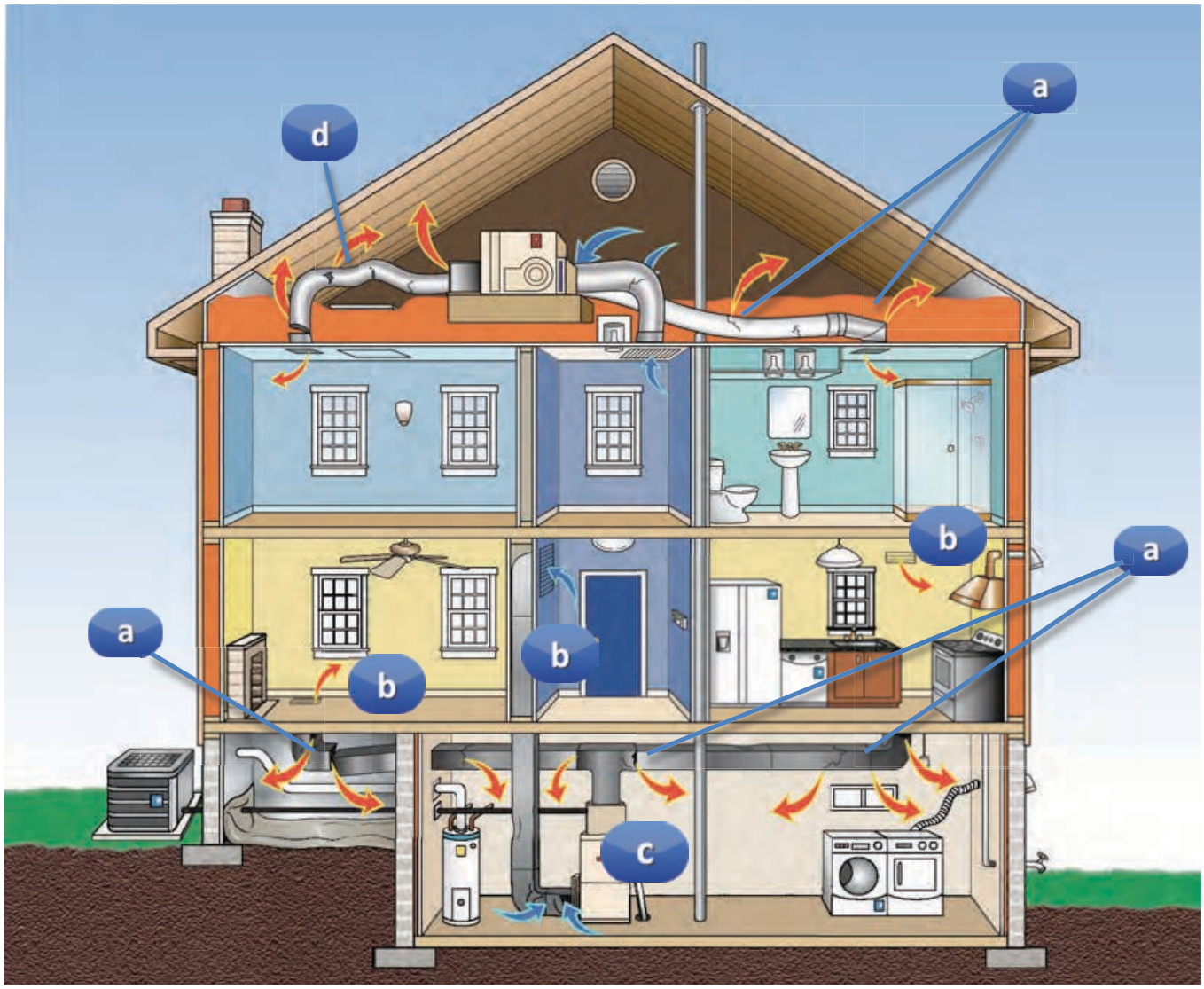
- insulate ducts in unconditioned areas with insulation that carries an R-value of 6 or higher;

- include a new filter as part of any duct system improvement;

- use diagnostic tools to evaluate air flow after all repairs are completed; and

- ensure that there is no back-drafting of gas- or oil-burning appliances, and conduct a combustion safety test after all ducts are sealed.

Common Duct Problems



- **a** Leaky, torn and disconnected ducts
- **b** Poorly sealed registers and grilles
- **c** Leaks at the furnace and its filter slot
- **d** Kinks in flexible ductwork, which restricts air flow

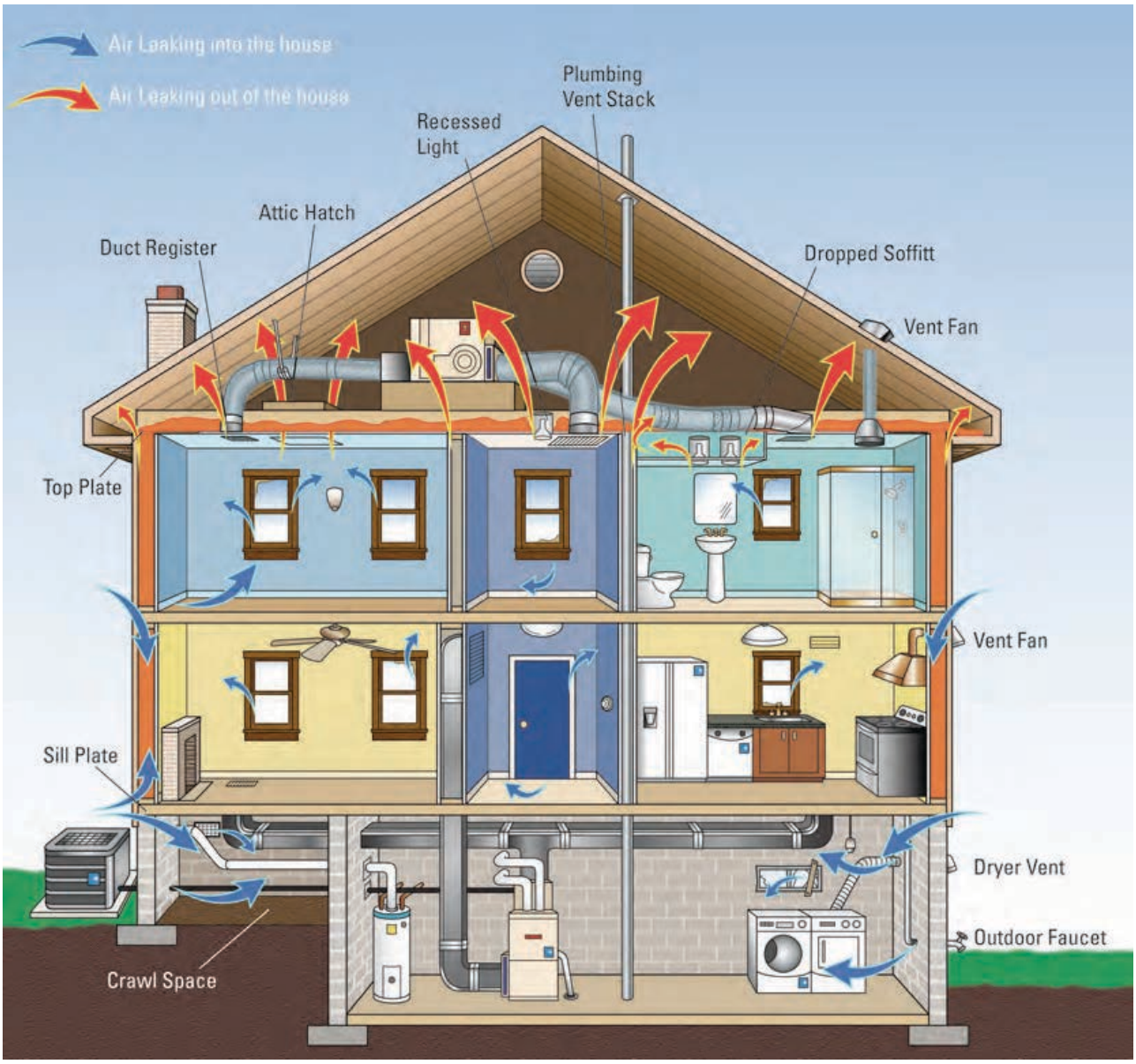
Seal and Insulate with ENERGY STAR

The exterior of your home—the outer walls, ceiling, windows and floor—is called the "envelope" or "shell." As a knowledgeable homeowner, or with the help of a skilled contractor, you can save up to 20% on heating and cooling costs (or up to 10% on your total annual energy bill) by sealing and insulating your home envelope. It will also make your home more comfortable and help your heating and cooling system run more efficiently.

Hidden Air Leaks

Be sure to look for and seal air leaks before you install insulation because it performs best when air is not moving through or around it. Many air leaks and drafts are easy to find because they are easy to feel—like those around windows and doors. But holes hidden in attics, basements and crawlspaces are usually bigger problems. Sealing these leaks with caulk, spray foam, or weatherstripping will have a great impact on improving your comfort and reducing your utility bills.

Common Locations for Air Leaks



Homeowners are often concerned about sealing their house too tightly; however, this is very unlikely in many older homes. A certain amount of fresh air is needed for good indoor air quality, and there are specifications that set the minimum amount of fresh air needed for a house. If you are concerned about how tight your home is, hire an InterNACHI-Certified Home Energy Auditor who'll use diagnostic tools to measure your home's actual air leakage. If your home is too tight, a fresh-air ventilation system may be recommended.

After any project where you've reduced air leakage, have a heating and cooling technician check to make sure that your combustion appliances (gas- or oil-fired furnace, water heater, and clothes dryer) are venting properly. For additional information on indoor air quality (IAQ) issues related to homes, such as combustion safety, visit the EPA's Indoor Air Quality website at www.epa.gov/iaq.

Adding Insulation

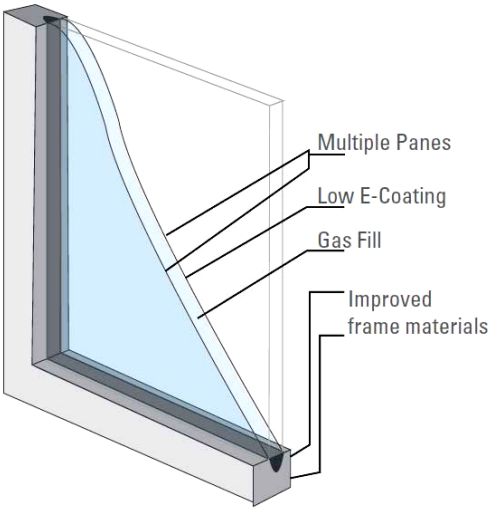
Insulation keeps your home warm in the winter and cool in the summer. There are several common types of insulation: fiberglass (in both batt and blown forms); cellulose; rigid foamboard; and spray foam. Reflective (or radiant-barrier) insulation is another insulating product that can help save energy in hot, sunny climates. When properly installed with air sealing, each type of insulation can deliver comfort and lower energy bills during the hottest and coldest times of the year.

Insulation performance is measured by R-value—its ability to resist heat flow. Higher R-values mean more insulating power. Different R-values are recommended for walls, attics, basements and crawlspaces, depending on your area of the country. Insulation works best when air is not moving through or around it, which means it's very important to seal air leaks before installing insulation to ensure that you get the best performance from the insulation.

To get the biggest savings, the easiest place to add insulation is usually in the attic. A quick way to see if you need more insulation is to look across your uncovered attic floor. If your insulation is level with or below the attic floor joists, you probably need to add more. The recommended insulation level for most attics is R-38, or about 12 to 15 inches, depending on the insulation type. In the coldest climates, insulating up to R-49 is recommended.

ENERGY STAR-Qualified Windows

Windows are an important part of your home's envelope. ENERGY STAR-qualified windows feature advanced technologies, such as invisible glass coatings, vacuum-sealed spaces filled with inert gas between the panes, improved framing materials, better weatherstripping, and warm edge spacers, all of which reduce undesirable heat gain and loss.



Increase your savings. With more efficient windows, you can save money and use less energy. Installing ENERGY STAR-qualified windows can reduce your energy bills by about 7 to 24%, compared to non-qualified windows. Your estimated savings will vary depending on current heating and cooling costs in your region.

Improve your comfort. ENERGY STAR-qualified windows do more than just lower energy bills; they keep your home's temperature consistently comfortable. During the winter, the interior glass of ENERGY STAR-qualified windows stays warmer compared to typical windows, even when the temperature outside dips well below freezing. In the summer, most ENERGY STAR-qualified windows reduce the heat gain into your home without reducing the visible light.

Protect your valuables. Drapes, wood floors, a favorite photograph: all these things can fade or discolor after repeated exposure to direct sunlight. ENERGY STAR-qualified windows have coatings that keep out the summer heat and act like sunscreen for your house, protecting your valuables from harmful, fading ultraviolet light without noticeably reducing visible light.

Look for the ENERGY STAR. The ENERGY STAR guidelines for windows are tailored to four climate zones. For example, windows in the North are optimized to reduce heat loss in the winter, while windows in the South are optimized to reduce heat gain during the summer. For optimal results, select the ENERGY STAR-qualified windows that are appropriate for your climate zone.

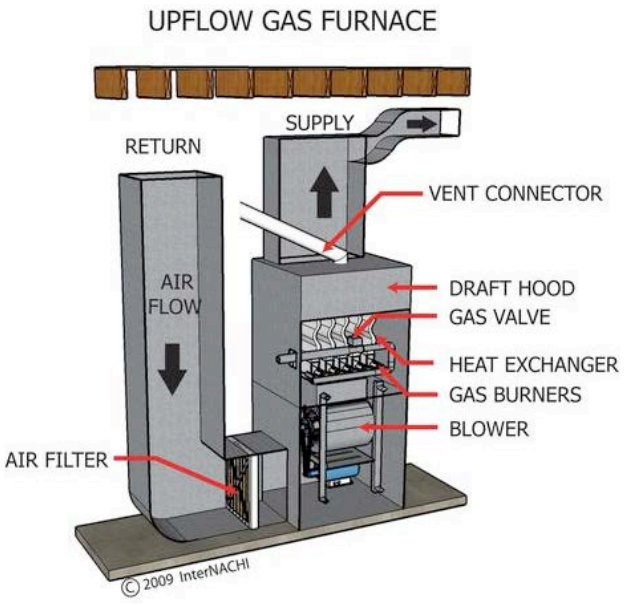
Making a Change?
Choose the Right Equipment.

If you've taken the steps outlined in the previous sections to improve your home's energy efficiency but you continue to experience problems, or if your HVAC system is old (10 to 15 years) or not working, consider replacing your equipment with a high-efficiency unit that has earned the ENERGY STAR. It's a good idea to do some research on options for a new heating or cooling system before your current one breaks down so that you can make an informed decision if you need to act quickly.

How much energy you'll save will vary based on your use and climate, with colder regions saving more with ENERGY STAR heating equipment, and hotter regions saving more with ENERGY STAR cooling equipment.

Furnaces

Furnaces are the most common residential heating systems used in the United States. Most run on gas, but some use oil, propane or electricity. Furnaces deliver their heat through a duct system. Furnaces that have earned the ENERGY STAR have higher AFUE (annual fuel-utilization efficiency) ratings. AFUE is the measure of heating equipment efficiency represented as a percentage.



Most furnaces that qualify for the ENERGY STAR are "condensing" furnaces. This means that their transfer of heat is so thorough, water or condensate is a byproduct of combustion. This condensing occurs with systems that are over 90% efficient. Another feature of efficient furnaces is a highly efficient blower motor, which is typically an ECM or electronically commutated motor, or another type of advanced main air-circulating fan.

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Boilers

A boiler heats your home by burning gas, propane or oil to heat water or steam that circulates through radiators, baseboards or a radiant-floor system. Boilers do not use a duct system. Boilers that have earned the ENERGY STAR have higher AFUE ratings. Features that improve boiler efficiency include an electronic ignition, which eliminates the need to have the pilot light burning all the time, and technologies that extract more heat from the same amount of fuel.

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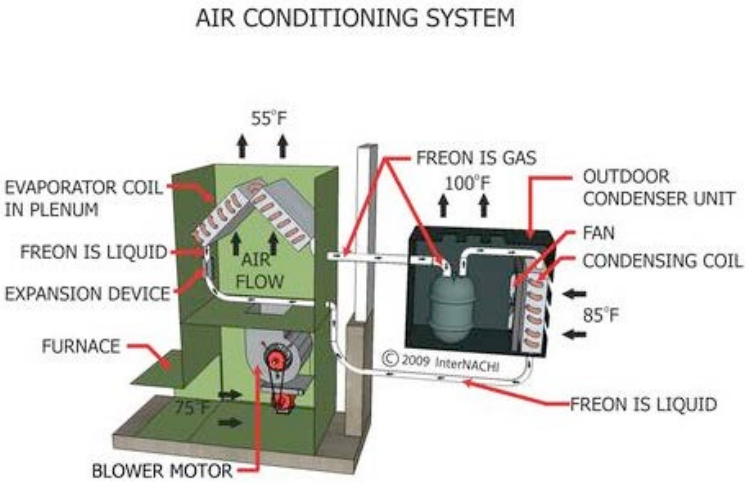
Central Air Conditioners

Most residential central air conditioners are called "split-systems" because they have an outdoor component with a condenser and compressor, and an indoor component with an evaporator coil. It's very important to replace both of these units at the same time. Installing a new outdoor unit without replacing the indoor unit is likely to result in low efficiency, and may lead to premature failure of the entire system.



ENERGY STAR-qualified central air conditioners have higher SEER ratings (SEER = seasonal energy efficiency ratio) and EER ratings (EER = energy efficiency ratio) than a lot of today's standard models. SEER is the most commonly used measurement of efficiency for air conditioners. It measures how efficiently a cooling system will operate over an entire season. EER measures how efficiently a cooling system will operate when the outdoor temperature is at a specific level (95° F).

The central air conditioner also needs a blower motor—which is usually part of the furnace—to blow the cool air through the duct system. The only way to ensure that your new air conditioner performs at its rated efficiency is to replace your heating system at the same time. It's especially recommended if your furnace is over 15 years old. If you purchase a new energy-efficient air conditioner but connect it to an older furnace and blower motor, your system will not perform at its rated efficiency.

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Heat Pumps

Heat pumps provide both heating and cooling in one integrated system.

Electric Air-Source Heat Pumps (ASHPs): ASHPs, often used in moderate climates, use the difference between outdoor and indoor air temperatures to cool and heat. ENERGY STAR-qualified ASHPs have higher SEER and EER ratings than conventional models. They also have a higher heating and seasonal performance factor (HSPF), which measures the heating efficiency of the heat pump.

Geothermal Heat Pumps (GHPs): GHPs are similar to air-source heat pumps, but they use earth instead of outside air to provide heating, cooling, and often also water heating. Because they use the earth's natural heat, they are among the most efficient and comfortable heating and cooling technologies currently available. Although initially expensive, you can achieve significant cost savings on your energy bills over the long term. GHPs are most often installed in new homes and require a duct system.

Work with a Heating and Cooling Contractor

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Whether you want to schedule an annual equipment maintenance check-up, or you've decided that you need to purchase and install new heating and cooling equipment, you'll need to hire a contractor.

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The following sections will help you find the right contractor, get a signed agreement on the work to be done, and get quality and value from the contractor and your new equipment. Many of the following recommendations also apply if you choose to work with a contractor to make other home improvements, such as home sealing or duct work.

Choose the Right Contractor

A reputable contractor should:

- perform an on-site inspection of the work you want completed and provide a detailed bid in a timely manner;
- demonstrate to you that the company is licensed and insured to repair and install heating and cooling equipment (many states require this);
- be able to provide his/her certification for refrigerant handling, required since 1992;
- have several years of experience as a business in your community, and provide examples of quality installation of energy-efficient heating and/or cooling equipment work, with names of customers that you can contact;
- complete and submit the warranty information card on your behalf. S/he should leave you with all the owner's manuals.

S/he should also provide documentation of installation procedures, including sizing calculations, AHRI certificate, and records of any measurements or testing; and

- clearly explain the benefits of regular maintenance, and help you set up a schedule to keep your system operating at its best.

Sign an Agreement Before Work Begins

Both you and your contractor should sign a written proposal before work gets started.

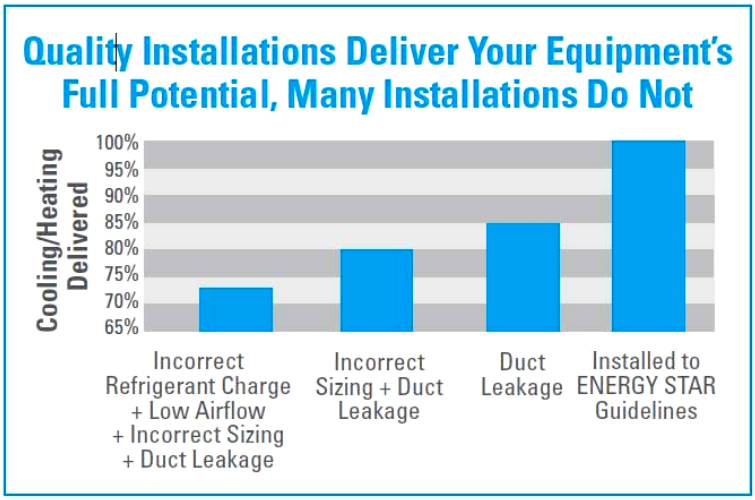
The agreement or proposal should:

- list, in detail, all the work that is being contracted;
- show you a layout of where the equipment is going to be installed;
- specify all products by quantity, name, model number and energy rating;
- provide equipment documentation and the manufacturer's warranty;
- provide the contractor's own installation warranty (if applicable);
- provide the contractor's liability licenses and insurance, if required by your state;
- outline any paperwork and permits needed for the project;
- give the payment schedule;
- state the scheduled start and completion dates; and
- describe how disputes will be resolved.

Get an ENERGY STAR Quality Installation

Replacing your old heating and cooling equipment with new, energy-efficient models is a great start to lowering your energy costs. But to make sure that you get the best performance, the new equipment must be properly installed. In fact, improper installation can reduce system efficiency by up to 30%—costing you more on your utility bills and possibly shortening the equipment's life.

Make sure to ask your contractor if his/her work meets ENERGY STAR Quality Installation guidelines. These guidelines are based on specifications for quality installations written by the Air Conditioning Contractors of America (ACCA). They require:



Proper Sizing of Equipment

Installing the right-size equipment for the home is essential to getting its best performance and optimum comfort. Many homeowners believe that bigger is always better when buying new heating and cooling equipment. In reality, a system that's too large will not keep your home comfortable because of frequent on/off cycling. Incorrect sizing can also put stress on the system's components and shorten the equipment's life. With an ENERGY STAR Quality Installation, your contractor will make sure that you get a system that's the right size for your home.

Sealing Ducts

To help ensure that your new system delivers the heated/cooled air to all the rooms of your home, contractors using ENERGY STAR Quality Installation guidelines will evaluate your duct system to identify leaks, and then seal them using mastic, metal-backed tape, or an aerosol-based sealant. In some instances, your contractor may advise you that it is necessary to replace or add ducts.

Ensuring Proper Refrigerant Charge

The incorrect refrigerant level can lower your system's efficiency by 5 to 20% and can ultimately cause premature component failure, resulting in costly repairs. With an ENERGY STAR Quality Installation, your contractor will verify that the refrigerant level in the system is correct.

Optimizing Air Flow

If air flow in your heating and cooling system is too high or too low, you may experience comfort problems and higher utility bills. With an ENERGY STAR Quality Installation, your contractor will test air flow and make any needed adjustments for optimal performance.

When purchasing heating and cooling equipment, choosing energy-efficient products is a step in the right direction. However, asking the right questions of your contractor and making sure your equipment is properly sized and installed are also important factors for ensuring that your new system will perform at its optimal efficiency.

Quality Installation Checklist

When installing your new heating and cooling equipment, your contractor should do the following to ensure a quality installation:

- provide adequate room around the equipment for service and maintenance;

- install and set up a programmable thermostat (if not already in use);

- show you how to change the filter(s);

- test and verify adequate air flow (if you have a furnace or heat pump);

- verify that your furnace or boiler has been tested for proper burner operation and proper venting of flue gases. The vent piping should be inspected for leaks and deterioration and repaired or replaced as necessary;

- install a properly matched indoor coil when replacing an outdoor unit. An old coil will not work efficiently with a new outdoor unit;

- confirm that the level of refrigerant charge and the air flow across the indoor coil meets the manufacturer's recommendation. It's estimated that more than 60% of central air conditioners are incorrectly charged during installation; and/or

- place the condenser in an area that can be protected from rain, snow and vegetation, as specified by the manufacturer. If you have a central air-conditioning unit, cover your outside equipment during the winter to protect it from snow and ice. Heat pumps need to be left uncovered to operate properly.

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