



Inspecting a house for inefficiencies is the first step toward optimized comfort and minimized utility costs

BY JEFFERSON KOLLE

Every House Needs

Measuring air infiltration, then pinpointing its location. One of the most valuable scientific tools an auditor can use is a blower door, which is mounted temporarily on an exterior-door frame. The blower door's calibrated fan pulls air through the building, measuring the amount of air leaks. While the fan is operating, an auditor uses a smoke stick to locate the leaks. Smoke pulls away from the leaky spot and toward the blower door.



Don't give free audits the cold shoulder

In the bill from her gas company, Leslie MacKensie of Minneapolis learned that she could have a free energy audit performed on her house, so she made an appointment. After assessing the 1915 bungalow, the auditors showed her air leaks and other problems that resulted in a monthly bill of \$110. The auditors left her with weatherstripping and foam-insulation pads to install, along with a list of other needed improvements.

Chipping away at the list has had dramatic results. Even after she expanded her home with a small addition, her current gas bill averages \$80 a month. "Almost as important," she says, "is that now our home is really comfortable to live in all year round."

Home-energy auditing—the process of diagnosing and recommending improvements to reduce a house's energy consumption—is not a new idea, but the reasons to get an audit are more pressing as concerns about costs, comfort, personal health, and the environment loom large.

Along with free or reduced-cost audits offered by utility companies, an increasing number of private companies perform audits. And while an old leaky house might be the obvious choice for an energy-waste diagnosis, new houses can benefit, too. The results can be an excellent marketing tool for builders and can help homebuyers qualify for an energy-efficient mortgage, which uses energy-cost savings to lower debt-to-income ratios.

The most important thing to note about energy audits, however, is that they don't save money or energy. Implementing the recommended improvements is how the savings happen.

There are two types of audits

Audits vary in complexity from an unscientific but learned assessment to one that uses an assortment of diagnostic equipment to measure the performance of a house and its systems.

an Energy Audit

The unscientific assessment typically consists of a thorough two- to three-hour walk-through, during which the auditor makes a visual inspection; takes photographs; and records information about the size of the building and specifics about the assumed efficiencies of the insulation, the appliances, and the HVAC system. (For instance, he might know how fiberglass batts should be performing but can't tell if they were installed properly.)

The scientific approach, which takes four to six hours to complete, uses diagnostic equipment to record and quantify a home's energy shortcomings. The auditor completes a walk-through of the house, but he doesn't stop there.

The first step is often a blower-door test. After closing windows, exterior doors, and often flues, the auditor turns on a calibrated fan mounted in an airtight frame temporarily set in an exterior door (photo facing page). The fan reduces air pressure inside the building, pulling air in through all the holes in the building envelope. Depending on the blower door's supporting software, the auditor quantifies the number of air changes the house goes through in an hour (expressed as ACH) as well as the combined size of all the air leaks. In an old house, those leaks can easily equate to leaving the bottom sash of a double-hung window open all year long.

To pinpoint where air infiltration is happening, the auditor holds a smoke stick or smoke pen in front of doors, windows, or other suspect building penetrations (inset photo, facing page). The pen emits a chemical smoke that wafts away from the leak and toward the fan to

President Jimmy Carter's 1977 Energy Policy Act required utility companies to provide energy audits to their customers. These programs have helped hundreds of thousands of homeowners to tune up their houses. One advantage of many utility-company audits is that they might also give you some free products, such as compact-fluorescent light-bulbs, or perform remedial work, such as air-sealing and weatherstripping.

Although it might seem contrary, utility companies want homes to save energy. It helps them to manage peak power loads, the times

of day or season when energy use is at its greatest. Plus, it's not bad for a company's public relations. And an electric company can actually save money if it doesn't have to construct new power plants.

Don't be surprised if a so-called "free audit" comes with strings attached, though. An electrical utility in Connecticut, for example, has a great-sounding program. But for the program to be free, the house must be heated with gas or electricity; otherwise, the service costs \$300.

Most experts agree that **air infiltration** is the

identify air infiltration. The auditor makes a note of the location and later suggests how to seal the leak.

A blower-door test can find air leaks in heating and cooling ductwork that runs through unconditioned spaces, such as an attic or a crawlspace. But it can't find leaks in ducts that run through the conditioned space, such as walls and floors. A tool made specifically for that job is a calibrated airflow-measurement device called a duct blaster. After turning off the blower door and taping over the floor, wall, and ceiling registers, the auditor connects the blaster to a central return in the system and measures its airtightness. Leaky ductwork can lead to substantial energy loss, which can be especially costly when that loss is happening in an unconditioned space.

Perhaps the best qualitative scientific tool an inspector pulls out during a diagnostic audit is an infrared thermograph, a camera-style device that shows the relative temperatures of objects portrayed as a kaleidoscopic image (photos p. 46). The colors reveal heat loss or gain, which indicates if a wall or attic floor is insulated, for example, and how well that insulation is performing. It also can identify moisture problems and leaky pipes behind the walls.

The auditor might also use a combustion analyzer and flue-gas monitor to measure the efficiency of boilers and furnaces (photo facing page). Finally, he plugs in an electricity-use monitor near appliances like the refrigerator to determine their efficiency.

Proponents of these diagnostic audits say that scientific measuring allows individual house components

to be assessed as part of a whole system in which change to one part affects another. For instance, extensive air-sealing could make the building too tight and result in a furnace's flue gases being sucked down a chimney and into the living space—something that might not be detected without testing. This systems approach might also show that increasing insulation levels would allow a home to be heated by a smaller boiler. Test equipment can measure these kinds of occurrences, whereas a strictly visual inspection results only in an educated guess. The other main reason to use testing equipment is that retesting can determine the success of the recommended improvements.

Steve Luxton, regional manager for CMC Energy Services (www.cmcenergy.com), disagrees with the need for scientific testing. Luxton's company has trained more than 1000 energy auditors, 90% of whom are working as home inspectors, the folks that mortgage companies require you to hire before they'll lend you money. "These guys already know what to look for in a house," says Luxton. "[They] don't need a fan to tell you where the leaks are."

His point is well taken; most experts agree that air infiltration is the No. 1 cause of energy loss in any house. Most buildings have common air-infiltration areas that are easy to spot if you know where to look.

New homes need audits, too

There are a number of reasons to have a new home audited as well, not the least of which is to ensure



Making the improvements. Sealing leaky windows and air ducts, and adding insulation are the most common improvements auditors suggest. Attics can be the largest culprit for air and energy loss. For more on sealing and insulating an attic, see "Attic-Insulation Upgrade" on pp. 68-73.



A duct blaster is not quackery. Similar to a blower door, a duct blaster is a calibrated fan. It is used on buildings with forced-air heat or central air-conditioning. Leaking ducts can decrease the overall efficiency of your heating and cooling system by as much as 20%.

No. 1 cause of energy loss in any house

that the building envelope and mechanical systems are performing as they were designed to perform. The Residential Energy Services Network (RESNET; www.natresnet.org), a not-for-profit membership corporation, has developed an index called the home-energy rating system, or HERS, that both predicts and confirms a new home's energy performance. The HERS index can be used to evaluate a home's plans and specifications before it is built, then assign it a number from 0 to 100. A house that scores a 0 is said to be net zero, meaning it uses no net purchased energy. A home that scores 100 is built to the energy specs of the 2006 *International Residential Code (IRC)*. Once the house is completed, it is tested by a RESNET auditor using scientific-testing equipment to ensure that the as-built house conforms to the as-planned HERS rating.

The reasons to get a verified new-house HERS rating are fourfold. Not only can a HERS-index rating help homeowners to qualify for an energy-efficient mortgage, but it also assures them that building efficiencies have been verified by an independent third party. The HERS rating is also an excellent marketing tool, and it helps builders to qualify in the Energy Star program.

How to hire a qualified auditor

As home-energy audits become a more important part of building and owning a home, more and more auditors are entering the field. Free audits are available from local utility companies, but this avenue has its pros and cons (sidebar p. 43). Independent auditors tend to offer various packages that can be tailored to a home's needs and the client's goals, but look for an auditor who has been certified by CMC Energy Services, Building Performance Institute (BPI), or RESNET.

Although they don't provide diagnostic testing of a home, CMC Energy Services auditors are screened and complete energy-inspector training. CMC-trained auditors pay \$300 and spend two classroom days learning about energy fundamentals; they also receive instruction in how to use the company's proprietary reporting software. Online refresher courses keep inspectors up to date. CMC maintains a searchable database so that you can find an inspector in your area.

BPI (www.bpi.org) in Malta, N.Y., trains auditors to use diagnostic-testing equipment. To get BPI accreditation, an auditor goes through "a rigorous, credible, and defensible written- and field-examination process administered to individuals by BPI or its affiliates," according to BPI's Web site. BPI affiliates,



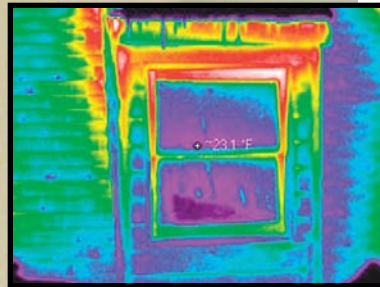
such as the Metropolitan Energy Center in Kansas City, Mo., are trained to give exams to prospective auditors. Then BPI awards certification to those auditors who pass the tests.

According to Dustin Jensen, associate executive director at Metropolitan Energy Center, a 40-hour auditor-training class costs \$1000, and the examination costs about \$500, if there is no government subsidy involved, which there often is. Affiliates are allowed to set their own prices for training, so they vary across the country. A searchable database of

Tools for a furnace tune-up. Your heating and air-conditioning systems could be the third-largest energy-wasting devices in your home. An auditor can use a combustion analyzer and flue-gas monitor to measure the efficiencies of your systems.



A **thermograph** shows a kaleidoscopic image of the problems lurking **behind your walls**



Infrared imaging paints an informative picture. Auditors can use a thermographer, or infrared camera, to locate differences in the temperatures of a house's parts. The image in the handheld infrared camera shows cold spots in blue around the warmer crown molding, indicating insulation voids. In the inset photo, taken outside in the winter, heat loss from inside the house appears in red and yellow. Cooler areas of the exterior wall appear blue. An auditor will use images like this to indicate un- or under-insulated areas, air leaks, and even moisture problems.

all BPI-certified professionals is maintained on the Building Performance Institute's Web site.

RESNET has a similar teacher-mentor system. RESNET trains providers, who then train raters, who are the folks that do the audits. Certification requires a week of classroom time, and the cost varies from \$1200 to \$1500, depending on the provider. A list of providers and raters is available on the RESNET Web site.

The Department of Energy's Energy Star program is not involved directly in the certification of auditors, but Energy Star endorses both RESNET and BPI auditors in two separate programs. In the first program, Energy Star Qualified New Homes, houses must score at least an 85 on RESNET's HERS-index rating. The second program, Home Performance with Energy Star, currently has locally sponsored programs in 21 states that help homeowners to improve a home's energy efficiency cost-effectively. The contractors that participate in the program are BPI-certified and are listed at www.energystar.gov.

Regardless of certifications, ask any auditor you might hire for a list of customers you can contact to find out if they were satisfied with the auditor's work.

Consultant or contractor?

There are two schools of thought about whom to hire to perform an energy audit on a home. One says that a disinterested third party is the most trustworthy opinion, while the other argues for the convenience of hiring someone who can pinpoint the improvements needed and then perform the work.

Brian Smith of Energy Saving Comfort Systems (www.escs1.com) prides himself on the fact that his company isn't selling anything other than testing services. When he sits down with customers to review what his blower door and infrared camera have detected, they know that "I'm not then going to try to sell them new windows or a furnace." CMC's Luxton concurs: "We feel strongly that an audit should be performed by an unbiased person."

John Jennings is an energy auditor with Steven Winter Associates, an architecture/engineering research and consulting firm in Norwalk, Conn. He favors the idea of independent auditors who can provide a list of vetted contractors that can make the recommended improvements.

Inset photo this page: Courtesy of What's Working

Mike Rogers, senior vice president of business development for Green Homes America, a Syracuse, N.Y., firm that tests homes and then does improvement work, disagrees. "Would you take your car to one guy to tell you what's wrong with it and then to another to do the repairs?" he asks. Some companies, including Green Homes, even have a financing program for energy-performance upgrades.

Costs and reports vary

Whether a basic inspection or an in-depth scientific test, an auditor's findings will likely be output from software that not only takes into account the physical data about the structure but also data about utility bills, the local climate, and, possibly, comparative information from other houses.

A CMC-trained auditor will generate a report about the existing house's needed improvements, including a cost-benefit analysis and payback time in years. CMC doesn't control what its inspectors charge, but Luxton says audits cost from \$200 to \$400, depending on the size of the house.

RESNET auditors are licensed to use company software that produces a HERS-index report. An audit with a HERS report (report fees can run around \$150) costs from \$1000 to \$1500. While BPI doesn't supply its own software, there are independent programs available that auditors can choose.

An audit from BPI-accredited TerraLogos in Baltimore costs \$495, and though it is thorough in its assessment of and recommendations for the house's existing systems, it does not predict energy savings if the suggested upgrades are carried out.

On the other end of the scale is a soup-to-nuts audit done by a company such as Steven Winter

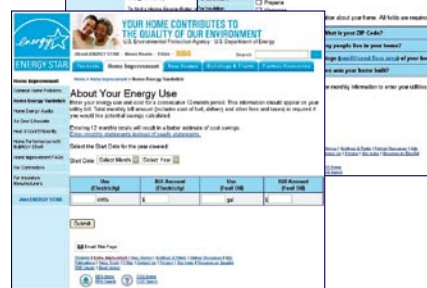
Associates. Along with a basic inspection of a house up to 4000 sq. ft., which includes no scientific testing, the a-la-carte audit menu could include a blower-door test, a duct-leakage test, appliance-combustion testing, infrared-imaging, energy-modeling, and a HERS rating. All this adds up to an audit that costs upward of \$2000.

What's next for energy audits

The business of energy-auditing is getting huge. "It's at a tipping point," says Courtney Moriarta, senior engineer at Steven Winter Associates. "Not only do homeowners think it's a cool thing to do, but it's also being driven more and more by energy-efficient mortgages and potential tax credits." Both Massachusetts and California are working on legislation that will require house sellers to divulge energy-audit information to prospective buyers.

Also on the horizon is a joint energy-auditing standard between RESNET and BPI (which could be adopted by Energy Star, too). The main reason for the standard is to clear up confusion among homeowners, but the reciprocity between the two organizations will also help auditors, many of whom have previously felt the need to get accreditation from both nonprofit groups. Steve Baden, executive director of RESNET, says that the standard will recognize the efficacy of all types of energy audits and auditors from "the DIY type to the guy with the clipboard and flashlight to the guy who also uses a blower door and an infrared camera." □

Jefferson Kolle is a former editor at *Fine Homebuilding*. Photos by Chris Ermides, except where noted.



Online audits can help you save, too. Spend some time with online home energy-savings applications, and you could realize substantial savings on your energy bills (sidebar below).

FineHomebuilding.com

Check out the Magazine Extras section of our home page to see a video of a home-energy auditor in action.

DIY online audits

Before you schedule an audit, you might want to check out the many online do-it-yourself energy-audit programs. Although they don't require any scientific-testing equipment and some suggest lots of behavior modifications—turn down your thermostat, take shorter showers—their computer

applications will give you guidance and information about energy improvements. According to Energy Star's John Passe, "A homeowner who follows these programs to a T might save 20% to 30% on his energy bills." Along with your local utilities, here are some sites to try.

- **Home Performance with Energy Star**, the branch of the organization that deals with existing homes, has three auditing tools you can complete online at www.energystar.gov. After entering data about your utility bills, the Home Energy Yardstick gives you a 1 to 10 rating on your consumption as compared to others in your

area. The Energy Star Home Advisor gives you savings recommendations based on your ZIP code and utility use. Energy Star at Home offers room-by-room and lifestyle energy-saving tips.

- **The Home Energy Saver** (<http://hes.lbl.gov/>), developed by Lawrence Berkeley National

Laboratory, is sponsored by several government agencies and is visited by about 750,000 people a year. To start, all you do is enter your ZIP code; hours later, you will have gathered tons of valuable information.

- **The Alliance to Save Energy**, a nonprofit funded by private grants and government agen-

cies, sponsors Home Energy Checkup (www.ase.org). According to the site, you can select from more than a dozen energy-efficiency measures, see how much money and pollution you can save, find out where to get energy-efficient products, and get tips on how to act on your choices.