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HEATING & AIR CONDITIONING

Todd Brock

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Home Heating & Cooling For Dummies®, Service Experts Special Edition
Published by
John Wiley & Sons, Inc.
111 River St.
Hoboken, NJ 07030-5774
www.wiley.com

ISBN 978-1-119-06275-2 (pbk); ISBN 978-1-119-06332-2 (ebk)

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

Publisher's Acknowledgments

Some of the people who helped bring this book to market include the following:

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Business Development Representative: Kimberley Schumacker

Project Coordinator: Melissa Cossell

Special Help: Jill Johnson, Strategic America; Rob Haines, Service Experts Heating & Air Conditioning; and Dave Moody, Service Experts Heating & Air Conditioning

Introduction

The ability to manipulate the temperature inside our homes and completely control our comfort — right down to the degree, no matter the weather — is what separates humans from every other species on the planet. (Well, that and common sense and reasoning and that whole opposable-thumb thing.)

But despite having this genuinely amazing technology right at our fingertips (literally), many of us don't give our homes' heating and cooling system a second thought. Your heating, ventilation, and air-conditioning (HVAC) system shouldn't require constant attention, but it shouldn't be taken for granted, either. If you haven't considered yours within recent memory, you could be faced with a home that's too hot or too cold, indoor air that's loaded with dust or allergens (or worse), or even an inefficient heating and cooling system that's wasting energy and money with every utility bill.

Whether your current system is on the fritz or you're just thinking it may be time for an upgrade, *Home Heating & Cooling For Dummies,* Service Experts Special Edition, is ready to help you make a smart decision.

About This Book

This book contains eight short chapters that are meant to give you a basic understanding of your home's HVAC system and serve as a guide to upgrading either a single component or your home's entire heating and cooling system. Topics include a rundown of the best features of today's furnaces, air conditioners, and heat pumps; emerging "green" technologies that increase energy efficiency while decreasing your environmental impact; the importance of often-overlooked items such as your home's ductwork and even the thermostat; some of the air quality issues that can be anything from a nuisance to a health hazard in your home; and questions to ask when choosing an HVAC contractor to perform work inside your home.

Foolish Assumptions

Here's what I'm assuming about you, the reader of this book:

- You're in the market for new HVAC equipment or you think you might be in the very near future.
- You're willing to do some homework on the ins and outs of making a major home purchase like a furnace or air conditioner.
- You don't want to buy the first piece of equipment shown to you; instead, you want to research various options and features to find the HVAC system that's the perfect fit for your home and lifestyle.
- You recognize the upside of considering new state-of-the-art technology.
- You understand that you're not just buying an appliance, but entering into a working relationship with an HVAC professional who will help to create the right whole-home comfort system for you.

Icons Used in This Book

Throughout this book, I call your attention to key pieces of information with the following graphic icons:

The Tip icon highlights an extra piece of information that will be helpful to you as you do your research and, ultimately, make a decision about new heating and cooling equipment.

Pay close attention to any info marked with the Warning icon. It's there to keep your family safe or prevent you from making a potentially costly error.

Chapter 1

Knowing When to Replace

In This Chapter

- Evaluating your existing system
- Examining the comfort level of your home
- Understanding what to expect when it's time to buy

If you're reading this book, you probably already suspect there may be a problem with some part of your home's heating, ventilation, and air conditioning (HVAC) system — the mechanical equipment and internal infrastructure that are responsible for heating your home in the winter and cooling your home in the summer.

But replacing a furnace or an air conditioner, upgrading an entire home's worth of ductwork, or making the switch to a more environmentally minded piece of green-technology equipment is a big decision for a homeowner. It's possible that you've picked up this book hoping to find a legitimate reason for riding out your current HVAC system for a while longer.

This chapter starts exactly where you're starting: at the beginning, trying to determine if new heating or cooling equipment, or even an entire HVAC system, is in your immediate future.

Watching for the Warning Signs

The signs can come slowly, creeping up on you gradually over time. Maybe the house doesn't feel as comfortable as it used to. Perhaps your utility bills have gotten a little higher than you remember them being.

Just as your body uses aches and pains, bumps and bruises, and noises and sensations to tell you when it's time go see a doctor, your home's heating and cooling system has a variety of ways to warn you when something is wrong.

Here are just a few of the telltale symptoms that you should be on the lookout for. None of them automatically means you must drop this book immediately and call an HVAC contractor, but any one of them is a pretty good indication that it may be time to start doing some more homework.

Frequent repair costs

Pieces of machinery wear out and break down. Your furnace one day needing a new blower fan or the AC unit eventually requiring a relay switch replacement is no big deal. It's part of the total package of owning a home that contains large and sophisticated pieces of mechanical equipment.

But by and large, a well-maintained HVAC system should just work, without much fixing or repairing along the way. Just as with our automobiles, you'll probably get a sense of when it's starting to turn into "It's always something." If you're calling a service technician repeatedly for the same issue, or needing multiple visits during the same heating or cooling season, or constantly writing checks simply to keep the house comfortably warm or pleasantly cool, it's time to look into why.

One good rule of thumb: If annual repair costs reach 50 percent of the present value of the heating or cooling system, it's likely time to replace.

Energy inefficiency

As a homeowner, it doesn't take long to begin to see a pattern in your utility bills. Compare your bills from year to year. Are you spending more for heating and cooling than you did last year, even though you haven't touched your thermostat? When you factor in possible rising utility costs, are the price increases otherwise unexplainable? Read those numbers on your statement closely: Are you simply using more energy for heating and cooling than you used to? That may be a sign that some part of your HVAC system is weakening.

Many companies can provide a residential energy audit. If you've never had one performed in your home, it can be a fascinating glimpse into the inner workings of your house's construction. Although an audit can point to easily remedied inefficiencies like weather-stripping around doors and windows or attic insulation, it may also be the first step in determining if your furnace or air conditioner is giving up the ghost. Older units can be very inefficient, while newer technologies are much more efficient at heating and cooling your home.

Another reason to look at energy usage? Upgrading to a high-efficiency system could mean tax credits or utility rebates and incentives to help you recoup the costs of the new system.

Old age

No one likes to be replaced simply for being "too old." But those pieces of HVAC equipment were never designed to last forever. Newer, better, more efficient technology is coming out all the time.

Think of it as you do your computer. For most of us, it has become an unavoidable reality that we just have to bite the bullet and upgrade our system every few years, to keep pace with the rest of the world.

HVAC equipment has a shelf life. Anything past that shelf life, and you're living on borrowed time. So, how long is that shelf life?

- **Heat pumps and air conditioners:** For a heat pump or an air conditioner, it's ten years, on average. Anything older than that just isn't as efficient as it should be, and it's costing you money every single day. A high-efficiency system can save you up to up to 30 percent or more on heating and cooling expenses.
- **Furnaces or boilers:** The magic number for a furnace or boiler is 15 years. Many older furnaces operate at an efficiency of just 65 percent or worse! A replacement that's been qualified with the Energy Star rating (more on this in Chapter 4) can be up to 30 percent more efficient, and that's a difference you'll notice immediately.

Excessive noise

Almost every piece of machinery makes noise when operating, and you've probably grown accustomed to the normal sounds that come from your heating and cooling units. If, however, you find that you have to raise your voice to talk over your running air conditioner or furnace, it may be an indicator that your duct system is undersized, and too much air is being pushed through too small an opening.

Other unusual noises — squealing, rattling, clanking, or banging — can be signs of a mechanical problem. It could be as simple as a worn belt or bad bearing, but it may mean an internal component of the unit has loosened or come completely disconnected.

Today's latest systems operate more silently than ever. Often, you'll have to really pay attention to even know when they're running. If noise pollution is an issue for you, that may be reason enough to upgrade to more modern equipment.

Temperature and comfort issues

Is your home just not comfortable, no matter how much fidgeting you do with the thermostat? If you're having to constantly jack up the furnace or keep kicking that AC lower and lower to keep things in the house cozy, it should be a major red flag that it's time to re-evaluate your HVAC system.

This issue may be resolved with nothing more complicated than a new thermostat, one that allows for more control. Before you assume that you're in for a whole new furnace or air conditioner, give some thought to your thermostat. You'll find more about this easy fix in Chapter 6.

Humidity issues

Humidity — the moisture that's present in the air — is generally thought of as a weather issue for outdoors. But there's humidity in the air inside your home, too, and it can dramatically affect how comfortable you feel inside your home.

Too much humidity in the summer forces your AC to work harder to try to remove that moisture in order for you to feel

as cool as you want. In the winter, low humidity makes the air inside your home feel colder than it is, often tricking you into bumping up the heat.

Excessive humidity can result in foggy windows in the home, a musty odor, noticeably moist air, or even clammy skin. If your humidity is too low, dry air, sore throats, and chapped skin are common complaints. Improper humidity can even negatively impact wood floors and furniture.

Today's best heating and cooling equipment helps to keep this precious balance right where it should be, adding or removing moisture before it ever enters the HVAC system.

Air quality issues

Heating and air conditioning are the stars of the HVAC show, but don't forget about the V: ventilation. Many issues that don't directly relate to temperature can be improved significantly with an expertly designed and properly installed HVAC system.

Basic household odors, airborne allergens such as pollen and pet dander, bacteria, mold, germs, ozone, and even plain old dust can wreak havoc on the air your breathe in your own home. If you're experiencing problems with any of these issues (I get into them more in Chapter 7), consulting an expert HVAC contractor can start you on the road toward correcting them.

Boning Up on the Buying Process

So, let's say that after you do all your homework, you discover that you do, in fact, need a new furnace or air conditioner. Or maybe you've decided to upgrade to green technology, replace your home's ductwork, or do a total overhaul of the entire HVAC system.

That can be a daunting prospect for a homeowner. To help make it a little less intimidating, here's a quick summary of how the buying process should generally go.

It starts with talking to HVAC contractors. Describe your HVAC issues or concerns and let the contractors do their thing. Don't try to troubleshoot the cause of the problem for them; let them use their professional expertise to investigate it fully for themselves. Your contractor should then present you with a suggested solution and a written estimate that details the work to be performed, the equipment to be installed (perhaps with multiple options), the total price, and additional considerations such as warranties, service plans, and even financing options that can allow you to purchase a better system for less of an initial cash outlay.

After your estimates have been collected and studied, it's time to award the job to someone. Chapter 8 has a few hints and questions to ask that should help you decide on the right contractor for the work.

When install day arrives, you should already have a good idea from your contractor of how things will progress. Most heating and cooling equipment can be installed in about a day, and that includes the removal of the old system. More complicated systems may take more than a day. And if a lot of ductwork is being moved around or replaced entirely, you may be looking at multiple days of work.

After the install is compete, your contractor should perform a full test of the new system, review everything with you, and give you a full debrief on how it all works and what you need to know in order to operate it, including the thermostat. Finally, you should receive any documentation that comes with the equipment — manuals, warranty paperwork, and so on — and be given a good expectation of what you need to do moving forward in regard to scheduling routine service and maintenance tune-ups.

Regardless of the contractor you choose or where you are in the buying process, it's important to remember that the furnace, AC, or heat pump are just a part of a larger system that also includes your home's ductwork, thermostat, and even insulation. Pairing the best mechanical equipment with substandard ducts, an outdated thermostat, or insufficient insulation won't provide you with the expected comfort and efficiency.

Chapter 2

Warming Up to Heating

In This Chapter

- Understanding furnace efficiency
- Figuring out which features are right for your family
- Looking at boilers and air handlers

Buying a new furnace is a big decision. It is, for all intents and purposes, a major appliance that your family will literally depend on every single day for a significant portion of the year. Think about it: If your dishwasher breaks down, it's an inconvenience. If your TV goes on the blink, it's a bummer. But if your furnace suddenly takes a dive in mid-January, it can become an emergency-type situation within hours.

And while you'll likely never show off your home's heating system the way you might a sleek new car or a state-of-the-art home theater, a new furnace represents a sizable investment, with most major brands averaging between $4,900 and $7,500. So, doing your homework and making a wise choice is critical.

This chapter sorts through the ins and outs of furnaces, from different types to consider to the features you should look for. Then you get a crash course in what to expect when it comes to the installation, maintenance, and service of whichever heating system is right for you and your family.

Finding Your Perfect Furnace

Given how little thought most people give to their furnaces, it may surprise you to learn that different types of furnaces even exist. Your HVAC professional can certainly help steer you in the direction of the type that's best for your home and your

family's needs, but here's a quick primer on the various types that are out there.

Gas furnaces

Natural gas is the most common heating fuel in use today. In turn, gas-fueled furnaces are the most popular choice for home heating throughout most of the United States.

Within this broad category, you'll find a dizzying number of furnaces available. Narrow things down by looking at the efficiency level you want. Many manufacturers and contractors break down the models they offer into tiers — for example, "standard," "moderate," and "maximum" efficiency.

If you're a scorekeeping kind of person, look for a furnace's AFUE rating. AFUE stands for *annual fuel utilization efficiency,* and it's an exact number assigned to gas furnaces that shows how well that particular model converts gas into heat. It's like gas mileage for a vehicle; the higher the number, the more efficient the furnace.

For example, an old furnace built in the 1970s may have an AFUE of under 65 percent, while modern technology offers furnaces with near-perfect AFUEs of 98 percent!

Of course, you can expect to pay more for that extra efficiency: An AFUE increase of 10 percent may translate to an extra thousand dollars on the price tag. But remember that you're paying for *efficiency,* so a higher-rated furnace burns cleaner and wastes less gas than a lower-rated model. That means you're more likely to recoup some of your investment over time in the form of lower utility bills.

Your HVAC pro can calculate the annual operating cost of any furnace you're considering (based on local utility rates) to help you get a clear picture of the real-world cost of your new furnace.

If you like the idea of having the most energy-efficient furnace you can get, but you're concerned about cost, most HVAC contractors offer financing plans that let you spread payment out over time — just as with a new car — to get more furnace for less cash upfront.

In addition to energy efficiency, you'll want to investigate some other key features when comparing gas furnaces. Noise, for example, is a big issue for many homeowners — no one wants a furnace that sounds like a freight train barreling through the house. But if your furnace will be tucked away in a well-insulated part of the home, decibels may not be a determining factor.

Here are some other features to ask about:

- **Air filtration:** Some furnaces come with specialized filters that trap airborne allergens, dust, and other contaminants. For some people, this is a nonnegotiable must-have. Learn more about how the right HVAC system can solve air quality issues in Chapter 7.
- **Dual heat exchangers:** The heat exchanger is what draws heat out of the gas fueling the furnace. High-efficiency models often use two heat exchangers to extract a maximum of heat.
- **Ignition system:** Older furnaces use a pilot light, an actual flame that stays lit 24/7 and ignites the burners on command. Newer models may employ a direct spark or other type of intermittent ignition to reduce energy consumption.
- **Variable capacity:** Some high-efficiency furnaces can operate at one, two, or modulating levels of output. Instead of always cranking at 100 percent, the furnace may run at a lower speed at certain times to use less energy while maintaining the desired temperature in the home.
- **Warranty:** Like any big-ticket purchase, most furnaces come with some sort of a warranty. Typically, the longer the warranty, the more it will cost.
- **Zoned heating:** For certain homes, this feature can make a dramatic impact on utility bills by dividing the house into zones with different heating needs. Rooms (or entire levels of the home) that aren't used often may comprise a different zone and need less heat than the main living spaces. Zoned heating can complicate the HVAC equation with extra thermostats, advanced control panels, and ductwork that can open and close automatically — and that may raise your maintenance and service requirements in the long run.

Oil furnaces

Furnaces fueled by heating oil are not nearly as widespread as gas furnaces, but those who have them often swear by them. Found largely in the Northeast, oil furnaces require the homeowner to have a contract with a company that delivers heating oil, which must also include an actual oil storage tank. Oil furnaces require regular service that can be fairly extensive with each visit, because there is a good deal of soot and dirt buildup that comes with running an oil furnace. Chimneys must be periodically checked and cleaned and oil filters changed regularly.

Oil furnaces are generally much less efficient than gas models; the very best oil-burning models max out with an AFUE of around 90 percent, making them far less energy-saving than some "entry-level" gas furnaces.

Finally, because the fuel is affected by the world oil market, oil prices can be significantly higher than natural gas prices. That means you'll pay more to fuel your oil furnace — maybe four times as much per year!

Still, in bitterly cold climates or where there simply is no natural gas service, oil furnaces may be the preferred choice. Your HVAC contractor can walk you through whether an oil furnace makes sense for your situation.

Boilers

Although boilers are components of some HVAC systems, they're really different animals entirely. Instead of pumping heated air around your home through a series of ducts, a boiler heats water or creates steam and routes it to the living spaces through plumbing pipes, where it warms each room via a radiator or baseboard heater.

Boilers are often associated with older homes, and typically, a homeowner would seriously consider buying one only as a replacement for one the home already has. Cost-wise, boilers are much more expensive than even the best gas furnaces.

But boilers do have benefits:

- They can use less energy to heat up than forced air furnaces.
- They run silently.
- They offer pinpoint zone temperature control.
- They keep humidity levels in the home comfortable.
- They don't blow dust and allergens through your home's air. (Be aware that they don't filter the air either.)
- They make it relatively easy to retrofit niceties like radiant floor heating into your home.

Air handlers

The air handler actually works with both the heating *and* the cooling components of your HVAC system.

At first glance, an air handler closely resembles a furnace and simply blows already-heated (or already-cooled) air through your ducts. Air handlers work with either an AC or a heat pump and contain the indoor coil used to either cool your home or (with the heat pump) cool and heat your home. And sometimes air handlers also have electric heating elements that can be used to heat the home or provide backup heat for the heat pump.

Confused yet? Don't be. Here's what you need to know: If you're shopping for a conventional furnace and/or AC unit, you'll likely never need to know what an air handler is. If you're in the market for an electric heat pump (which I cover in Chapter 3), know that an air handler is part of the equation and that your HVAC contractor can guide you through the different models and their features.

Understanding Installation, Maintenance, and Service

Installing a new furnace (either gas or oil) is usually a simple procedure for your HVAC contractor, and shouldn't take more than a day. But it's important to note that the comfort level in

your home depends not only on the physical piece of equipment itself, but also on your home's insulation, ductwork, and other factors. A furnace is not a "plug-and-play" appliance like a clothes dryer; the whole house is actually part of the system.

In other words, your furnace installation may require more than just putting in a new furnace. Your HVAC expert can determine if more considerations are needed to optimize the heating power you've just purchased. If you have ducts or registers that need to be properly sized, relocated, or replaced, the install may take quite a bit longer, depending on the scope of the work. (You can find more about the importance of ductwork to your overall HVAC system in Chapter 5.)

After your new furnace is installed, annual maintenance is recommended and is usually required by the manufacturer to keep the warranty valid. Just like your car, your furnace needs regular checks and cleaning for optimum performance. You may be expected to change the furnace filter once a month, or even less frequently in the case of some high-efficiency types. Your HVAC contractor can offer you a service plan that includes a full diagnostic check and tune-up of the entire system — usually performed in late summer, well in advance of when your furnace will be needed!

Chapter 3

Keeping Cool with Air Conditioning

In This Chapter

- Researching the ins and outs of central AC units
- Knowing which features matter most in a new unit
- Considering a heat pump to handle your cooling needs

There was a time (not that long ago, actually) when air conditioning was considered a primo luxury, the sort of ooh-la-la amenity that movie theaters and roadside motels would advertise on their signage as extra incentive to stay there on hot and muggy nights. Now, AC is practically a given on almost every part of the globe as a basic way to escape the heat and humidity of the warmer months.

As an expected part of daily life, most people don't give their air conditioners a second thought — until they suddenly stop working on some sweltering August afternoon. The time to replace your air conditioner is before you absolutely need to — to keep your home cooler, to lower your energy consumption and utility bills, or just to safeguard against your ancient cooling system dying during the dog days of summer.

But this isn't a purchase you should take lightly or go into unprepared. Buying even a basic AC system and having it properly installed can start at around $4,900; the price tag on a state-of-the-art model with all the latest innovations can easily top $10,000!

This chapter dives deeper into the air conditioner, showcasing some of the important features you should keep in mind

when shopping. I also show you how the best air conditioner for your home may not be an air conditioner at all, but an alternative piece of equipment that handles both cooling *and* heating. Finally, you gear up for the future with a look at the installation, maintenance, and service needs of your home's new central air-conditioning system.

Searching for Central Air Conditioners

In some areas of the country, air conditioning isn't used very often, and residents can get away with small window-mounted or portable appliances in a few key living areas to make their homes comfortable. But for most of us, an "air conditioner" means that big metal box that sits on a concrete slab behind our house and is responsible for cooling the entire home. That's called *central air conditioning,* and that's what I deal with here.

In the world of central air conditioners, there are *split systems* and *packaged systems.* The split system puts some of the equipment outside the home (usually at the rear or side of the home) and some inside, tying the two physical cabinets together with refrigerant lines. For residential applications, this type is more common than the packaged system, which puts everything in one physical structure, often located on the roof of the building it services (although some mobile homes or smaller homes with crawl spaces may find a packaged system preferable). Packaged systems often eliminate the need for a separate furnace, but they're far less efficient and ultimately cost more to operate. Moving forward through this section of the book, I talk about split-system central air conditioners.

The first thing to know about an air conditioner is that, technically speaking, it doesn't *cool* the air in your home. It actually just *removes heat* through a series of scientific principles at work inside its mechanical components.

Warm indoor air, pulled into the system through return ducts, passes across a refrigerant coil. (Perhaps surprisingly, this coil is located inside your home at the furnace or air handler, and is a good example of how heating and cooling systems work in tandem.) As the warm air is blown across the cooled coil, heat is extracted. Refrigerant lines then carry the heat

outside to the AC unit itself, where it's transferred to the outdoors. The now-cool air that's left over from that interaction at the coil is circulated throughout the house as what we call air conditioning.

How efficiently a particular AC unit makes all that happen is what separates the good from the great. This efficiency — or how much cooling power the unit actually delivers for each watt of electricity used — is expressed as the seasonal energy efficiency rating (SEER). Today's air conditioners start at a SEER of 13 and can go up to 26 or higher. The higher the SEER, the more energy efficient the system is.

Of course, there are other factors beside energy efficiency that you may want to consider when selecting a new air conditioner.

Single-stage versus variable capacity

A single-stage AC runs at one speed — 100 percent — every time it kicks on. It's either on or off, blasting the home with as much cool air as it can create — even if it doesn't require that much to keep the temperature where you want it. The result, as you may imagine, is less-than-optimum comfort (often either too hot or too cold with little in between) and a lot of wasted energy. Single-stage units are the least expensive, but don't offer the highest efficiency or best comfort. And they cost more to operate in the long run.

Alternatives to the single-stage unit include two-stage and variable capacity ACs. The compressor of a two-stage air conditioner can run at either a high speed or a low speed, depending on the need. It can maintain a desired temperature by running at its lower speed (about two-thirds of the compressor's max) for up to 80 percent of the time. This ability to ramp up only when needed means fewer "kick-ons" for the system.

Some newer ACs even feature variable capacity, which keeps the temperature exactly where you want it, providing precise comfort at the lowest energy cost.

Two-stage and variable capacity ACs leave the home feeling more comfortable more often, help with humidity issues (more on that in Chapter 7), and tend to have longer lifespans than

their single-stage counterparts. Yes, they cost more to purchase, but that increase in price is generally recouped over time with lower energy usage. And perhaps most important to some, they provide the greatest level of comfort.

Overall size

Air conditioners are categorized by size, in tons. This refers not to how much the unit itself weighs, but how much heat it can remove in one hour. A 1-ton unit, for example, is capable of removing 12,000 BTUs (British thermal units) in one hour, a 2-ton system removes 24,000 BTUs, and so on. The larger your home, the more BTUs you'll have to remove every hour to remain comfortable.

But the square footage of your home alone should never determine which AC you buy. There are many other factors at play, and only an HVAC professional can juggle all of them to come up with the perfect cooling system for you. See Chapter 8 for more on how a quality contractor will calculate your cooling needs based on the holisitic requirements of the home and your lifestyle.

Noise level

Some air conditioners can make a lot of noise. And depending on where your unit is located, that may be vitally important to you and your family. If your AC is to be placed close to a living space window or near a patio that sees frequent summertime use, you'll no doubt care about how much sound it cranks out.

Some units operate at close to 80 decibels — higher than a vacuum cleaner — which will certainly make you work to talk over it and may even wake you up at night. Others run at a level under 60 decibels, which is actually lower than conversational speech! They can be so silent, in fact, that you may not notice when they're on at all.

Solar readiness

Some air conditioners tap into the power of the sun to help decrease their own energy consumption. There's much more on solar heating and air conditioning in Chapter 4, but for

now, know that many air conditioners come ready to go solar — even if you're not yet. And because the AC you buy today may last you a decade or two, isn't it smart to be ready for the next technological advance?

Looking at Heat Pumps

If your overall goal is cooling your home, something called a "heat pump" may sound like an odd choice. But this piece of HVAC gear not only keeps you cool in summer, but also heats your home in winter, eliminating the need for both an air conditioner and a furnace! (Despite its name and double-duty nature, a heat pump is generally considered a piece of cooling equipment in the HVAC industry; that's why I discuss it here instead of in Chapter 2 with the furnaces.)

Best of all, heat pumps do both their jobs in an energy-efficient way, making them an increasingly attractive option for more and more homeowners.

Instead of converting gas fuel into heated air, an electric-powered heat pump merely *transports* heat that already exists from outdoors to the interior of a home. In summer, it extracts heat from indoor air and then moves that heat to the outdoor unit, where it's transferred to the outdoor air. In winter, the heat that is extracted from the outdoor air is what's sent indoors. (Even on a cold day, there's more than enough heat energy in the outside air to warm your home via a heat pump.) The fact that it's not *generating* heat — only *moving* it — is what makes the heat pump an energy-efficient marvel that will translate to lower utility bills.

Because they rely on the outdoor ambient air where you live, heat pumps tend to work better in moderate to warmer climates. If you're in a very cold region and want to go this route, a supplemental heating system may be necessary. And some homes may be best served by a heat pump/furnace combo called a *hybrid system* (see Chapter 4).

In addition to consuming less energy than more traditional HVAC components, a heat pump generally runs more quietly and can easily be matched with a variety of air filtration options. (You can find much more about air quality issues in Chapter 7.)

As you investigate heat pumps, you'll notice that their cooling efficiency is quantified by a SEER number, just like a standard AC unit. (Heating capability, however, is measured differently from that of a furnace, with a heating season performance factor [HSPF] score. Your HVAC expert can walk you through the formula used to arrive at the final figure, but higher is better.)

Because they heat *and* cool, you can expect to pay more upfront for a heat pump, but its higher efficiency will save you money on energy consumption and may well offset those additional costs sooner than you think.

Understanding Installation, Maintenance, and Service

An air conditioner is very difficult to install, and due to laws governing the sale and handling of potentially hazardous refrigerants, do-it-yourself installation isn't recommended. An HVAC professional should be able to make quick work of installing your new cooling system, completing the job in less than a full day.

But your cooling system's effectiveness also depends on your home's ductwork, insulation, register, and return placement, and even your thermostat. If modifications to any of these things is necessary, adjust your time (and cost) expectations accordingly, but know that the overall goal is a home that's perfectly comfortable for your family no matter what the weather outside is like.

Your installed cooling system should remain a hands-off appliance for you moving forward. Apart from changing the occasional air filter, your only responsibility should be to schedule an annual maintenance tune-up with your HVAC contractor prior to the cooling season. During this visit, a technician will run a full system test, check refrigerant levels, and give everything a proper cleaning before the first heat wave of the summer hits.

Chapter 4

Going Green with Environmental Energy Solutions

In This Chapter

- Using the power of the sun to efficiently cool your home
- Harnessing underground temperatures with a geothermal system
- Getting the best of both heating worlds with a hybrid system

United States Department of Energy statistics show that home heating and cooling accounts for 48 percent — *almost half* — of your home's annual energy costs. So, any method you can employ to cut that number means a little more money in your pocket. Not heating and cooling your home isn't really an option, but no one says you have to keep heating and cooling it in the same old expensive and energy-wasting ways.

The desire to be more environmentally friendly has led to a whole host of exciting new technologies that are far less harmful to our planet than many conventions that we as a society have come to simply take for granted. Best of all, many of these "green" practices are often less costly over the long run than "the way it's always been done."

This chapter explores a few of the up-and-coming alternatives to traditional furnaces and air conditioners to help you determine if they're solutions you should consider for your own home.

Soaking Up Solar Heating and Air Conditioning

The sun is the oldest energy source of all, and it's arguably still the best. But it's taken us humans a long time to figure out how to harness its infinitely renewable (not to mention free) power. Although we're still at the early end of the learning curve when it comes to solar energy, more and more people are realizing the benefits of using the sun to help heat and cool their homes through incredibly efficient systems that also have next to no harmful effect on the environment.

Most solar technologies depend on modules made up of photovoltaic (PV) cells, or what most of would us would generically refer to as "solar panels." These PV cells convert sunlight into electricity that, in a residential application, can be used to power lights and appliances, heat your household water, warm your swimming pool, or run your home's heating and cooling system.

Two types of solar systems

When you start basking in the nuts and bolts of solar energy, you'll find that there are two types of systems: stand-alone systems and grid-tied systems.

Stand-alone systems

As the name suggests, a stand-alone system is completely independent of the greater utility grid. Going "off-grid" with one of these systems means you're totally on your own: You generate all your own power, and all the power you create is yours to either use or store.

But there is no backup — you can't supplement your solar output with conventional means. Plus, setting up a stand-alone system can be a very expensive proposition, so be warned.

On the upside, though, it does eliminate your dependency on an electric company, and it stops those pesky bills from showing up at all. In some remote areas where there simply are no power lines, this may be the only way to go.

Grid-tied systems

A solar system that's connected to an area's electric utility grid is far more common and much less expensive. Power created by your system is yours to use, first and foremost. Whenever you're using your own solar electricity, you're saving money because you're not pulling power off the grid, and you're contributing to at least a little less energy being created by conventional means.

At times when your system is not producing its own power (like at night when the sun isn't feeding the PV cells), you're simply using regular electricity supplied by your utility company, the way you always have.

But here's where it gets really interesting. In cases where your solar system is generating more electricity than you're actually using, that surplus is transferred to the grid (in a process called *net-metering*) for the utility company to use — and they pay you for it!

With a net-metered, grid-tied system, the electric meter at your home will spin as normal when you're using the grid's power. The meter will actually slow and perhaps even stop as you use more and more of your own solar-generated juice. And then there's the favorite moment of solar fans: When you're supplying excess electricity back to the grid and your meter actually spins backward!

The long-term savings are a popular reason for going solar. But keep in mind that the government tax credits and utility company rebate incentives that can help make solar heating and cooling such an enticing option usually are available only with grid-tied systems. In the United States, to see what incentives are available in your area, visit `www.dsireusa.org`.

Using solar for heating and cooling

Harnessing solar energy to heat your home isn't much of a stretch. Using the sun to actually *cool* your home, though? That seems like an impossible oxymoron. But that's precisely what a solar air conditioner or heat pump does. A few

manufacturers now offer central AC units and heat pumps that can draw their power from solar cells instead of traditional electric lines.

Because solar technology is still making inroads with consumers, what you'll typically find is a lineup of air conditioners and heat pumps that are *solar-ready,* meaning that they can work like a conventional electric-powered AC, until you're ready to make the switch and install solar modules. That makes it even easier to adopt green technologies like solar, even if you're not all-in right out of the gate.

Solar-powered furnaces don't exist (at least not yet), because furnaces still require the physical burning of a fuel to heat the air that's then blown into your home. But heat pumps *can* be powered by sunlight, and they're an increasingly popular way to handle home heating (and cooling) in many areas of the United States. (For more on letting a heat pump do double duty for heating and cooling in your home, refer to Chapter 3.)

For all the benefits of solar-powered heating and air, it may not be for everyone. If you're seriously considering a solar system, schedule a meeting with your HVAC contractor to discuss all the nuts and bolts.

In the meantime, here are some questions to consider before you commit to going solar:

- **Do you get enough sun?** It's difficult to ascribe one magic number that says how much sunlight is enough to make solar power worthwhile. Factors for your home can include not only hours of sunlight, but nearby trees and buildings, the orientation of your home's roof (where the solar modules will be installed), your region's average snowfall, cloud cover, and even smog! These things can all impact your PV system's effectiveness.
- **How's your roof?** The solar modules will be mounted on your roof, so the structure itself needs to be up to handling the added weight. In addition, the direction that the largest portions of your roof face could determine your solar feasibility — southern-facing roofs receive far more direct sunlight. Finally, the size of your roof matters, because a single solar module eats up about 15 square feet of space, and you'll likely need more than one of them.

- **Can you even have solar modules?** In some areas, residential covenants and homeowners' association rules may prohibit the installation of solar modules on your roof, or at least require you to jump through some hoops to obtain permission. Your home's existing electrical system may not be equipped to handle the addition of solar panels. And doing your homework with the utility company before assuming you can just tie into the grid is definitely a good idea.
- **Do you have Internet access?** Many solar systems require an always-on Internet connection with a broadband router. This allows the system to send performance information to a monitoring website, where you can log in and track things like the system's status, energy production, and utility savings.

Digging Deeper on Geothermal Heat Pumps

Don't look now, but the answer to significantly lower utility bills and quite possibly the cleanest, quietest, most efficient home heating and cooling system you'll ever experience is right under your feet. Actually, it's way, way under your feet.

Dig far enough beneath the earth's surface, and the ground stays at a relatively constant temperature year-round. And that's the key to a geothermal heat pump's efficiency, which can cut your annual heating and cooling costs by as much as 70 percent!

A geothermal heat pump (GHP) is an electrically powered system that typically has a looping series of pipes buried deep underground. The pipes are filled with a pressured (and environmentally friendly) antifreeze/water solution that cycles through the system to capture and transfer heat, just as in a standard heat pump (see Chapter 3).

But whereas a standard heat pump has to work to change the temperature of the external ambient air, which can swing from stiflingly hot in summer to frigidly cold in winter, a geothermal heat pump works with that subterranean environment that's one mild temperature all the time, a much easier task.

As a result, a GHP uses far less electricity (half or even less) than a conventional heat pump to produce the same number of BTUs. GHPs are roughly twice as efficient as the best AC units at cooling your indoor air and about 50 percent more efficient than a top-of-the-line gas furnace when it comes to heating your home. In fact, the U.S. Department of Energy's National Renewable Energy Laboratory has stated that an average-size home with a geothermal heat pump can generally be heated and cooled for as low as $1 a day. And to further sweeten the deal, many GHPs can even heat your household water, doing the job for free in summer while cutting winter-time water-heating costs in half.

A geothermal heat pump is astonishingly energy efficient and quiet enough (because there's no exhaust fan) that it can be placed inside the house where zero exposure to the elements means less wear and tear. And after you buy a GHP, you won't be in the market again for quite some time — the units themselves often last two decades or more, and the pipes usually carry a warranty of up to 50 years!

So, what's the downside? For many, it's the initial cost of burying thousands of feet of pipe, which requires major digging and drilling — often hundreds of feet below ground. Every situation is different, but geography and geology could translate easily to a GHP upfront price tag that's equivalent to a new car.

There are several different configurations that the field of pipe loops can take, depending on how much accessible land space you have around your home. Some systems can even take advantage of a backyard pond if it meets volume and depth requirements, burying the pipes underneath the water's surface!

If the idea of using the constant temperature of the earth to keep your home constantly comfortable is appealing, talk with an HVAC contractor who deals in geothermal systems. There are usually nice tax credits and rebates available, and even with the most expensive dig-and-drill installation, you'll likely recoup your costs in less than ten years — or maybe as little as two!

Meeting Halfway with a Hybrid Home Comfort System

Hybrid cars made a big splash because of their capability to automatically switch back and forth between regular gas and electric power, depending on which is needed at any given moment. A hybrid home comfort system works in very much the same way, by combining a traditional gas-fueled furnace with a more efficient electric heat pump.

A conventional furnace delivers air that's around 130°F (54°C) to the living spaces of your home. In the dead of winter, that's great. But if it's merely an autumn evening with a hint of a chill in the air, that blast of hot air can be overkill for most people (and their utility bills). Likewise, a heat pump excels at supplying soft heat — 100°F (38°C) or so — that's just enough to provide optimum comfort.

Remember that a heat pump is using the outside air as its source for heat — transferring it to the interior of your home. So, the colder the outdoor air, the harder the heat pump has to work. At a certain point, air gets too cold for the heat pump to effectively maintain the thermostat's setting. (This point is usually around 25°F to 30°F [–1°C to –3°C] — and why heat pumps are generally not recommended in extremely cold climates.) This temperature is the heat pump's *balance point.*

A heat pump also has what can be referred to as an *economic balance point* — the temperature at which it actually becomes more costly to operate than a traditional furnace. This point is even higher — generally between 30°F and 40°F (–1°C and 4°C).

A hybrid system uses both a heat pump and a furnace to handle heating duties at various times. To combat mildly cool and even chilly temperatures, the energy-saving heat pump is plenty adequate with its gentle warmth. But when the outside temperature dips below the heat pump's balance point — and it would be more economical and energy-efficient to maintain the desired thermostat setting with gas fuel — the furnace automatically comes to life and takes over.

Defining "high-efficiency"

I cover furnaces in-depth in Chapter 2, but this is an appropriate place to discuss a key term you may hear while talking to your contractor about environmentally friendly HVAC equipment.

High-efficiency is a generic-sounding term that's used to describe certain furnace models. You should understand that a "high-efficiency" furnace is not a different *type* of furnace; it's merely a classification of furnace based on its annual fuel utilization efficiency (AFUE) rating.

Every furnace you may be considering features its own AFUE score, but the Department of Energy mandates that only furnaces with an AFUE of 90 or higher can technically be referred to as "high-efficiency." By way of comparison, furnaces more than ten years old may have AFUE ratings of 65 or lower. A high-efficiency furnace is certainly more energy-saving (and, therefore, more eco-friendly) than one with a low AFUE score.

Yes, a hybrid system requires two different pieces of heating equipment, and that increases your out-of-the-box cost. But keep in mind that it's the heat pump — with its low operating cost — that will see the most usage. Every minute that the heat pump runs is a minute of furnace fuel you're not paying for; you'll be billed only for the shorter periods of time that the furnace is fighting away the very coldest temps of the season.

Your HVAC professional can design a hybrid home comfort system that will both satisfy your heating needs (and the heat pump will take care of your cooling, too!) and translate to tangible utility savings. A contractor will even be able to calculate your monthly savings, which will help you understand exactly how long it will take to recoup your initial investment.

Chapter 5

Dealing with Ductwork

In This Chapter

- Getting to know your ducts
- DIYing your way to more efficient ductwork with easy fixes
- Working with an HVAC pro to upgrade your home's ductwork

While the rock stars of your typical HVAC system are the furnace and air conditioner, it takes more than just these big pieces of equipment to heat and cool your home. Without ductwork — the tubing or channels actually carrying the air around the home — the air that you've paid so dearly to carefully heat and cool can't get to the living spaces where it's needed.

But not all ductwork is created equally. And just as with the other components of your HVAC system, poor ductwork design, insufficient capacity, timeworn neglect, and other inefficiencies in your ductwork can rob your heating and cooling system and contribute to an uncomfortable home.

A top-of-the-line furnace and air conditioner are not enough to overcome bad ducts. If the heating and cooling units are like a heart, the ductwork is what makes up the arteries and veins. And if those aren't up to snuff, the crucial job that the heart is doing is ultimately wasted.

This chapter dives deeper into duct design. You'll learn easy and simple ways to improve upon your existing ducts, as well as options for upgrading the ductwork in your entire home to make your HVAC system as efficient as possible.

Understanding "Builder-Grade" Duct Design

The vast majority of homes have rather simple heating and air duct systems that were put in as the rest of the home was being constructed. A crew came in and spent a couple of days laying out and installing a basic duct design that meets the required codes, usually with the least expensive materials and a minimum of real design thought to maximize comfort and efficiency. (That may explain why, whenever you try to rearrange your furniture, there's always an air register in the very spot where you really want to put the sofa.)

There's nothing really wrong with that approach, per se, but it's a lot like "builder-grade" landscaping. Sure, there are some bushes around the house because there are supposed to be, and they allow the builder to check that box on his punch list, but it's the bare minimum. And while many homeowners spruce up the yard after they move in by upgrading their garden beds, few people go through the expense and hassle of improving upon the bare-bones ducts that cool and heat the air inside their homes every single day.

Residential HVAC duct design usually comprises two types of ductwork. *Supply ducts* carry treated air to the various rooms of the home. When the air is heated or cooled by the furnace or air conditioner respectively, it's routed through the ducts — pushed along the straightaways and through any necessary bends, turns, or splitters — until it reaches the register in a given room. This register can be found on the wall, floor, or even the ceiling of the living space and can often be identified by a lever that allows you to control and direct the airflow by opening or closing small vents just behind the grate.

The second type of duct is a *return duct*. Air return ducts are generally located on interior walls and don't have control levers or louvers. The simple grates allow circulating air in the living space to be pulled back into the ductwork system, where the return ducts move the untreated air back to the furnace or air conditioner to be reheated or recooled — and then redistributed as needed.

Improving Your Existing Ductwork

It's estimated that the typical home loses up to 20 percent of heated and cooled air through flaws in the ductwork. Although the idea of rooting around behind the walls, under the floors, and in the ceilings of your home to access your ductwork may sound like biting off more than you can chew, there are some simple things you can do as a homeowner to give your existing ductwork a fighting chance at doing its job better.

Before you assume that a major ductwork redesign is what your HVAC system needs, try these easy fixes to get a little more productivity out of your ducts. They may be enough to make a noticeable difference in your comfort level, or bridge the gap until you're ready to replace your whole duct system.

- **Move the furniture.** It may sound silly, but you'd be surprised at how much impact a sofa or bookcase can have on your heating and cooling if it's blocking a room's supply register or return vent. Remember that heating and cooling is largely about air circulation; anything that obstructs circulation makes the whole system work harder and decreases the overall output.
- **Have your ducts cleaned.** Dust and dander buildup in the actual ducts of your home can impede proper airflow, help breed allergens and biocontaminants, and blow debris and pollutants into your living spaces as well as your HVAC units. Consider having your ducts cleaned by an HVAC professional.
- **Take care of minor duct repairs.** If you have access to some of the ductwork — in an attic, crawlspace, or unfinished basement — inspect the joints where pieces of ductwork are attached to one another. Pieces that have become obviously disconnected or have visible gaps, kinks, or punctures are leaking air and keeping it from getting where it truly needs to go.

  Reconnect the fittings and seal any gaps either with duct mastic (similar to spreadable spackling) or with UL-approved metallic foil tape.

Despite the name, regular duct tape is not the best choice for duct repair. It fails quickly, especially when exposed to heat or moisture. You'll end up having to re-tape before long.

- **Insulate your ducts.** Builder-grade ductwork can be horribly inefficient, allowing lots of heat or cooling loss through the thin metal of the ductwork itself. Insulating or sealing your ducts can make a huge difference; there are products that you can use to wrap your existing ducts, or you can buy insulated ductwork to replace a problematic section.

But beware: Insulating your ducts can drop the overall temperature in a basement or attic. That heat loss through the ducts in an unfinished basement may be all that's keeping your plumbing pipes from freezing in winter. If you insulate the ducts in an uninsulated room, you may need to consider adding insulation to the room, too.

Deciding on Better Ductwork Options

Replacing anything more than a stray section of ductwork is usually a task better left to an HVAC expert. This ensures that the new ducts are properly sized for the space and system for optimum airflow and efficiency and correctly balanced for both return and supply air.

Your HVAC expert can offer recommendations on whether it makes sense for you to upgrade your ductwork or perhaps even re-duct your entire home. Although this job can be messy and time-consuming, the long-term benefits to your overall comfort, energy bills, and even personal health may make it ultimately worthwhile.

One significant upgrade could include the use of flexible ductwork over the more common rigid metal. When properly installed, this bendable material often eliminates the need for pieces and fittings where air leakage often occurs. It may also be wrapped with top-notch insulation, instantly maximizing your energy efficiency.

Chapter 6

Understanding Thermostats

In This Chapter

- Maintaining perfect temps with programmable thermostats
- Checking out next-gen thermostats that learn your habits
- Reaping the rewards of lower utility bills

The thermostat is probably the most familiar component of the HVAC system. It is essentially the "brain" of the system that tells the heating and cooling equipment what to do and when to do it.

Gain more control over this vital (but often overlooked) piece of HVAC equipment, and you can make a huge dent in your utility expenses — maybe as much as 20 percent.

This chapter looks at today's more efficient thermostats, which state-of-the-art features should matter most to you, and how you can program your way to both a more comfortable home and lower energy bills.

Examining Programmable Thermostats

While traditional manual thermostats are still out there, their single-setting operation is terribly inefficient, with the HVAC system working 24/7 to maintain one temperature all the time — morning, noon, and night — whether you've got a full house, even if no one is home.

You likely don't need your home to be one temperature all the time. Your comfort needs at 7 p.m. on a Tuesday are vastly

different from 2 a.m. on a Sunday, so why lock your system in on one number all the time?

Programmable thermostats allow you to preset multiple temperatures for various times of day. Use keypad buttons or a touchscreen to set your ideal temps: one for when you wake up and the family is getting ready for the day, one for when everyone is away at work or school, another for afternoons and evenings, and a final setting for overnights when everyone is asleep.

Programmables also let you customize your heating and cooling schedule for different days of the week. Look for these options as you decide which best suits your family's lifestyle and routines:

- **7 day:** These thermostats allow you to create a unique heating and cooling schedule for each day of the week. Busy families with full calendars will appreciate this style.
- **5–2 day:** This option maintains one heating and cooling schedule for the work week and another for weekends.

Today's programmable thermostats offer more than just customizable heating and cooling schedules. Here are some other features to consider when shopping:

- **Advanced recovery:** If you want your home to be 70 degrees when you wake up, this feature factors in how long it will take for the system to reach that mark and starts your HVAC system automatically to hit the target temperature at the time specified.
- **Backlit displays:** Many thermostats have screens or light-up displays that not only make controls and settings easier to read but can also change colors to match your home's décor.
- **Battery backup:** Your settings and schedules are saved and restored after a power loss.
- **Filter-change reminder:** Some models can prompt you with an indicator light when it's time to change your home's air filters.
- **Vacation mode:** The push of a single button ensures maximum energy savings during a prolonged absence and restarts the regular schedule upon your return.

A word about Wi-Fi and "learning" thermostats

The newest style of thermostat is so revolutionary that it deserves its own section in this discussion. Although programmable thermostats are a boon to energy savings, some homeowners find them tricky to properly set, with a sometimes-confusing array of menus to scroll through or a cycle of days and times and temperatures that all require dozens of pushes of up and down arrows to navigate.

Enter the "learning" thermostat with a simple number display on the front and a basic user interface. The idea is that after you install it, you simply set the temperature where you want it, and do so at various times of the day to maintain your comfort level. Over the course of just a few days, the thermostat "learns" your patterns and then takes over.

Many newer advanced thermostats also connect into your home's Wi-Fi network. This functionality allows you to control your home's temperature from anywhere using an app on your phone or through a computer. These thermostats can often be configured to compile your energy usage figures on a website, where you can easily call up your statistics and see everything associated with your account.

Considering Installation

Even the more advanced learning thermostats are designed for easy installation. Most promise that even with their Wi-Fi technology, you'll have it up and running within 30 minutes (though you may want to have a teenager handy just in case). Some models, though, may require an extra wire to work properly and may not be compatible with certain types or models of equipment. An HVAC expert can determine your exact wiring needs.

A thermostat should be located on an interior wall of the home, out of direct sunlight and away from any air registers. (Any of these things could give the thermostat false temperature readings.) If your thermostat needs to be relocated from its current location, it's probably best to leave that task up to an HVAC expert.

Managing Usage and Cost Expectations

Programmable thermostats range greatly in price, from around $30 for a simple one-week controller to $250 or more for the latest touchscreen model or a learning thermostat with Wi-Fi.

The key point to remember, though, is that a programmable thermostat usually starts saving you money immediately through better regulation of your heating and cooling system. How long it takes you to make back the upfront cost of a new thermostat in utility savings depends on you and the temperatures at which you keep your thermostat set. It is not a stretch, though, to expect to cut up to 20 percent off your heating and cooling bills annually.

Where should you set your thermostat? That's a question only you and your family can answer (and perhaps occasionally fight about), but here's a strategy that keeps energy efficiency in mind:

- **Summer:** Start at 78°F (25°C) when someone is home and adjust incrementally from there for comfort. When the house is empty, let the temp climb to 85°F (29°C).
- **Winter:** Try 68°F (20°C) when the home is occupied and bump it up as needed. For times no one is home, letting the temp drop to 58°F (14°C) shouldn't cause any issues.

Don't let anyone tell you that your furnace has to work harder to bring the temperature up from a cooler temperature; that's a myth. No matter how cool the house has gotten, it will warm up at the same rate. And most of the better programmable thermostats have the advanced recovery feature, which tells the thermostat how long it will take to reach the desired temperature.

Chapter 7

Examining Indoor Air Quality

In This Chapter

- Investigating air quality issues in your home
- Understanding how humidity affects your home's comfort level
- Thinking about HVAC solutions to improve your air quality

Many people, when they think about heating and air conditioning, think only in terms of regulating the ambient temperature inside their home. But a properly designed HVAC system should also be getting rid of things in the air that shouldn't be there in order to increase your overall comfort and health.

This chapter takes a closer look at some of these indoor air quality issues, how humidity and ventilation can affect your heating and air-conditioning equipment, and how these issues can often be resolved with the right HVAC upgrade.

Checking Out Common Air Quality Issues

Poor air quality inside your home can come from a number of sources, ranging from mild irritants to serious pollutants that are downright hazardous to your health. Here are some of the most common air quality issues:

- **Allergens:** Household dust, pet dander, pollen particles, mold, and mildew can wreak havoc for many people, making it difficult to breathe and causing sniffling,

sneezing, coughing, and even hives or more severe health and respiratory problems.

- **Bacteria and germs:** Biological contaminants like bacteria, mold, mildew, dust mites, fungi, pet dander, and viruses can survive on many surfaces in your home. Circulated in the air, they can cause and spread a variety of sicknesses.
- **Household chemicals:** Stored under your sink as cleaning products, in your workshop as paints and solvents, and even in things like your carpeting and furniture, many household chemicals give off fumes, vapors, and volatile organic compounds (VOCs) that can cause serious health concerns if breathed in over time.
- **Household odors:** Pet and cooking smells shouldn't linger in your home. Besides being unpleasant, home odors can trigger allergic reactions, headaches, and nausea in some individuals.
- **Ozone:** This form of oxygen helps block harmful radiation from reaching our planet, but at ground level, it's a toxic gas that can cause chronic respiratory issues. Amazingly, many electronic air purifiers intended to clean and filter your home's air actually *create* ozone.
- **Stale air:** Every home should allow for some fresh air infiltration from outside. Once inside, that air needs to move and circulate. If it doesn't, it can become stale and stuffy. A buildup of moisture on walls or windows can be an indicator of stale air, which can contribute to and compound many of the air quality issues in this list.

Getting Up to Speed on Humidity

Humidity occurs to many of us only when we're watching the weather forecast on TV, trying to figure out how oppressively hot it will feel outdoors during our summer weekend plans. But *humidity* (the moisture level that's present in the air) plays a huge role in indoor air quality, too. And just like it does in the great outdoors, humidity dramatically affects how comfortable (or uncomfortable) we feel inside our own homes.

In the summer months (and especially in some geographical regions), the air outside is loaded with humidity. Some of that moisture inevitably finds its way into your home. But we also add to our indoor humidity by showering, running dishwashers,

and other household activities. Basements also tend to trap a lot of dampness in the air.

Excessive humidity can manifest itself in a sticky, clammy feeling on the skin, fogged windows and glass doors, a persistent musty odor, even wet spots on walls. Too much (or even too little) humidity is a direct cause of discomfort in the home.

National studies show that for optimum comfort and health, the relative humidity inside your home should be between 35 percent and 50 percent. By way of comparison, desert air is often around 25 percent; a sweltering summer day in the Deep South can easily top 95 percent humidity.

In addition to lowering interior temperatures, your air conditioner also works to remove excess moisture from the air in your home. This happens thanks to the cold evaporator coil that condenses water vapor from the hot, humid air. The condensation is collected and piped outside or to a drain as the AC is in operation.

If your existing air conditioner can't keep up with high humidity, though, you'll *feel* warmer than the temperature indicates. (You've heard the phrase, "It's not the heat, it's the humidity.") Maybe you set the thermostat lower to compensate. And at that point, you're negating the effects of your cooling system.

Bigger isn't always better when it comes to AC units and humidity control. Buying a unit that's too large for your home means the system will run less to cool things, giving it less of a chance to do its other job of removing moisture.

As you may expect, the opposite is true during winter: Cold, parched air means less relative humidity in the home. You'll see evidence of this in a dry nose or throat, flaky skin, static shocks, even furniture and floorboards that shrink, warp, and crack.

But that low humidity also makes the air in your home feel cooler than it actually is, often convincing you to jack up the heat (and tax your heating system even further) to try to improve comfort levels.

Alternately, a new modulating AC system may cause you to feel cooler at a higher temperature than you're used to. That's because the new AC is doing a better job than the old one of removing humidity. This keeps you comfortable at a higher temperature, saving money at the same time.

Solving Air Quality Issues

Indentifying air quality issues in your home is a great start. But how do you correct those issues? Here are some HVAC components that are worth asking your HVAC expert about, depending on your particular air quality concern.

- **Air purifier:** An air purifier as part of your HVAC system uses powerful filtration technology to minimize allergens, biological pollutants, household odors, and VOCs. The good ones will reduce ozone in the home as well.
- **High-efficiency air filter:** You may be able to reduce many air quality issues simply by upgrading your HVAC air filter. The inexpensive disposable type may filter at 60 percent to 80 percent efficiency; some electronic air cleaners are rated at more than 98 percent. And high-efficiency particulate air (HEPA) filters use hospital-grade technology to further clean your air to the highest possible levels.
- **Germicidal light:** Tucked away inside your HVAC system, these lamps kill many airborne contaminants by blasting them with ultraviolet rays as they pass by.
- **Dehumidifier:** An HVAC system with its own dehumidifier will pull excess moisture from the air before it's forced through the ducts. This creates less condensation at the coil and makes the house feel cooler in summer.
- **Humidifier:** A humidifier installed on your HVAC system adds moisture to the air before it enters your home's ductwork. The result is a warmer home in winter months and proper humidity levels indoors when the air is driest outdoors.
- **Ventilators:** Heat recovery ventilators (HRVs) and energy recovery ventilators (ERVs) replace stale indoor air with fresh outdoor air, while also getting rid of odors, vapors, and pollutants. Which one is right for you depends largely on your location; HRVs are typically for use in Canada or the north and central United States, while ERVs are recommended only in high-humidity climates.

Chapter 8

Ten (Or So) Questions to Ask When Choosing an HVAC Expert

In This Chapter

- Checking up on your prospective contractor's qualifications
- Ensuring that your contractor follows industry standards
- Getting the most for your money even after the installation

When you purchase a new HVAC system, you're not only buying the equipment, you're also paying to have it installed. Selecting the best contractor for the job is just as important as choosing the right system for your home. Here are some questions you should ask any prospective HVAC contractor.

Can You Provide Local References?

It can be awkward to call a stranger and ask them about their HVAC system. But remember, that stranger was once in your shoes, too — trying to make an important and potentially costly decision on upgrading an integral part of their home. You'll usually find that the person on the other end of the phone is more than happy to walk you through their particular experience in regard to deciding on a system, dealing

with the company, and working with them after the fact. And a good contractor will be more than happy to provide references.

Will You Provide a Detailed, Written Estimate?

Don't settle for a number jotted down on the back of a business card. A proper estimate should detail the scope of the work, the equipment to be installed, the exact price, what is included in the cost, and any special circumstances or notes pertaining to the installation. It protects not only you as the customer, but also the contractor. No one wants a surprise on install day, and while things can change once work begins, a written estimate gives both parties something definitive to refer back to.

Are You Properly Licensed, Bonded, and Insured?

A quality HVAC contractor will appreciate the fact that you're doing this kind of background check. Proving that he's licensed (permitted to perform the work in your location), bonded (financially backed by a bonding company in the event of a claim being filed), and insured (to prevent you from being held liable should a worker be hurt) is what separates an expert contractor from the fly-by-night operations out there. A good contractor will be only too happy to show that he's got all his ducks in a row when it comes to being licensed, bonded, and insured.

Are Your Technicians NATE-Certified?

The HVAC industry changes rapidly. One way to make sure that your contractor's employees are up to speed on the latest technologies is to check for NATE certification. NATE stands for *North American Technician Excellence;* it's an independent

organization that certifies installation and service technicians with an actual test to gauge core and specialty knowledge.

NATE-certified technicians carry a card that proves their credentials, and many wear a special identifying patch on their work uniform. NATE certification is an extra measure of reassurance that you're getting skilled technicians who will properly install your new system.

How Will You Calculate the Size of the System I Need?

No matter how good an HVAC contractor says he is, he can't accurately determine what you need with just a phone conversation or even a perfunctory walk-through of your home. A quick rundown of the number of rooms in the home isn't enough information to properly determine the equipment needed. Nor is the home's square footage. Not even the make and model of your existing equipment tells an HVAC contractor what your home actually needs.

A load calculation is a diagnostic test that quantifies the heat load (the amount of heat that must be added to a home to replace what's naturally lost in cold weather) and the cooling load (the amount of heat that must be removed to maintain a given temperature in warmer weather). This important calculation determines the size of the equipment and even a ductwork design that will properly handle a home's heating and cooling loads. It takes into account everything about the home's construction, from the type of foundation to the location of windows and doors to insulation values to even the color of your roof!

What Is the Condition of My Home's Duct System?

A true HVAC expert will always consider the condition and design of your home's ducts, even if all you've asked about is a new furnace or AC system. As explained in Chapter 5, properly designed and sealed ductwork is vital to your HVAC

system's efficiency and your comfort. Installing even the best furnace or air conditioner on a substandard duct system will result in continued inefficiency, poor comfort, or worst of all, the failure of your new HVAC system. Asking this question shows that you understand the importance of your ducts. If your prospective contractor doesn't have a solid answer for it, it may be time to keep shopping for your HVAC expert.

Do You Follow Manual J Standards?

Manual J is an industry-wide standard from the Air Conditioning Contractors of America (ACCA) for determining the load calculation described earlier. By specifically asking about Manual J by name, you're showing the prospective contractor that you've done your homework and won't accept a vague "guesstimate" when it comes to your new system's requirements.

Manual J calculations can determine the load calculation for the whole house (when there is no need to modify the existing ductwork) or on a room-by-room basis (when individual duct sizes and layout must be considered).

Do You Meet the QI Standard?

Quality Installation may sound like a generic phrase, but QI is actually a specific benchmark put in place by ACCA and the American National Standards Institute (ANSI) that details the steps that a contractor must take to ensure that an HVAC system is properly installed for the highest possible quality.

The QI standard includes not only using a high-efficiency system and equipment, but also scores contractors on the proper design, installation, final testing, and even owner education of the HVAC system.

QI is a comprehensive and rigorous process that costs more than standard installation, but it actually provides more value over the long term. Energy Star estimates that a QI installation can cut heating and cooling costs by up to 30 percent.

How Should the New System Impact My Energy Bills?

Your contractor should be qualified not only to help you determine which HVAC system is right for you and your home, but also to inform you on how the new system will affect your heating and cooling bills.

By using the heat-load and/or cooling-load calculations, a quality contractor should be able to also estimate annual operating costs for new equipment and help you understand how that will translate to your monthly bills.

What Maintenance, Warranties, and Guarantees Are Included?

While the upfront costs of a new HVAC system may be at the forefront of your decision-making process, don't neglect to inquire about what happens after the installation, too. Ask about warranties for the equipment being installed, any guarantees that would cover the equipment's installation, and even what future maintenance expenses may be included as part of the initial cost. Also, ask if your HVAC contractor offers a 100 percent satisfaction guarantee.

What Are Your Financing Programs?

You may not have considered financing your new HVAC system, but extending the overall cost over a longer period of time often makes sense. Spreading out payments over, say, a ten-year period can allow many homeowners to purchase more energy-efficient and important air-quality equipment than if they tried to pay for everything all at once. Frequently, the energy savings realized with the more efficient system helps to offset any added expense.

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- **Advice for working with an HVAC professional to get the most bang for your buck**

Todd Brock is a freelance writer whose work has been featured on HGTV, DIY Network, and PBS. He is also a correspondent for the website Serious Eats and a food writer in the Atlanta area.

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ISBN 978-1-119-06275-2
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