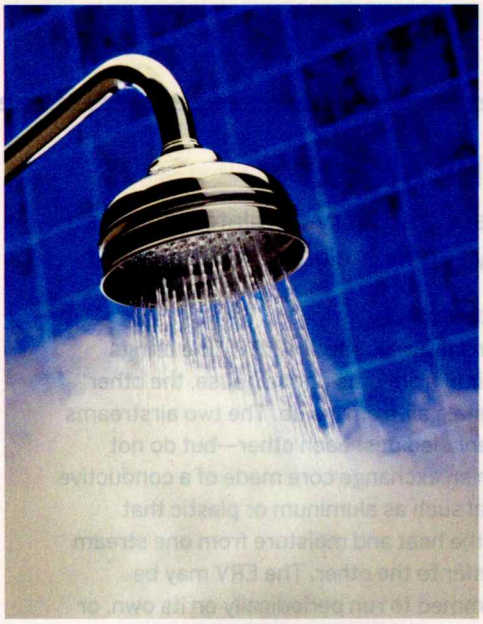

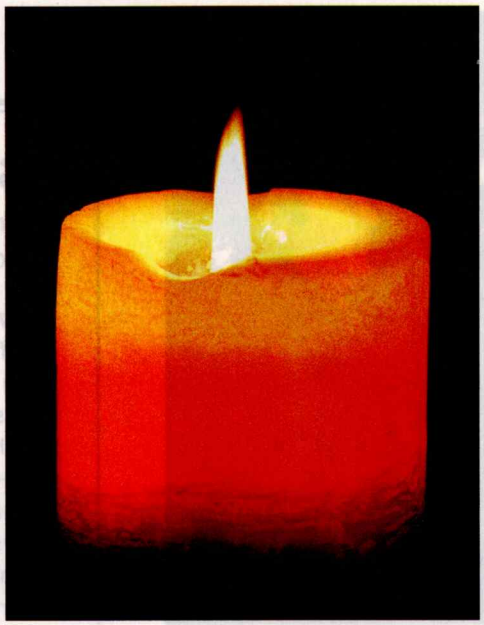

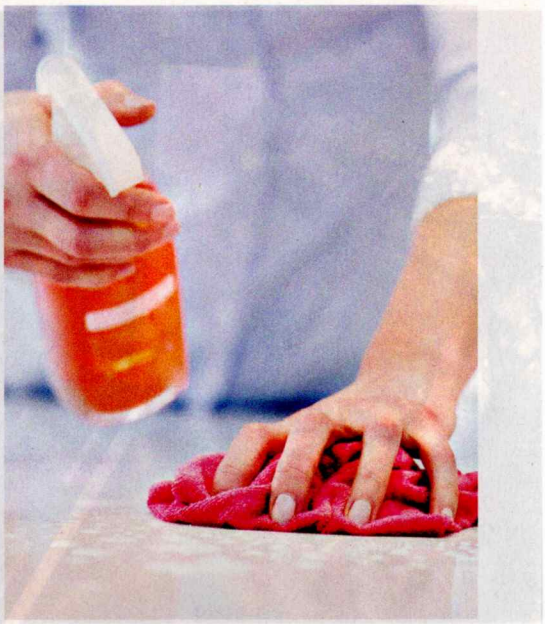

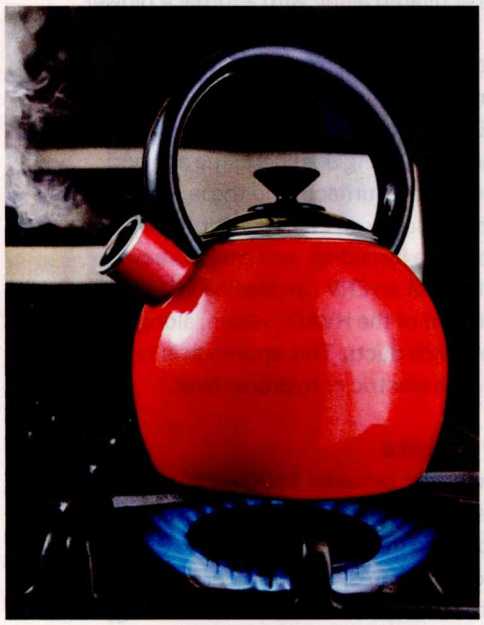

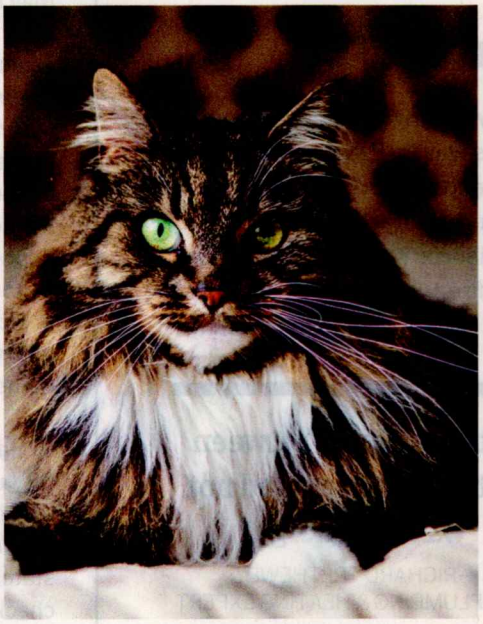

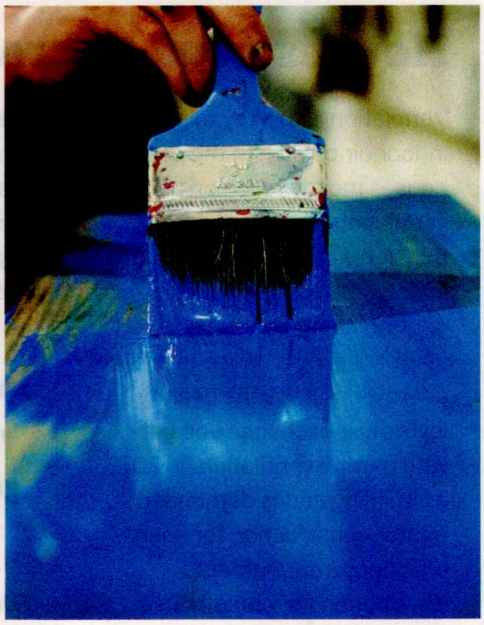

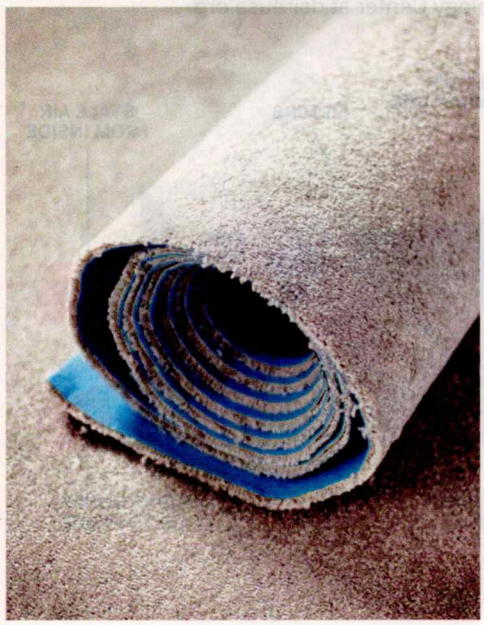


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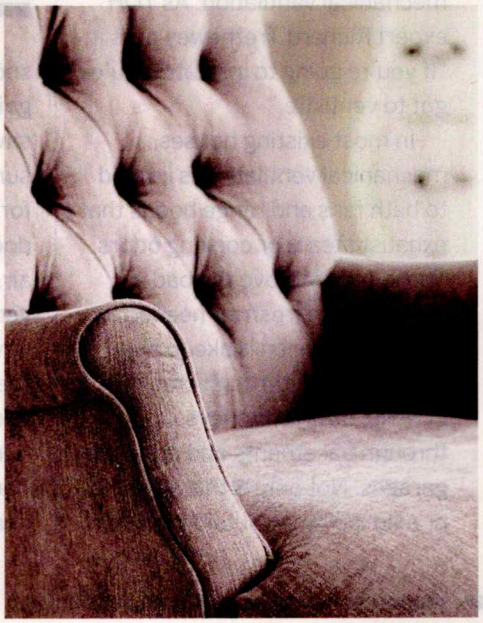


THIS OLD HOUSE HEALTHY HOME

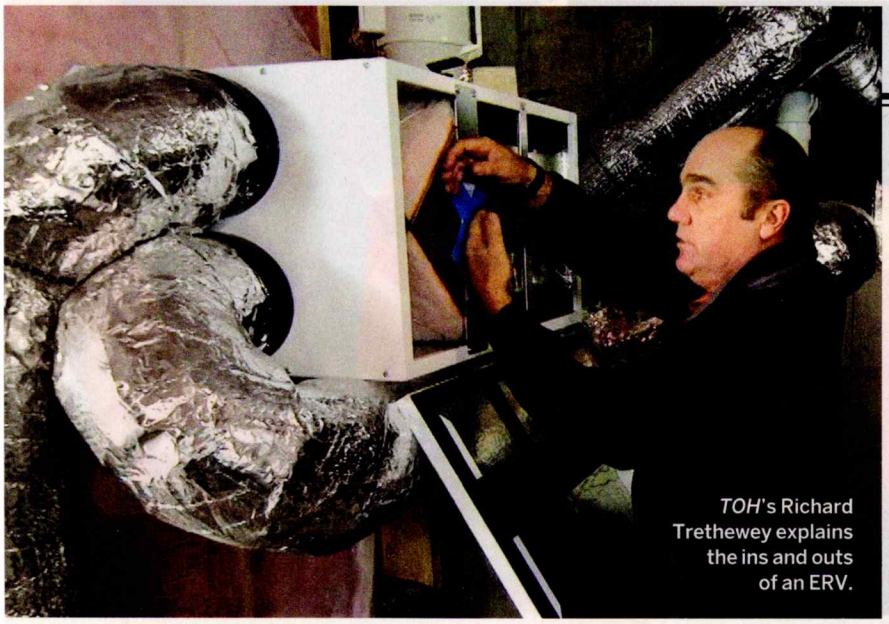
CLEARING THE AIR

While a tight, well-insulated home is great for saving energy, trapping lots of stale air indoors can undermine your health. Here's what you need to know to ensure that the quality of the air inside is as good as—or even better than—the fresh stuff outside. BY DEBRA JUDGE SILBER

We all want homes that are comfortable and energy efficient. But all our efforts to replace drafty windows, seal up air leaks, and blanket wall cavities with insulation have had an unfortunate consequence: They've made the air in our houses less healthy to breathe. More of the airborne pollutants that once might have found their way outside—household chemicals, smoke, pet dander, and cooking gases, to name a few—are building up inside. Our well-intentioned efforts to restrict the flow of air in and out of our houses have led to indoor air-pollution levels that can be two to five times higher than those outside, according to the Environmental Protection Agency.

That doesn't mean we should give up on making our houses tighter, of course. But it does mean now is a good time to pay as much attention to indoor air quality, or IAQ, as we do to energy efficiency. That begins by getting a better understanding of how to balance the movement of air in and out of a house, and of mechanical systems that usher in fresh air and expel stale air without compromising energy efficiency—or comfort—in all seasons. Monitoring your IAQ is a useful first step in raising awareness, too. Because when we know what we're up against, and how to minimize our exposure, we can all breathe easier.

OPPOSITE: Most of the common contributors to poor indoor air quality are right under our noses. They include many items we welcome into our homes, from synthetic furnishings and fresh paint to gas ranges and steamy showers. Learn more about these and other potential sources of indoor air pollution, plus how to control them, on page 50.



TOH's Richard Trethewey explains the ins and outs of an ERV.

Houses need to breathe, too

Ventilation is the key to good indoor air quality. In the past, houses mostly relied on natural ventilation—air moving freely through windows, doors, and leaky walls—to flush out stagnant, contaminated air.

But sealing a house to prevent energy loss halts the healthy level of air exchange you get with natural ventilation. In 2012, as building codes demanded tighter construction for energy efficiency, requirements were added for whole-house mechanical ventilation. As *TOH* expert Richard Trethewey puts it: "If you're going to insulate, you've got to ventilate."

In most existing houses, mechanical ventilation is limited to bath fans and range hoods that exhaust steam or cooking odors. These fans remove the bad air, but often the fresh air needed to replace it—called makeup air—simply slips in through cracks in walls, down chimneys, and through basements and attached garages. Not only is this air as hot or cold as the air outside, it's very likely picking up contaminants on its way in. Extreme lack of makeup air can cause dangerous back-drafting of combustion appliances such as furnaces and gas-fired water heaters.

A home's ventilation system should balance the amount of air going out and coming in. And to save energy, you want to make sure the energy used (and paid for) to heat or cool your home doesn't flow out with the stale air. Enter the energy recovery ventilator, or ERV. This box-like device moves air in and out of the house while conditioning it to about the same temperature and humidity level as the air inside. You get fresh air, customized for a healthy, energy-efficient home.

> **"It's a balance between getting fresh air and not wasting energy."**
>
> —RICHARD TRETHEWEY, *TOH* PLUMBING & HEATING EXPERT

INSIDE AN ERV

An energy recovery ventilator ensures a steady supply of clean, conditioned air.

How it works

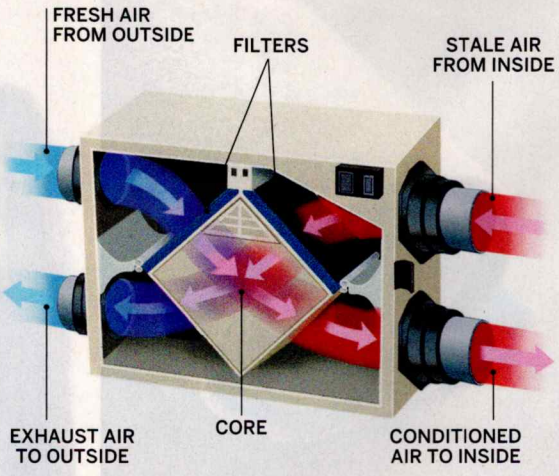
Two fans draw air into the ERV: One brings fresh air in from outside the house, the other draws stale air from inside. The two airstreams are channeled past each other—but do not mix—in an exchange core made of a conductive material such as aluminum or plastic that allows the heat and moisture from one stream to transfer to the other. The ERV may be programmed to run periodically on its own, or may be activated along with a furnace blower.

How it's installed

The way fresh air is moved through a house via an ERV depends on factors such as the presence of existing ductwork, the age and efficiency of the furnace, and the layout of the home. Usually an ERV is tied into existing ductwork in a forced-air system (as shown, opposite). But an ERV can also be installed independent of the HVAC system, along with its own 6-inch ducts. This approach is typical in homes with electric or hydronic heat.

What it costs

ERV units cost between $800 and $1,500, with installation running $1,000 to $2,000, depending on the scope of the work. Some states offer rebates; to see if yours does, check the database of the NC Clean Energy Technology Center at dsireusa.org.



Fresh air in, stale air out

This home's balanced ventilation system relies on an ERV tied to an existing forced-air HVAC system. Along with kitchen and bath fans, it maintains indoor air quality without compromising energy efficiency.

1 > ERV INTAKE Fresh air is drawn in through a duct and passes through the ERV's core, where heat and moisture are exchanged. In this case, cold winter air is warmed by the outgoing conditioned air so the furnace does not have to work so hard to bring it to room temperature.

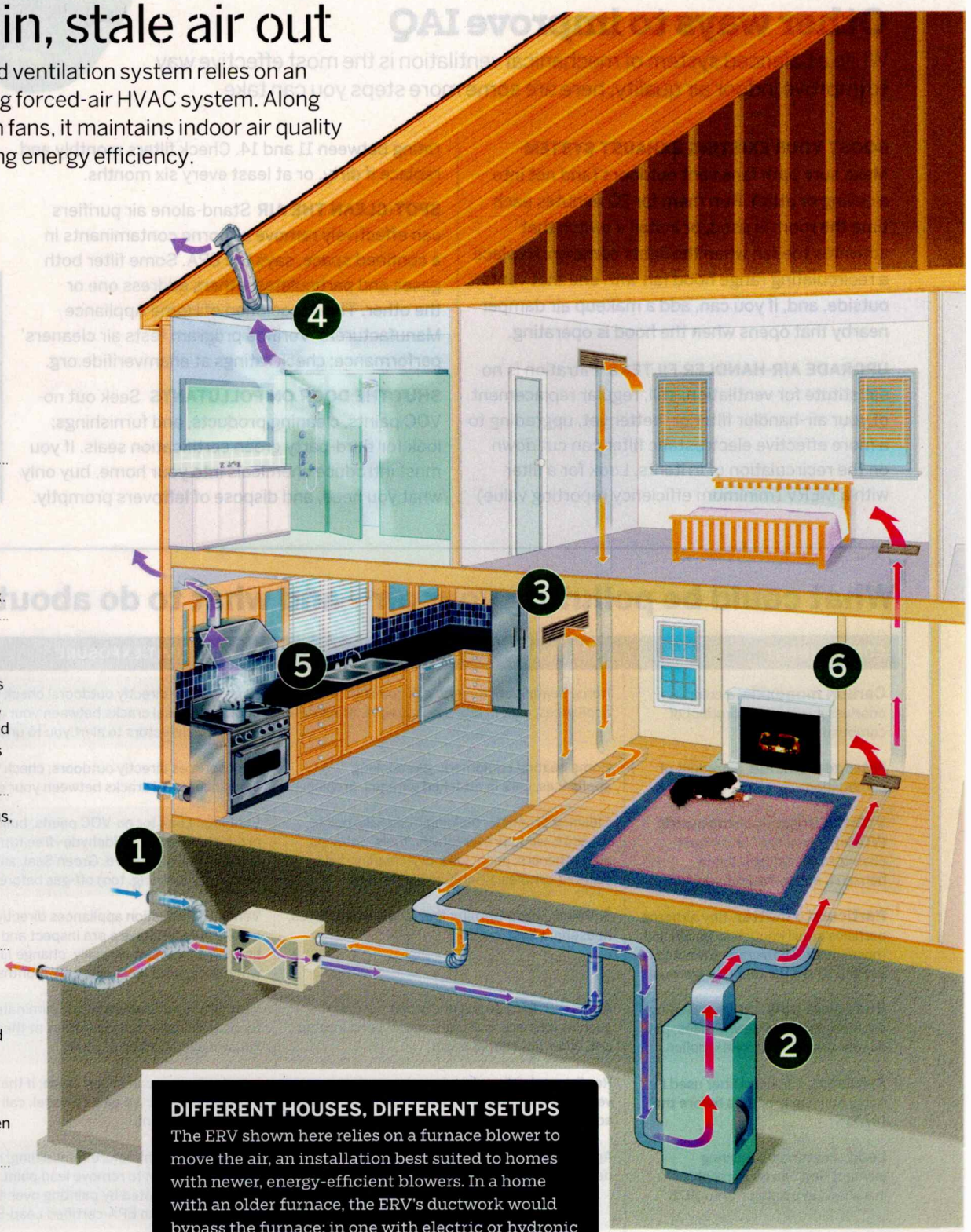
2 > FURNACE In this home, air that is conditioned by the ERV passes through the furnace, where it is fully heated and then distributed through the HVAC ductwork.

3 > AIR RETURN Stale, conditioned air from bedrooms and living areas is drawn back toward the ERV, where most of it is exhausted outside after transferring its heat to the incoming air.

4 > BATH VENT FAN Odorous, moist air that can lead to mold and mildew vents directly outside to prevent recirculation through the house's HVAC system.

5 > RANGE HOOD Cooking gases drawn through the range hood are ducted outdoors. This high-powered hood requires dedicated makeup air, which enters through a vent behind the cabinet that is activated when the vent fan is turned on.

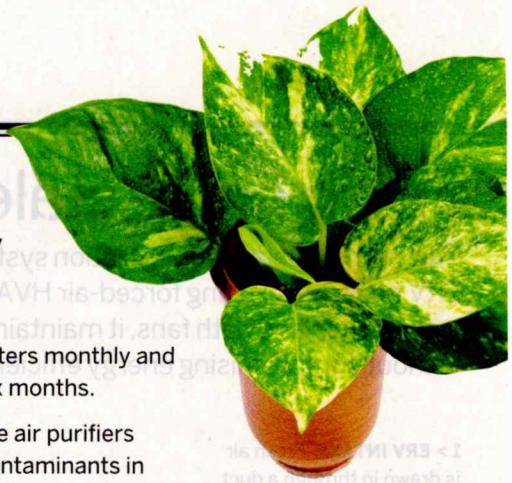
6 > SEALED FIREPLACE A sealed insert helps control both indoor air pollution and energy loss by sending combustion gases up the chimney, not into the room.



DIFFERENT HOUSES, DIFFERENT SETUPS

The ERV shown here relies on a furnace blower to move the air, an installation best suited to homes with newer, energy-efficient blowers. In a home with an older furnace, the ERV's ductwork would bypass the furnace; in one with electric or hydronic heat, an ERV requires ductwork of its own.

ILLUSTRATIONS BY IAN WORPOLE



Other ways to improve IAQ

While a balanced system of mechanical ventilation is the most effective way to improve indoor air quality, here are some more steps you can take.

BOOST YOUR EXISTING EXHAUST SYSTEM Make sure bath fans vent outdoors (and not into a ceiling or attic). Run them for 20 minutes each time the room is used, or install a switch that activates the fan when the lights come on. Replace a recirculating range hood fan with one that vents outside, and, if you can, add a makeup air damper nearby that opens when the hood is operating.

UPGRADE AIR-HANDLER FILTERS Filtration is no substitute for ventilation; still, regular replacement of your air-handler filter or, better yet, upgrading to a more effective electrostatic filter can cut down on the recirculation of irritants. Look for a filter with a MERV (minimum efficiency reporting value) rating between 11 and 14. Check filters monthly and replace if dirty, or at least every six months.

SPOT-CLEAN THE AIR Stand-alone air purifiers can effectively remove airborne contaminants in a confined space, says the EPA. Some filter both gases and particulates; others address one or the other. The Association of Home Appliance Manufacturers' Verifide program tests air cleaners' performance; check ratings at ahamverifide.org.

SHUT THE DOOR ON POLLUTANTS Seek out no-VOC paints, cleaning products, and furnishings; look for third-party green certification seals. If you must introduce chemicals into your home, buy only what you need, and dispose of leftovers promptly.

CAN PLANTS HELP?
An indoor jungle may brighten up your surroundings, but while laboratory experiments have shown plants can reduce levels of some airborne chemicals, there's no evidence that a few houseplants can significantly improve household air.

What could be polluting your air—and what to do about it

CONTAMINANT	POTENTIAL SOURCES	HOW TO LIMIT EXPOSURE
Carbon monoxide, a colorless, odorless gas that is a product of combustion	Home heating equipment, gas cooking appliances, cars in attached garages, fireplaces	Vent sources directly outdoors; check the operation of appliances; seal cracks between your garage and home. Install CO detectors to alert you to unsafe levels.
Nitrogen dioxide, a product of combustion	Home heating equipment, gas cooking appliances, cars in attached garages, fireplaces	Vent sources directly outdoors; check the operation of appliances; seal cracks between your garage and home.
Volatile organic compounds (VOCs), a variety of household chemicals including toluene, benzene, and formaldehyde	Cleaning products, building materials, paints, solvents, wood preservatives, fuels, aerosols, air fresheners, pesticides, dry-cleaning fluid, scented candles, printer ink, adhesives	Ventilate. Look for no-VOC paints, building materials, and cleaning products; urea formaldehyde–free furnishings; and certification seals from Greenguard, Green Seal, and Green Label Plus. Let items (dry cleaning, too) off-gas before they come inside.
Particulate matter, tiny airborne particles small enough to be inhaled; those under 2.5 microns (denoted as PM2.5) are the most dangerous	Smoking, wood-burning fireplaces, woodstoves, household dust, pollen	Vent all combustion appliances directly outside; don't smoke indoors; have a pro inspect and clean flues and home heating equipment annually; change filters on HVAC systems when dirty, or at least every six months.
Biological pollutants, including bacteria, mold, mildew, viruses, pet dander, pests, dust mites, pollen	Areas with food debris and moist humidity, such as kitchens and baths; dust; pets; insects and other household pests	Ventilate to remove moist air; eliminate plumbing and foundation leaks; remove shoes at the door; keep your house clean and free of pests.
Asbestos, a mineral fiber used in many building products before the 1970s	Roofing and siding shingles, pipe coatings, vermiculite insulation, some vinyl flooring and adhesives, fire-resistant materials	Intact asbestos can be left alone; if the material is damaged or might be affected by a remodel, call in a professional for an assessment.
Lead, a naturally occurring element that can be present in soil and in paints prior to 1978	Aging paint and the dust it produces as it degrades; contaminated soil	Test for lead paint before remodeling; never sand, scrape, or use a heat gun to remove lead paint. If intact, lead paint can be encapsulated by painting over it. For large-scale removal, call in an EPA-certified Lead-Safe pro.
Radon, a naturally occurring radioactive gas found in rock, soil, and water	Cracks in basements and foundations can provide a pathway into the house, as can water supply lines.	Test when you move into a house, and after any renovation that disturbs the surrounding soil. Some experts suggest testing every few years. Install a radon mitigation system if warranted.

Testing, testing

New interest in IAQ has led to a wave of devices that will keep tabs on your home's air quality. Many will alert you via smartphone to changes in IAQ, or communicate with your smart thermostat to activate the ventilation system. "Knowledge is power," says TOH home technology expert Ross Trethewey. "A monitor will let you know if your air quality is not that great, so you can do something about it."

CHOOSING A HOME IAQ MONITOR

Ross Trethewey
TOH home technology expert

Decide what pollutant you want to monitor. Not all devices track all pollutants. If someone in your home is allergic to dust or pollen, for example, you'll want to make sure the one you select tracks those specific particulates.

Pay attention to the sensor. The sensor is the most critical part of the monitor. A table of sensors tested by the EPA is available at epa.gov/air-sensor-toolbox. Be prepared to pay more for a good one.

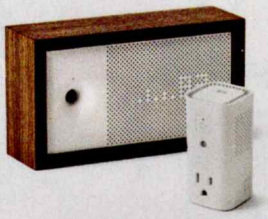
Consider the next step. Knowing that your indoor air is unhealthy only gets you so far. A monitor that can trigger ventilation either directly or through a smart thermostat ensures a quick response to poor IAQ.

MUST-DO MONITORING

While most monitors use carbon dioxide (CO_2) as a general indicator of air quality, few track carbon monoxide (CO) or radon. Carbon monoxide is the leading cause of accidental poisoning deaths in the U.S.; all homes should have a CO detector installed on each level. Radon, a carcinogenic gas, can be detected with an at-home test kit; if levels are high, a dedicated mitigation system that vents the gas outside should be installed.

FOOBOT
Airboxlab

The Foobot tracks tiny respirable particulate matter (PM2.5), total VOCs (TVOCs), temperature, and humidity. Its LED display indicates overall air quality by glowing blue (good) or orange (bad); the app rates your IAQ on a numerical scale from 0 to 100. *$199; foobot.io*



AWAIR, GLOW C
Awair

The retro-styled Awair 2nd edition (left) tracks temperature, humidity, CO_2, TVOCs, and PM2.5. The plug-in Glow C measures only TVOCs, temperature, and humidity, but will trigger "non-smart" devices like air purifiers or fans that are plugged into it. *$199 and $89; getawair.com*

LASER EGG
Kaiterra

With a clock-like appearance, both the Laser Egg (left) and Laser Egg+Chemical track PM2.5, temperature, and humidity; the latter also monitors TVOCs. Both are Wi-Fi-enabled and work with other home appliances via Apple Homekit and IFTTT. *$149 and $199; amazon.com*

TEMTOP M10
Temtop

The Temtop M10 has no Wi-Fi connectivity and no app, but offers at-a-glance readings of PM2.5, TVOCs, and formaldehyde with a series of clicks. Two other versions are available: The P10 measures only particulates; the M10i offers Wi-Fi connectivity. *$80; temtopus.com*

AIRVISUAL PRO
IQAir

The AirVisual Pro rates household air using EPA's Air Quality Index of 0 (good) to 500 (hazardous) and compares that score with locally reported conditions. It tracks PM2.5, temperature, humidity, and CO_2, and recommends remedial action when IAQ is poor. *$269; iqair.com/us*

WAVE PLUS AND MINI
Airthings

The Wave Plus (shown) monitors temperature, humidity, air pressure, TVOCs, CO_2, and radon, but not particulates. The desktop Wave Mini tracks temperature, humidity, air pressure, and TVOCs. Both offer app control and a color-coded display. *$269 and $79; airthings.com*

FOR MORE INFORMATION, SEE DIRECTORY, PAGE 66