

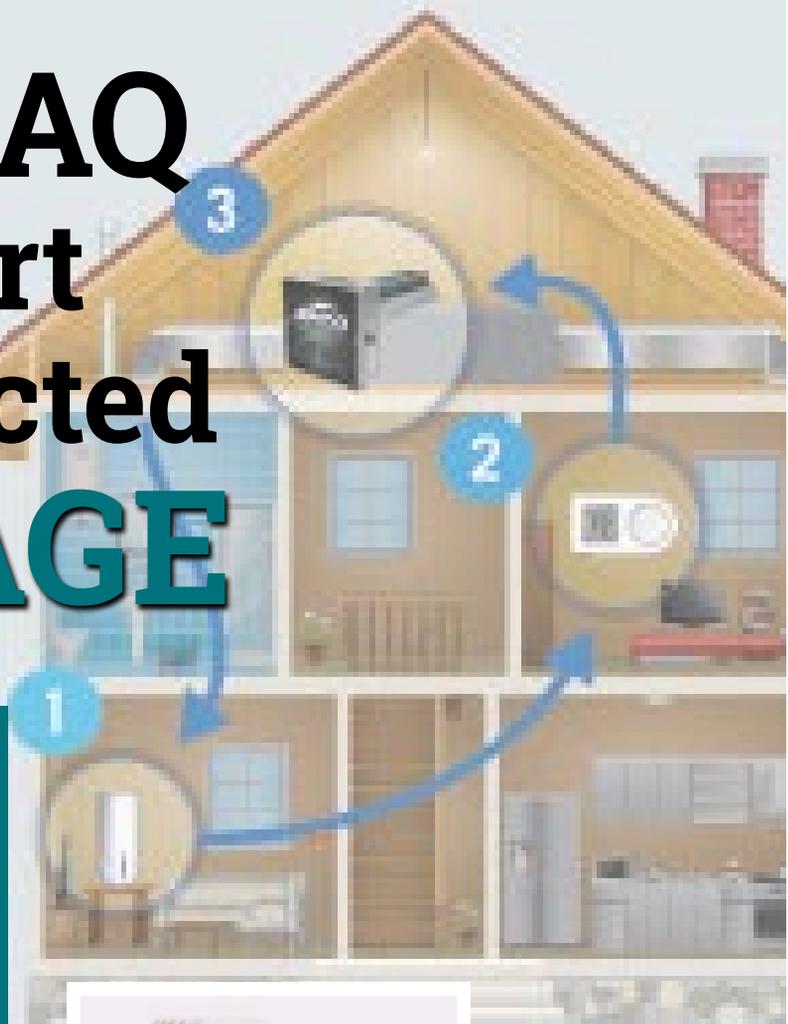
# HVAC & IAQ in the Smart and Connected HOME AGE

Discover how whole-home IAQ is becoming more automated through the Internet of Things and smart HVAC technology.

BY CHRIS WILLETTE  
*Images courtesy of Fresh-Aire UV.*

Imagine a home full of “smart” devices: a refrigerator that knows when it is time to change the water filter, an HVAC system that cools (or warms) your home in anticipation of your arrival, or smart lights that automatically turn off when you leave a room. This home would be more comfortable, efficient and even useful to its inhabitants. Welcome to the age of the smart and connected home.

The Internet and smartphones have changed lives, but many people remain unaware that smart devices will be the next big change. Advancements in wireless technology will result in connecting all types of devices that add convenience and comfort in the home. Home automation, and in particular HVAC systems and related equipment, will certainly play a big role in this change. The popular Nest® Labs thermostat is a good example; it learns from the habits of home occupants and communicates with them via a smartphone app. The next generation of those devices will communicate with each other as well, to coordinate their functions in order to maintain optimum living conditions for home occupants. To remain competitive, HVAC manufacturers and contractors will have to adapt to this



« Smart and connected systems can not only detect when something is wrong with the air, but do something about it by alerting the smart thermostat to engage the air system's fan.

revolutionary technology. Those who do so first will profit the most in the long run. This paradigm shift will force the HVAC industry to embrace these new technologies and honor their customers' requests.

Eventually, smart and connected home thermostats, air handlers, condensers and related equipment will become the norm. One of the most profitable markets within this revolution for HVAC contractors will be indoor air quality (IAQ). Equipment such as whole-house air purifiers, air quality monitors, smart/wireless thermostats, and similar devices will all be interconnected through a home's Wi-Fi network and be part of the “Internet of Things” (IoT), which is a network of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators and network connectivity that enable them all to compatibly exchange data.

## New business for HVAC contractors

Over the past couple of decades, an increasing number of HVAC contractors have been reaping big profits by selling IAQ-related devices, particularly whole-house air purifiers. As the market matures, contractors who are looking for a competitive edge are eager to find the next big thing to provide customers. Promoting the new generation of smart and connected home IAQ devices is an obvious choice that capitalizes on this technological revolution. The smart and connected home of the future will benefit from a wide variety of interconnected components.

Companies such as Nest Labs, Apple®, and Samsung®, are now providing smoke and carbon monoxide alarms, indoor/outdoor security cameras, smart/learning thermostats, and doorbells, all interconnected via the home's Wi-Fi. These smart devices allow homeowners improved control with immediate feedback and status notifications with their accompanied smartphone and tablet apps. Compared to electrical, computer and security technicians, the HVAC contractors are uniquely qualified to sell, install, integrate and service these products. The other trades have no thermostat or HVACR-based air-cleaning equipment installation experience, therefore the smart and connected home industry prefers HVACR contractors, according to Gene LaNois, head of professional channel, Nest Labs, Palo Alto, CA, who recently presented an HVACR industry webinar on the future of home connectivity.

## Smart and connected home IAQ

There are many whole-house air purifiers, indoor air quality monitors, and advanced thermostats already on the market, but up to this point they have not been able to communicate with each other. Smart and connected home technology will allow these devices to talk to each other, unlocking their full potential. An air-quality monitor may provide some useful information but does nothing by itself to improve air quality. Likewise, a whole-house air purifier is only effective when the HVAC system fan is circulating air. Smart and connected home IAQ devices will solve this problem by working together to respond to changing conditions inside the home in real time and address those issues.

## How it works

An air-quality sensor placed at a central location in the home monitors the air for contaminants, including particulates, carbon dioxide (CO<sub>2</sub>) and volatile organic compounds (VOCs). Should the concentration of these contaminants



^ An example of a smart thermostat and an air quality sensor, which work together to maintain healthy IAQ in a home.

reach a level of concern, the air-quality monitor wirelessly signals a smart thermostat to activate the air-handler ventilation fan so the air can be cleaned by the whole-house air purifier before the contaminants reach a critical level. When air quality is restored to an acceptable level, the air-quality monitor then signals the air handler to turn off the ventilation fan.

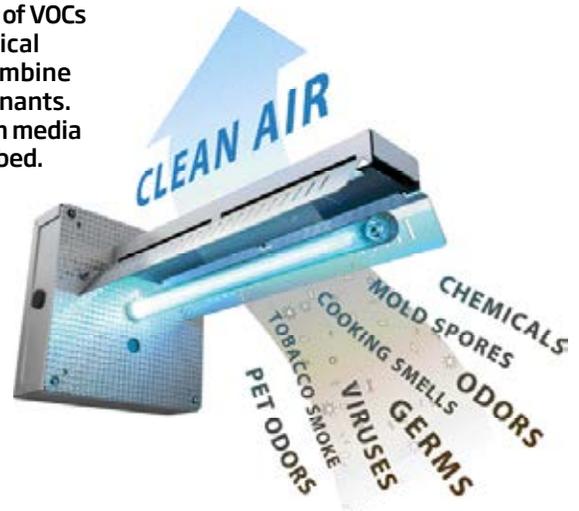
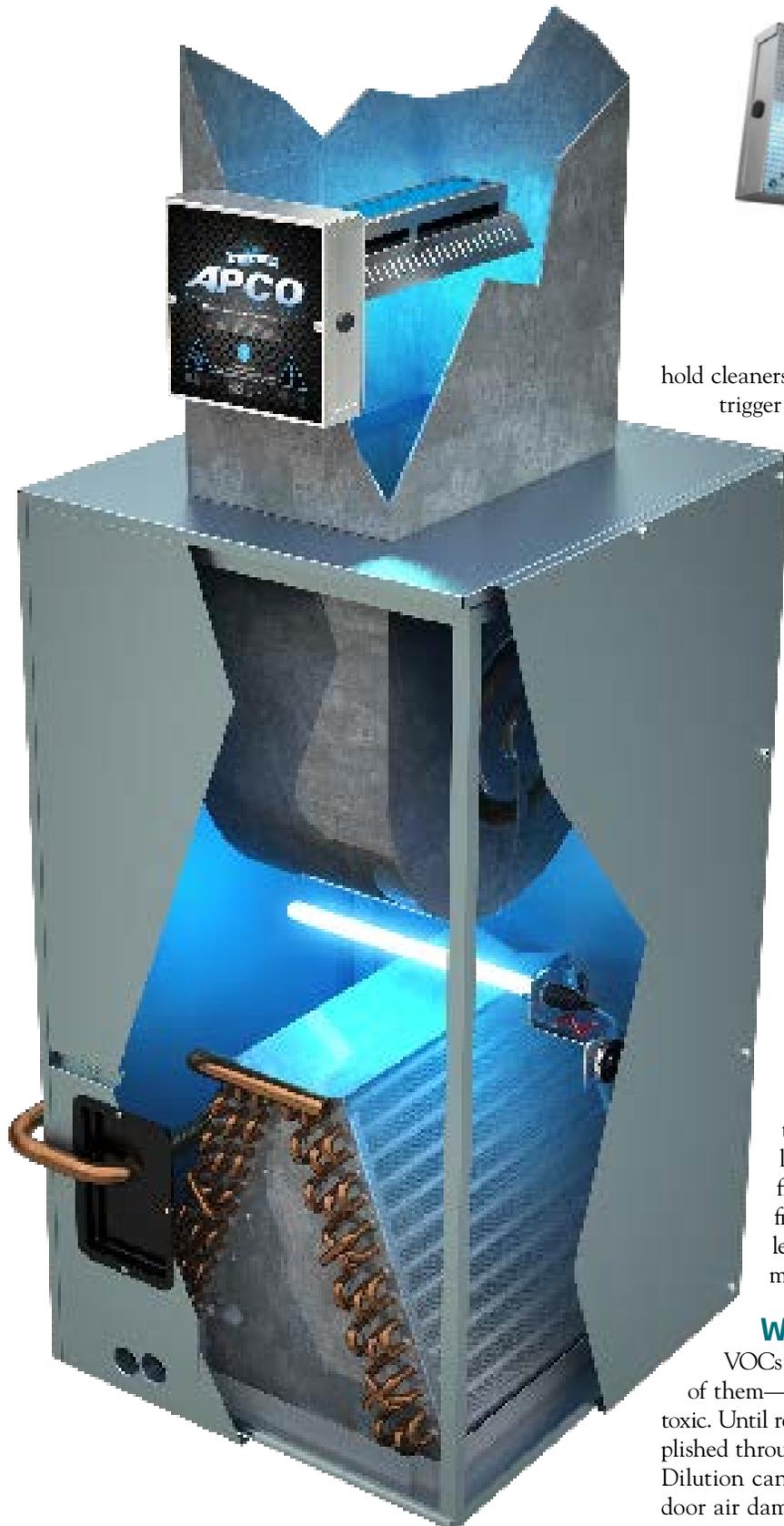
Monitoring airborne contaminants is not new, but taking action when levels are high represents a completely new approach that was not possible just a few years ago. Smart thermostats and HVAC system-based air-purifying devices are not new either, but they have never been integrated in this way with air quality monitors until now. These components are now being packaged by well-known HVAC industry brands and will debut at the 2017 AHR Expo in Las Vegas, NV. In 2017, contractors will be able to go to their favorite HVACR wholesaler and pick up a branded package of connected IAQ components to sell to their customers.

## Monitor

This package begins with an easily installed portable air monitor that can be positioned anywhere in the house with a 120-V outlet. This air-quality monitor is one of dozens on the market today that detects VOCs, CO<sub>2</sub> and particulates like dust. Recent technological breakthroughs have made these products more affordable.

VOCs and CO<sub>2</sub> are typically monitored in parts per million (ppm). Particulates can be monitored as fine as the Particulate Matter (PM) 2.5 standard. These monitors include adjustment capabilities to raise or lower the threshold sensitivities of all three contaminants and excessive amounts will trigger the monitor. For example, excessive levels of house-

»Using a carbon media-based air filter in an air handler purifies the air of VOCs that the IAQ monitor detects. While monitors do not detect biological contaminants, such as mold, bacteria or viruses, some air filters combine carbon media filtration with a UV lamp that kills biological contaminants. Some carbon media filters use UV lamps to also regenerate the carbon media in a photocatalytic oxidation process that eliminates VOCs it has adsorbed.



hold cleaners used while cleaning a home or pet odors would trigger the monitor's VOC sensors, while dusting or using a vacuum that leaks excessive airborne particulates would trigger the monitor's particulate sensors.

What makes this package so useful is that the monitor not only notifies the homeowner about poor air quality, it actually does something about it by wirelessly signaling a smart thermostat to activate the air system's fan. The fan creates circulation so the whole-house air purifier can clean the air. When contaminant levels fall below a preset threshold, the air monitor wirelessly signals the thermostat to turn off the fan.

### Thermostat

The thermostat has been programmed to accept wireless information from the air monitor. It controls the air system by the original household thermostat wiring. The thermostat also has smart and connected capabilities, such as remote operation, that provide temperature based on past usage, occupancy and other intuitive features.

When particulate levels are high, turning on the air system's ventilation fan will remove particulates from the air stream with its standard media filter. Air systems with higher MERV-rated media filters will do an even better job. When particulate levels fall below a preset threshold, the air quality monitor signals the thermostat to turn off the fan.

### Whole-house air purifier

VOCs are the source of nearly all household odors, many of them—such as formaldehyde and toluene—are also toxic. Until recently, reducing high VOC levels was accomplished through dilution by continually recirculating the air. Dilution can be accelerated when combined with an outdoor air damper or an energy-recovery ventilator (ERV).

Introducing outdoor air is now a residential new construction housing code in many local jurisdictions throughout the United States. While dilution works, it is slower and not as energy efficient as removing VOCs with an HVAC system-based whole-house air purifier that uses gas-phase air-purification technology.

Gas-phase air purification removes VOCs from the HVAC airstream by adsorbing them into carbon-based media. The best gas-phase air-purification devices use photocatalytic oxidation (PCO) to remove VOCs and regenerate the PCO media. They use carbon cells infused with titanium dioxide. UV-C light shining on the media creates a photocatalytic reaction that neutralizes VOCs by breaking them down into trace amounts of harmless water vapor and carbon dioxide. The same reaction keeps the carbon cells clean, effectively regenerating them. Gas-phase air purification is a scientifically proven technology that is well accepted by the HVAC industry. It has a long history in commercial applications where it is used for VOC control in heavy industry as well as commercial buildings. Unlike most other air purification and adsorption methods, PCO destroys contaminants rather than simply capturing them with some type of media.

Existing air-quality monitors cannot detect biological contaminants such as mold, bacteria, viruses, and allergens, which represent about one-third of indoor air pollution. Fortunately, the UV-C light in these PCO air purifiers irradiates the interior of the air system and will disinfect biological contaminants on air system surfaces (such as the cooling coils which are prone to mold) and in the air as it cycles through. Therefore, a combination UV light/gas phase carbon/PCO air cleaner will remove VOCs and microbes, while the air handler's onboard fiber media filter removes particulates—the three keys to IAQ.

## The way forward

The best advice for HVAC contractors is to anchor their companies with an air purification technology that disinfects biological contaminants, neutralizes VOCs and also accommodates protocols of numerous interconnectivity networks. With the right whole-house air purifier

installed, the contractor can then add components such as Wi-Fi enabled thermostats, air monitors and other equipment related to IAQ. Contractors will then have the option to integrate cameras, smoke/carbon monoxide detectors, and other non-HVAC products into the home network as well. This will promote profitability and better position the company to take advantage of all the exciting advancements to come. ☁

*Chris Willette is President of Fresh-Aire UV located in Jupiter, FL. Willette is an engineer, a designer/developer and patent holder of several innovative indoor air quality products. Fresh-Aire UV is introducing a package of three integrated components featuring an air monitor, a smart thermostat and whole-house PCO air purifier (winner of the prestigious AHR Innovation Award). For more information, visit [www.freshaireuv.com](http://www.freshaireuv.com).*

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