

## Equinox House: Energy-Efficient Indoor Air Quality

Energy-efficiency and sustainability are two trademark design characteristics of the 21st century, especially in residential architecture. The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) continues to urge homeowners to cut energy use by up to 25% ([www.energysavers.gov/tips/save\\_energy.cfm](http://www.energysavers.gov/tips/save_energy.cfm)). In fact, a typical U.S. family spends approximately \$1,900 per year on home utility bills – with a significant portion of that energy wasted.

### Lower Utility Bills a Breath of Fresh Air

Newell Instruments' Equinox House is an energy-efficient residence known for its ability to consume the same amount of energy as it produces due to a grid-tied solar photovoltaic array supplying 100% of its annual energy requirements. A key feature of the home is its Conditioning Energy Recovery Ventilator (CERV), designed to detect and remove a broad range of potentially harmful volatile organic compounds (VOCs) from indoor air. Newell Instruments uses AppliedSensor's iAQ-100 Indoor Air Quality (IAQ) Module to help make this function possible. When VOCs are minimized, the module instructs the system to decrease ventilation, thereby improving energy efficiency and lowering utility costs. Data gathered by Newell Instruments show a consistent correlation of VOC-to-carbon dioxide (CO<sub>2</sub>) levels (Figure 1). In addition, overall results indicate optimal indoor air quality and quick recovery from episodes involving higher levels of VOCs.

The same CERV unit that is installed in Equinox House was also featured in the University of Illinois at Urbana-Champaign's Re\_home. The solar-powered house placed seventh out of 19 in the 2011 DOE Solar Decathlon held in Washington, D.C. Re\_home was the only entry in the competition featuring a ventilation system capable of monitoring VOCs and CO<sub>2</sub>. Re\_home is now located on the U of I campus and is open to the public for tours.



Newell Instrument's Equinox House

### VOC Sensor Meets ASHRAE Standard

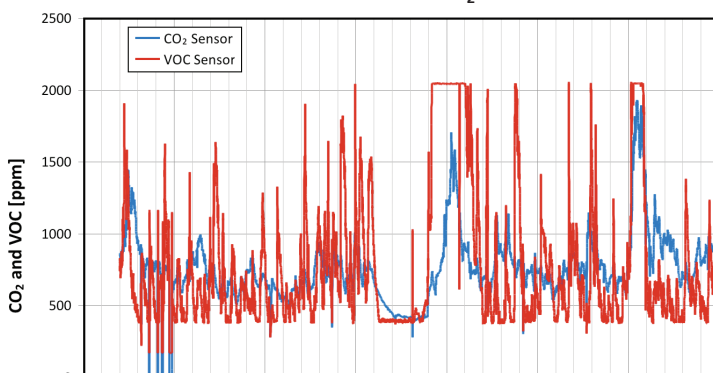
The EERE refers to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for issues specific to residential ventilation and indoor air quality (IAQ). ASHRAE Standard 62.2 for residential ventilation specifies that healthy IAQ translates to minimal odors and CO<sub>2</sub> levels. Due to Equinox House's energy-efficient structure and furnishings, VOCs such as alcohol, butanone or formaldehyde are not found inside the home. In fact, all of the VOCs in Equinox House are emitted from humans. When the home is unoccupied, human-generated VOCs evaporate or dissipate within a day, leaving indoor air at a quality level comparable to fresh outdoor air.

The home is currently occupied by Mr. and Mrs. Ty and Deb Newell. Mr. Newell is the vice president of Newell Instruments, a company that develops and manufactures electronic concentration sensors for refrigeration and air conditioning industry research. According to Mr. Newell, "The iAQ-100 has proven to be a very accurate and cost-effective VOC sensor. The installation has certainly helped Newell Instruments understand how human activity correlates with CO<sub>2</sub> and VOC levels – and how to implement these findings with a demand-controlled ventilation algorithm."

### iAQ-100 for Commercial, Residential Applications

Now available for residential installations, AppliedSensor's indoor air quality technology was originally developed to integrate with commercial HVAC systems and ensure high air quality in commercial buildings. For example, at the Chicago Museum of Science and Industry, a micro-machined metal oxide semiconductor (MOS) sensor element enables the iAQ Module to alert the museum's maintenance staff that a restroom needs service when foul odors are detected. In addition to helping to ensure that the facilities are odor free for museum visitors, iAQ Modules reduce costs. Facility maintenance costs are lower as restroom maintenance is performed on an as-need basis, and energy costs are reduced as ventilation fans run only when necessary.

Figure 1 – Plot of VOC/CO<sub>2</sub> sensor data



Source: Newell Instruments

## iAQ Sensor Detects VOCs

While some homes and facilities use air quality sensors that signal fans to turn on when the threshold for CO<sub>2</sub> is exceeded, these CO<sub>2</sub>-based indoor air monitors do not measure odors caused by volatile organic compounds (VOCs) from humans, cooking, smoke, cleaning supplies, paint, glue, furnishings, appliances and other sources (Table 1).

In addition to making indoor air smell unpleasant, VOCs can be harmful to the occupant's health. In fact, the U.S. Environmental Protection Agency (EPA) notes that VOCs are two to five times more likely to be found inside the home than outside. Even through closed doors, polluted air can travel from room to room and affect occupants' health and comfort. In addition to detecting a broad range of VOCs, AppliedSensor's suite of iAQ Modules feature low power consumption to increase energy efficiency and auto-calibrating sensing technology to ensure accuracy.

Table 1 – Examples of VOCs and Sources

Substance Group	Example	Sources
Alkanes	heptane, methane	human breath, bio-effluents
Alcohols	alcohol, mineral spirits	cleaning supplies
Aldehydes	formaldehyde	building materials
Ketones	butanone	paints
Esters	methyl acetate	glues
Terpenes	pinene	perfumes and glues
Aromatics	xylo	paints and glues

Source: AppliedSensor



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