TOOLBASE℠
TECHSPECS

PROFILE

Whole-House Ventilation Systems

TECH @ A GLANCE

BENEFITS (+) / DRAWBACKS (-)

+ MARKETABILITY: Can reduce potential homeowner problems and callbacks associated with comfort, odors, moisture, and air quality
+ DURABILITY: Helps control interior moisture and reduce wintertime condensation, thereby reducing chance of moisture-related decay and deterioration of materials
+ SAFETY: Oversized ventilation systems can overwhelm the exhaust systems of fuel-burning appliances
+ ENVIRONMENTAL PERFORMANCE: Helps dilute moisture and indoor air pollutants; reduces condensation potential and moisture-related issues such as dust mites and mold during the winter.
– AFFORDABILITY: Requires some first and operational costs that do not exist in homes without whole-house mechanical ventilation; additional equipment and controls required; additional maintenance costs associated
– ENVIRONMENTAL PERFORMANCE: Use of a whole-house ventilation system in hot, humid climate may cause degraded IAQ as a result of moisture brought in with the make-up air; supplemental dehumidification may be required to assist the air conditioning system

INITIAL COST

Systems can cost between several hundred and a few thousand dollars more than an HVAC system without whole-house ventilation, depending on the system selected.

OPERATIONAL COST

Varies – will cost more to operate than a home without a separate ventilation system. A whole-house mechanical ventilation system uses electrical energy to power a fan and outdoor make-up air requires heating or cooling and dehumidification depending on season and climate.

CODE ACCEPTANCE

Sections R303 and M1506 of the International Residential Code (IRC) cover the requirements for ventilation and exhaust systems. Whole-house mechanical ventilation is not required, but some jurisdictions may require mechanical ventilation in addition to bathroom and range hood ventilation. Consult local building codes for specific ventilation requirements.

RESULTS FROM THE FIELD

One PATH Field Evaluation examined three separate ventilation systems in a new home in Alabama. A separate Minnesota Energy Office study examined 28 ventilation systems in 43 new homes.

WARRANTY

Standard manufacturer warranties for equipment and controls will apply.

MAKING THE SWITCH

Builders should work with an experienced installer or be willing to go through the “learning curve” with their usual HVAC contractor. Although typical HVAC tools and techniques are used, system design is different than conventional heating and cooling systems.

THE BASICS

A whole-house ventilation system delivers outdoor air into a home using a mechanical fan to improve indoor air quality (IAQ). There are a variety of ventilation system types including: exhaust-only; supply-only; balanced; and balanced with heat- or energy-recovery. Exhaust-only and supply-only systems rely on infiltration of air through cracks in the building shell for make-up air, while balanced systems avoid building pressurization (or depressurization) by using two fans to introduce as much outdoor air as is exhausted by the system. There are several methods for controlling each type of ventilation system including, timers, humidistats, or other duty-cycling mechanisms.

To mechanically introduce outdoor air, systems may use the home’s central air handler and ductwork, have separate ducts and fans, or rely on a combination. In addition to ductwork and fans, systems typically include a controller to activate the ventilation system based on humidity levels, time, or other variables.

DOLLARS AND SENSE

Three ventilation systems were installed in a PATH Field Evaluation site in northern Alabama. **System cost was found to be between $400 and $2,000**, installation time between 5 and 13 hours, and **operational cost between $0.22 and $0.52 per day** (based on $0.05 per kWh).

A Minnesota Energy Office study showed an **installed cost of $300 to $500 for three exhaust-only systems and $2,200 to $2,800 for 25 balanced heat recovery ventilation systems**.

MAKING THE SWITCH

What training, tools, and home design changes are required to switch from your current building practices to using this technology?

Implementing a whole-house mechanical ventilation system involves:

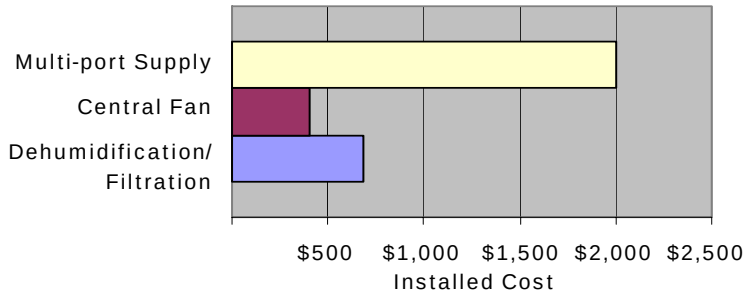
- **Careful design** of the system by a qualified HVAC company
- **Equipment selection** based on system requirements, house design, and climate
- **Installation of the system** including ductwork, fans, and controls, finishing around grilles, and exterior finishing around inlet air ports

RESULTS FROM THE FIELD

This technology has been evaluated by other builders in real-world building projects – learn from their experiences. For more information on these Technologies in Practice, visit www.toolbase.org.

Albertville, Alabama, Warren Builders (PATH Field Evaluation)

- Three different ventilation systems installed in one home in northern Alabama including:
  1) Multi-port Supply system that delivers outdoor air to several rooms in the house,
  2) Central Fan system that ducted outdoor air to the air handler of the air conditioning system, and
  3) Dehumidification/Filtration system that drew outdoor air into a dehumidification/filtration system before being distributed by the home's central air handler.
- Installed costs for the three systems:
  1) Multi-port Supply = $680
  2) Central Fan = $400;
  3) Dehumidification/Filtration = $2,000



- Installation time for the inexperienced contractor was:
  1) 5 labor-hours for the central fan system,
  2) 12 labor-hours for the multi-port supply, and
  3) 13 labor-hours for the dehumidification/filtration system.
- The whole-house ventilated home had an estimated additional cost of $21 to $61 per year for heating, cooling, and ventilation at an electric rate of about $0.05 per kWh .
- The multi-port supply system created one area in which supply air, during the winter, created draftiness and discomfort for the occupants.
- Using the central fan system keeps installed cost down. However, there are some additional costs for installing air intake ducts, wiring controls, and finishing around exterior penetrations.
- Ventilation systems added to the heating and cooling system loads.
- There was additional time required for design and planning HVAC system.
- Extra electrical wiring required for fans in systems that do not use central air handler
- Exterior finishing required for vents that terminated to the outdoors
- Extra ports may be required for supply or exhaust system, requiring cutting of drywall.
- Some systems may take up floor space in a closet or other area.

Minnesota Energy Office (Statewide Study)

- Statewide study of 43 new homes evaluated houses built under various energy codes for tightness of building shell construction and effectiveness of mechanical ventilation.
- Costs of ventilation systems between $300 and $500 for exhaust-only systems
- Cost for balanced heat recovery ventilation systems between $2,200 and $2,800

FOOD FOR THOUGHT

This section provides some things to think about before switching to this building technology – make sure it's the right choice for you.

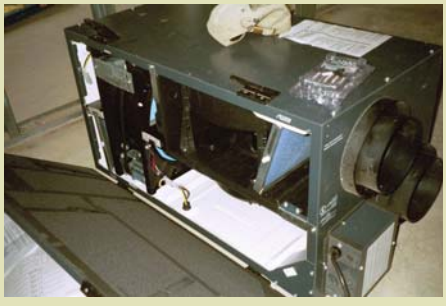
- Exhaust-only ventilation systems are best suited to mixed or moderate climates. Continuously operating exhaust ventilation systems are not recommended in hot humid climates, as they can draw moisture-laden air into the wall cavities where condensation may occur during the cooling season.
- Caution should be exercised, especially in small and tightly constructed houses that use atmospherically vented fuel-burning appliances. Oversized exhaust ventilation systems can cause fuel burning appliance backdrafting when there is inadequate combustion air. Consult with a reputable mechanical contractor for advice on proper sizing and combustion air requirements. Consult International Residential Code and the International Fuel Gas Code for appliance venting and combustion air requirements.
- Supply-only systems are best suited to hot and humid climates. In the heating season in cold climates, continuously operating supply ventilation may pressurize the home, thereby causing warm humid indoor air into the wall cavities where condensation may occur.
- Balanced systems are suited to all climates.
- Heat recovery ventilators improve the energy efficiency of mechanical ventilation systems in cold dry climates, whereas energy recovery ventilators improve efficiency and comfort in humid climates.
- Some homebuyers will value the peace of mind and potential for good air quality provided by whole-house ventilation; while some will balk at up-front costs and additional operating costs. Be prepared to explain the features and benefits of whole-house ventilation, how it works, why it is beneficial.
- Contractors who are not familiar installing ventilation systems may need some help during the first installation. The builder should be on site during the installation to ensure that the system is installed as designed.
- When using a supply-only system, be sure to locate registers so that they do not create drafts and thermal-discomfort for the occupants.

> ***"Once you have a tight house, you have to recognize the need for ventilation and humidity control. But this is easily attained with mechanically-controlled ventilation."***
>
> *Tony Grahame, EnergyValue Housing Award-winning builder*

DEFINITIONS

Backdrafting
Spillage of combustion by-products into the home.

Heat Recovery Ventilator
A mechanical ventilation system which recovers thermal energy from exhaust air to pre-heat (or pre-cool) incoming ventilation air. An energy recovery ventilator goes a step further by reclaiming moisture (also called latent energy) for a higher level of recovery efficiency.



TECH CHECK

Below is a checklist of steps to follow in order to implement this technology in each of your projects.

- ☐ **Be sure that the home is tightly constructed.** Conduct blower door testing, if possible, to determine natural air infiltration levels.
- ☐ **Be sure the duct system is also tightly sealed**, especially if the ventilation system will use the central air handler.
- ☐ **Work with a knowledgeable HVAC contractor** to design and select a ventilation system that is appropriate for the home and the climate.
- ☐ **Consider the loads induced by the ventilation system when sizing** heating and cooling equipment.
- ☐ **Consider wiring and controls** for the ventilation system.
- ☐ **Test and adjust** the ventilation system, as necessary.
- ☐ **Educate the homeowner** on the proper operation and maintenance of the system.

The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, and affordability of America's housing. Managed by HUD, the PATH partnership includes the homebuilding, manufacturing, insurance and financial industries, and Federal agencies concerned with housing.

PATH addresses barriers to innovation, provides information on advanced building technologies, and advances housing technology research; making affordable, quality American homes a reality.

For more information on the PATH program, visit www.pathnet.org.

Tech Specs are Prepared for PATH by the NAHB Research Center.

RESOURCES

ToolBase Services
Information on this building technology and many others brought to you by PATH and the building scientists at the NAHB Research Center.
www.toolbase.org

Whole-House Ventilation Systems
U.S. DOE fact sheet
www.nrel.gov/docs/fy03osti/26458.pdf

Home Ventilation and Indoor Air Quality, a Guide from the Home Ventilating Institute
www.hvi.org/associations/4692/files/HVI-2004-Guide.pdf

Recommended Ventilation Strategies for Energy-Efficient Production Homes
Lawrence Berkeley National Laboratory
enduse.lbl.gov/Projects/ESVentilation.html