Ask Jon Eakes

Choosing between an HRV and an ERV

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After 30 years of installing Heat Recovery Ventilators (HRV) we are now asked to choose between an HRV and an ERV (Energy Recovery Ventilator). What is an ERV and does it really work in Canada?

Early Development

Both HRVs and ERVs were developed together in the early 80s with the promise that the HRV would dehumidify the tightly sealed house, and the ERV would do the same job but return 50% of the moisture back to where it came from to not dry out a house too much. Unfortunately because the ERV actually retained moisture in their exchange core, they quickly self-destructed with Canada's freezing temperatures.

ERVs literally disappeared from Canada but became the ventilation mainstay in the hot humid air conditioning climate of Florida. They worked just the opposite down there, keeping outdoor moisture outdoors hence keeping humidity levels in the air conditioned house lower and more comfortable. And they never froze.

In the meantime up in Canada we sealed houses so the indoor relative humidity went up, and we ventilated the houses with HRVs and the relative humidity went down, sometimes so far down that we needed to put humidifiers back into operation. We built bigger houses with fewer people and they got too dry, while smaller houses with large families got too wet.

Obviously we needed more air control options. Around 2005, 25 years after its invention, this technology came back to Canada when Venmar concluded some serious research into creating an ERV that could stand up to freeze/thaw conditions.

Although today there are over 40 companies making ERVs, you must be very careful to check the Home Ventilating Institute (HVI) listings to identify the few models that are rated to last for 10 years at temperatures down to -25 C. For several years Venmar had the only unit capable of doing that; now there are a few more on the market. Few models available, combined with the old history of failure, has restrained the rapid uptake of this technology in Canadian residential ventilation, although it is now proven as a reliable option for ventilation strategies.

Understanding The Technology

During the Canadian winter a Heat Recovery Ventilator recuperates heat from the outgoing stale air and transfers it to the incoming fresh air bringing their two temperatures close to the same levels - although the outgoing air is moist and the incoming air is dry. An Energy Recovery Ventilator does some of the same temperature transfer but also brings over warm moisture into the fresh air stream. Under winter conditions the HRV will reduce humidity in a house, perhaps even make it too dry. An ERV will return about 50% of the moisture in the air, perhaps solving a dryness problem without adding humidifiers. But this is only part of the story. There is energy stored in that moisture. Very little energy is required to bring this moisture up to room temperature compared to cold vapour coming off a humidifier that just soaks up energy. An ERV recuperates a great deal of embodied energy or what is called enthalpy, latent heat. That is where a good part of its energy recovery comes from. Wet or dry air at the same temperature are much like a cast iron fry pan and a sheet of aluminium foil, both at the same temperature. The massive fry pan has enough energy stored in it to cook your skin -- the aluminium foil will be cooled instantly when you touch it because there is little mass to store energy.

The ERV

The ERV comes in two basic types -- Cross Flow cores that look like those used in most HRVs, and Thermal Wheels that rotate slowly through the two air flow streams. The real efficiency of one model or the other is best judged by the HVI test reports.

The Venmar EKO1.5 ERV is an interesting unit to illustrate the technology. One unique feature of this unit is that Venmar has built it so that the ERV core could be exchanged for an HRV core, in the same installed machine - both being cross flow exchangers. This interchangeability could be particularly useful if the occupational loads on the house were to change - such as from a quiet retired couple to a growing family and much more moisture, or if an indoor hot tub was added to the house and now dehumidification was necessary, or it was really unclear as to which technology would be best suited for the house, or if you just couldn't decided which one you needed in the first place.

So the ERV is now one more tool, amongst many, for us to use to try to create a healthy indoor environment. It may very likely surpass the HRV in being useful for that task as it has a positive energy effect in both heating and air conditioning mode.

So how much ventilation should we have?

In the early HRV days it was assumed that CO2, generated by human breathing, was a good indicator of indoor pollutants and was used to establish our norms for ventilation rates.

Today some question our established ventilation calculation formulas. A recent study published by BuildGreenAdvisor.com entitled Ventilation Rates and Human Health asked the question: "Have researchers found any connection between residential ventilation rates and occupant health?" The answer was that there were not very many studies on the subject and some of them said there was no relationship between the two. Joseph Lstiburek, with his typical frankness, put forward that with a lack of scientific basis for ventilation rates we would be far better off starting by controlling pollution sources. Many cases were cited where outdoor air was worse than indoor air and heavy ventilation only polluted the house. I only mention those thoughtful reflections to point out how much each house must be studied.

No builder can provide a specific ventilation rate to a house -- he can only provide a planned ventilation potential and then if it works well for that house, the occupants may actually use it.

A healthy air quality strategy is far more than just choosing the model of an air exchanger. It is minimizing the need for ventilation by reducing pollution sources then responding to the building's environment and the lifestyles of the occupants.

We have strategies during construction to limit indoor pollution sources.

We have educational strategies with our clients to communicate how they can restrain from adding pollutants -- or at least use point of source exhaust for punctual pollution activities, like cooking, laundry or handy crafts.

We have the HRV that exchanges air, recuperates heat and dries out the house. Unfortunately if you use an air conditioner a lot in the summer, the HRV works against you bringing moisture into the house.

We have the ERV that exchanges air, recuperates energy and dries out the house less. It also reduces the quantity of humidity coming into the house and saves energy during the summer air conditioning period.

We have control systems that modify their ventilation rates based on such things as outdoor temperatures, or indoor pollutants.

We can avoid installation shortcuts that reduce the effectiveness of whole house ventilation:

Maximize the coverage of the ventilation system by using ceiling diffusers or high wall grills with upward direction vanes for fresh air input that can pick up excess ceiling heat.

Place grills at the far ends of rooms and use the room and hallways as ductwork to get as much air in the house as possible moving between input and exhaust grills.

A cold weather ERV is not only a viable machine, it may be the best tool you have for your ventilation strategy. Just make sure it is HVI certified for 10 years down to -25 C.

Yes, the primary criteria for choosing an HRV or an ERV is the anticipated moisture level in the house, but as you can see, that's not the whole story.

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