

# ACTION PLAN: FRESH AIR VENTILATION



HAYWARD™  
SCORE

## IMPLEMENTATION MANUAL

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### OVERVIEW

When it comes to the air we breathe in traditionally built homes, it is useful to understand that “homes suck.”

Within our homes warm air rises. Think hot air balloon. It pushes out of the upper half of your home through the attic, walls and air pathways. The replacement air is literally “sucked” in through the basement, crawlspace, cracks, walls, air pathways and gaps around doors and windows. Think vacuum. The “sucking” effect draws in dust, dirt, pollen, mold spores, moisture, pesticides and outdoor pollutants.

Over time these air pathways through the wall cavities become coated leading to biological growth and decay as well as premature degradation of materials within these spaces. The odors and gases from those cavities further taint our indoor air quality.

Once “sucked” into your house those particles tend to stay. Studies show that outdoor pollutants tend to concentrate inside at a rate of 3-5 times higher than the outdoor levels. We used to think of our homes as a place to escape the detrimental effects of outdoor pollution only to discover the problem is worse indoors where we spend approximately 90% of our time.

Homes can concentrate pollutants indoors at a level 3-5x higher (and up to 100x higher) than they occur outdoors! You need ventilation!

During the 20th century we relied on the natural “sucking effect” to provide the primary ventilation system for our houses. Today, we have much healthier with the availability of 21st century technology we have much healthier and more effective options.

Not only does the “sucking effect” lead to problems in the wall cavities that further degrade your indoor air, it doesn’t deliver adequate air flow to remove the internally generated sources of pollution like cooking odors, chemicals from building materials, furniture, cleaning supplies or clouds of particulate generated from walking on carpet. In the 21st century, we can fix this design flaw with the modern tool of high efficiency, balanced mechanical ventilation with heat recovery – HRV/ERV.

Exhaust-only ventilation can help prevent some moisture problems but only balanced, mechanical ventilation can actually resolve the “house sucking” design flaw and make a home healthier.

For more information see:

Joseph Lstiburek, Building Science Institute.

<http://bit.ly/2D14zXn>

## HOW DOES AN HRV/ERV WORK?

To insure continuous, healthy levels of ventilation within the home install a high efficiency, balanced mechanical ventilation system with filtration. These are precise, efficient systems that balance both the supply and exhaust air thus eliminating the “sucking effect.” They are called Heat Recovery Ventilators (HRV). Think of an HRV/ERV as the lung for the home. Within the unit there are two very efficient DC fans. One delivers filtered outdoor air through a set of tubes to the living spaces of your home while the other draws out or “exhausts” stale, contaminated, moist air from the kitchen, laundry room and bathrooms. The system operates continuously which is a good idea because human beings are “continuous breathers.”

High efficiency (90% efficient or higher) HRV’s are designed to recover heat from the outgoing air stream so that the air being delivered into the home enters at close to the same temperature as the air inside. High efficiency (90% or better) is really important to insure that the incoming air doesn’t feel like a draft. The magic of heat recovery is that the system recovers more heat from the outgoing air than it costs to operate. These systems typically consume as little energy as a 60-80 watt lightbulb.

Balanced systems allow the installer to establish positive pressure inside the house by setting the supply fan at a slightly higher speed than the exhaust fan. This is extremely important to insure your home doesn't suck air in from places like the garage, crawlspace or mechanical room. Garages tend to have things like automotive fumes, carbon monoxide and stored chemicals and mechanical rooms often have combustion appliances. When the house "sucks" those fumes and combustion gases get "sucked" into your house making your air unhealthy. These are important life/safety issues.

## **HOW PEOPLE DESCRIBE THEIR EXPERIENCE LIVING WITH A FRESH AIR MACHINE:**

"I don't feel my allergies when I am in the house."

"The house always smells fresh, even when no one has been there for several days."

"When the kids get sick it doesn't seem to last as long as it does in other kids' homes and it doesn't seem to get passed back and forth between family members anymore."

## STEP 1: CHOOSE THE RIGHT “FRESH AIR VENTILATION SYSTEM” FOR YOUR HOME

- To choose an appropriate ventilation system for your home you need to understand your home’s layout, climate, and proximity to sources of outdoor pollution as well as how much moisture your family generates. This will help you and your contractor design a system that will provide moisture management and healthy ventilation for your home.
- Determine where there is enough space to install the ventilation unit and to route the ducting.
- If your home was traditionally constructed and has a crawlspace, basement, and/or attic, then you probably have space to easily install the ducting and equipment. In this case you could install a centrally located “fresh air system.”
- If your home is a modern design with no space for ducting or constructed of a cement slab and flat roof you will either need to install a decentralized system using smaller units in each critical room or install soffits in some rooms to conceal the ducting.

- The HRV/ERV needs to be installed within the conditioned space of the home or an insulated, air sealed area needs to be built around it if it is in the attic, crawlspace or garage.

## **CLIMATE**

- The climate in which you live will determine if you need an HRV or an ERV.
- In a very cold climate your HRV/ERV will need an electric preheater to warm the air when outdoor temperatures are below freezing.
- In a very humid climate you may also need additional dehumidification and in a dry or marine climate an ERV will help to stabilize indoor humidity.
- Each manufacturer has different specification for how to optimize their HRV/ERV in a specific climate zone.

## **OUTDOOR POLLUTANTS**

- Determine if the nearby outdoor sources of pollution that can come into your house are mostly dust (particles) or odors and fumes (chemicals).  
(Refer to Outdoor Pollutant Action Plan)

- Standard filters packages use a MERV 11 or MERV 13 filter for particles like ordinary dust, pollen, and pollutants.
- If you are in an area that has chemicals from nearby industry, restaurants, or golf courses you will need to add Carbon or a Carbon and Zeolite combination filter.
- Living within 1000 feet from highways and other high traffic areas will need both because of the combustion chemicals in the exhaust and the particles from dust, tire and brake wear, plus diesel particulate.
- Filters will need to be replaced 2-5 times per year, depending on pollution levels, so it is important that the equipment be easily accessible. It is important to keep the lung of your home clean because it's keeping your lungs clean.

## **INTERNAL MOISTURE**

Indoor moisture control is important to avoid potentially costly consequences to homes and occupants. You need to choose a system that will manage the moisture level particular to your home.

When sizing your system it is important to list all your internal sources of moisture. Ask yourself questions like:

How many people and pets live in the house?

How often do you and your family take showers 10 minutes or longer?

How often do you cook?

How often do you boil water or use a steamer?

How often do you use a dehumidifier?

Do you have an indoor Jacuzzi or steam shower?

## **WHY MOISTURE MATTERS A LOT**

Each person, every day, generates around 4 quarts of moisture inside our homes. Moisture comes not only from cooking, laundry, perspiration, and bathing but also simply from breathing. All that moisture adds up to 356 gallons (at 8.3 pounds per gallon) a year per person. That means a family of three creates over 9,000 pounds of water vapor inside their home each year!

Excess moisture causes multiple types of problems. Not directly from the humidity in the air but from the interaction of the humidity with the interior of the house through absorption and condensation. The damage can range from wood flooring and molding cupping to wood rot, corroded metal or the growth of bacteria and mold. Some insects are attracted to damp spaces as are rodents and dust mites. Modern building materials accelerate the release of chemicals as they begin to absorb excess moisture. Unlike solid wood, modern building materials are very intolerant of excess moisture.

## **YOU CAN'T BREAK THE LAW**

Internal moisture can't break the law (2nd Law of Thermodynamics) which says moisture is always moving from warm spaces to cold. We know that from how condensation forms after a hot shower on the cold bathroom mirror and windows or from observing the droplets that form on a glass of ice water on a warm day. What we don't think about is the fact that the shower is located near the closet. The closet doesn't have heat in it and is always colder. Moisture is always settling in the closet. When you pull the shoes out and find mold growing in them the 2nd Law is the reason. Since you can't break the laws of physics it is important that your home is designed to work within the law of building physics.

## **FACT**

Among a sample of 5500 people who have taken Hayward Score:

54% don't run bath fan regularly

55% don't run range hood fan regularly

The result? Problematic levels of internal moisture and pollutants!

## **STEP 2: CHOOSING YOUR ERV/HRV BRAND AND QUALIFIED INSTALLER.**

- Most suppliers of HRV/ERV's provide engineered designs.

What you will need to provide to the supplier is:

The square footage of your house

Average ceiling height to calculate

air volume

- A rough drawing showing the layout of bathrooms, bedrooms and living rooms with rough measurements or plans if you have them

- Size and location of basements, attics, and crawlspaces

- The moisture generating activities that occur in your house (see page 6)

This will be used to calculate the total volume of air needed, how many HRV's are necessary, how many vents in which locations, and how much ductwork.

## **FRESH AIR - AN INNOVATION!**

Fresh Air Ventilation is a 21st century innovation in housing! Shocking but true. Installers have been selling HVAC systems without fresh air their whole careers so this is shocking for them as well. Most installers have a great deal to learn about how to properly install and commission an HRV/ERV system. Installers typically have one brand they sell so if you ask for a high efficiency HRV/ERV and their brand isn't high efficiency they will spend a great deal of time telling you why you don't need it in an effort to sell the product they represent. For this reason we suggest doing your research on the product you want and then find an authorized installer.

### **STEP 3: INSTALLING YOUR SYSTEM**

Whether or not you need to hire a professional, it will depend on your own skill and the system you choose. Some systems can be shipped as parts with rolls of ducting tubes. These can be installed relatively easily by a skilled homeowner. Others are more complex and may require modifications or customized sheet metal ducting. Of course you may prefer to hire someone to install the system even if it is a simple install. If you choose to hire an installer it is important to find one who has experience in installing HRV/ERVs as these are fairly new to the US market though they have been popular across Europe since they were invented more than 30 years ago when it was noticed people were getting sick in homes). Europe invented these 30 years ago when people first started getting sick in homes. We recommend getting at least two bids. If they are reasonably close together pick the one you most trust. If they are substantially different get a third bid to help show what is most realistic.

If you choose to install it yourself, go to the manufacturer's website for installation instructions.

## **STEP 4: LOCATING THE OUTDOOR SUPPLY & EXHAUST VENTS**

Be thoughtful about where you locate the supply vent for your system. This is the snorkel for your home. It should be at least 6 feet above the ground and not near any sources of pollution, vents for exhaust, sewer, attic or crawlspaces, natural gas meters or chemical storage. It also needs to be at least 8 feet away from the system exhaust vent. Try to locate the exhaust vent downwind from the supply vent. The supply vent needs to be cleaned 2-4 times per year so make sure it is accessible. Sometimes the exhaust vent can be noisy depending on the length of the ducting between the HRV/ERV and the vent. Be thoughtful about not locating the exhaust near a bedroom window. Some manufactures offer silencers to mitigate this problem if it occurs.

## **STEP 5: DETERMINING VENTILATION RATES**

The minimum standard is to operate at 0.33 Air Changes Per Hour (ACH). Higher rates of ventilation are more effective at clearing internal pollutants. Higher rates of ventilation are necessary during unusual conditions and during the first 2 years after construction when the materials are off gassing at a much higher rate. Hayward Score research as well as research done by other experts demonstrates that an adjustable ventilation rate of 0.4-0.6 ACH is necessary to keep to provide clean, healthy air inside a home. It is also necessary to keep CO2 under 800 parts per billion (ppb). This is especially necessary for sleep quality and to maximize cognition.

## **STEP 6: PATCHING THE SHEETROCK AND PAINTING**

Since your focus is to create a healthy home be sure the installation process doesn't contaminate your home with chemicals or sheetrock dust.

### **SHEET ROCK**

When working with sheetrock there is a lot of dust created in the finishing. Request your installer wet sand or use dustless equipment, diligently isolate the areas from the rest of the house so that dust won't spread and vacuum up the residual with a true HEPA vacuum.

Installers typically want to use a standard job site vacuum like a Shop Vac which will pick up the bulk dust and debris, while covering your home with a layer of fine particles that you will smell for years. After HEPA vacuuming wipe all surfaces (floors, walls, ceilings and inside of cabinets and drawers) with a damp cloth to remove the last bits of the dust. (Refer to Hayward Score Dust Protocol)

## **PAINT**

Select only water-based, Low-VOC or No-VOC paint. VOC's are volatile organic compounds which you don't want to be breathing after the installation is done. VOC's from new paint can stay suspended in the air for as long as 6 months.

## **NEW DUCTING FOR THE HRV/ERV**

All vents and ducts must remain sealed during construction to insure dust doesn't contaminate the new, clean system.

## **EXISTING HVAC VENTS**

Should also be taped off and sealed during construction for the same reasons.

## **STEP 7: COMMISSIONING**

Every system must be professionally verified to insure adequate air flow to each room and positive pressure in the house. Make sure commissioning is required in your contract and make sure the installer goes over the report with you. Make sure the commissioning happens after cleanup and all the dust has been removed.

Don't skip this step!

## **STEP 8: CUSTOMIZE YOUR SYSTEM TO YOUR PERSONAL AIR FLOW PREFERENCES**

Experiment with the different settings to find your preferred air flow levels. As you get to know your system you will discover certain times of the year and conditions where you prefer increased ventilation. You may prefer higher flows first thing in the morning, at dinner time and while sleeping. You can schedule it to use lower setting when the house is unoccupied. When outdoor odors are extremely high you may prefer to operate the system at a lower ventilation rate. We recommend the flow rates to vary between 0.4 ACH to 0.6 ACH for normal occupancy. In an away mode we recommend a 0.2 ACH. We recommend never turning the system off.

**NOTE:**

0.4 ACH means 0.4 air changes per hour or in simple terms the system will replace the volume of air in your home or bedroom once every two and half hours. At 0.6 ACH this will happen once every hour and forty minutes. At .3 ACH this happens once every three hours and 20 minutes which is too low for healthy, fresh air.

# CHECKLIST

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1. Experiment with the different settings to find your preferred air flow levels. As you get to know your system you will discover certain times of the year and conditions where you prefer increased ventilation. You may prefer higher flows first thing in the morning, at dinner time and while sleeping. You can schedule it to use lower setting when the house is unoccupied. When outdoor odors are extremely high you may prefer to operate the system at a lower ventilation rate. We recommend the flow rates to vary between 0.4 ACH to 0.6 ACH for normal occupancy. In an away mode we recommend a 0.2 ACH. We recommend never turning the system off.

2. Air seal the air pathways that allow outdoor air to flow into the living space through the crawlspace, basement, attic, wall cavities and tiny cracks using nontoxic foam, sealants, caulking and tape designed specifically for this purpose. Do note that duct tape is not designed for this purpose). Very important to install ventilation prior to air sealing as air sealing without appropriate ventilation will significantly degrade your home's air quality.

3. Remove existing bath fans. You can now remove the noisy, inefficient existing bath fans because a continuously operating HRV/ERV system quietly exchanges all of the air within the house and is much more effective at removing moisture and odor. The old ducting is now a detriment as it allows untampered outdoor air to leak in and conditioned indoor air to leak out. Be sure to remove or block the old ducting to the outside to prevent reverse air flow and heat loss.

4. Patch the sheetrock that was cut during installation using dustless equipment, wet sand in lieu of dry sanding joint compound and paint with zero-VOC paint to avoid odors and chemical exposure. Thoroughly clean up all construction dust using a true HEPA vacuum and wipe off surfaces with a damp cloth.

5. Verify the system is delivering the correct amount of air to each room in your home and is creating a slightly positive pressure within the house. This requires a flow hood for measuring the air intake, exhaust, and flow patterns. Verify the system maintains positive pressure within the house using a pressure differential measurement tool. This testing can easily and affordably be done by a home performance contractor. The process is called commissioning. Do not succumb to the temptation to skip this step. It is critical to insure your system works properly and doesn't create unsafe conditions by depressurizing the garage, attic, crawl space or mechanical spaces that produce combustion gasses.

Depressurization will in essence "suck" those gases, chemicals and pollutants into your breathing zone.

# FAQ: FRESH AIR VENTILATION

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## WHY IS CHOOSING A HIGH EFFICIENCY SYSTEM HRV/ERV CRITICAL TO YOUR SATISFACTION?

HRV/ERV units range in efficiency from 60% to 94% and units above 90% are considered "high efficiency." The higher the efficiency of your HRV/ERV system, the more comfortable you will be, so choose the most efficient model that you can.

What does high efficiency mean to your experience in your home? First, high efficiency systems are silent while lower efficiency systems can be noisy to operate, often causing occupants to turn them off. Second, lower efficiency systems have a hard time maintaining comfortable air quality without feeling drafty when there is more than 20 degree difference between indoor and outdoor temperature.

Consider the following example. If your home is 70 degrees and the outdoor air is 40 degrees, there is a 30 degree differential between the two. If a unit is 60% efficient the fresh air coming through the “heat exchange” component of the HRV will be warmed to 58 degrees. When it comes to air, like temperatures mix readily. Air this cold will not mix with the warmer air. You will experience this as an annoying draft. Because it won't mix well with the warmer air in the room, the cold airstream will flow through your room to the exhaust vents like a river instead of slowly mixing with the air in the room. It needs to mix and push the older, stale contaminated air out to freshen the air. The whole goal of installing an HRV/ERV is to replace the volume of air in your home with new, filtered fresh air

If it doesn't mix it won't accomplish the goal. On the other hand, if your unit is 93% efficient in the same situation of 70 degree indoor air and 40 degree outdoor air the incoming air stream will be delivered at 67.9 degrees. At this small temperature differential you won't experience a draft and it will do the job it was intended to do of displacing the air in your home with fresh air.

Finally, high efficiency HRV are less expensive to operate. They recover heat from the outgoing air stream so that the air being delivered into the home is close to the same temperature of the air in the home. The magic of heat recovery is that the system recovers more heat from the outgoing air than it costs to operate. A high efficiency unit will operate at the equivalent of a 60-80 watt lightbulb, while a lower efficiency unit may use as much as 200 watts to operate.

The Home Ventilating Institute (HVI) evaluates the efficiency of HRV/ERV systems and publishes results at : [WWW.HVI.ORG](http://WWW.HVI.ORG)

## **WHY DO I NEED DEDICATED DUCTING FOR MY HRV/ERV?**

Delivering the right amount of air to each room, especially the bedrooms where you sleep at night, is the whole reason you are choosing to install fresh air ventilation. Dedicated ducting to each room is the only way to control how much air is delivered to each room. The difference in delivering 18 CFM to the master bedroom versus 27 CFM, although a seemingly small number, makes a huge difference in the quality of air in your bedroom and how you will sleep. Being precise matters!

In our research, attaching an HRV to the existing duct work of a HVAC system is only able to deliver about 1/3 of the health benefits of a dedicated system. There are two issues with using existing ducting:

- HVAC ducting is large and designed for large air flows. HRV/ERV's move much less air to do their job. When you push this small quantity of air into the existing ducting it gets lost in the first few rooms on the duct run and never makes it to the ends of the system in adequate quantities. The bedrooms, where you need it the most, are usually at the end of the runs.
- When your HVAC system is running it recirculates air and contaminants from each room throughout the house. With an attached HRV/ERV a small percentage of contaminants are removed with each recirculation. In a dedicated ducted HRV/ERV the exhausted air goes 100% to the outside and doesn't redistribute contaminants. This is especially important because contaminants generated in the kitchen, laundry room and bathrooms are not contaminants you want to redistribute into the rest of your living space.

## **WHAT HAPPENS TO MY FORCED AIR SYSTEM WHEN I INSTALL A DEDICATED HRV/ERV?**

The good news is that your existing forced air system will become about 20% more efficient when you install an HRV/ERV. Because the HRV/ERV is continuously moving small quantities of tempered, fresh, filtered air throughout the house, it causes the temperature in the house to stay more constant thus allowing your forced air system to cycle less frequently. This results in the increase in efficiency of your existing system. Nice benefit, don't you think?

## **WHERE DO I PUT THE OUTDOOR INTAKE?**

Think of the outdoor intake as the snorkel for the house. Your decision of where to locate the HRV/ERV itself will be driven by two factors, space and access to the best outdoor air. Ideally the intake is at least 6' above the ground. It should not be in the sun which would heat up the incoming air. Avoid locating it near sources of odors, chemical storage, gas lines or exhaust from kitchen, dryer or combustion appliances. The intake needs to be at least 8' away from the exhaust and ideally upwind.

## **DO I NEED OTHER SMALL EXHAUST VENTS?**

We store trash, recycling, cleaning supplies, soaps and sometimes chemicals under the kitchen sink. Add an exhaust vent set to 4 CFM under the kitchen and bathroom sinks to remove those odors before they ever enter the house. The enemies of indoor air quality are stale air and moisture. Moisture tends to accumulate in closed closets and storage places. Keep these fresh with additional small exhaust vents in closets and closed storage spaces. For a few extra dollars it makes a real difference in how fresh the house feels and how the house will age.

## **WILL I MISS MY BATHROOM FANS?**

Because HRV/ERV's operate continuously they are quite effective at clearing odors from the bathroom. You might miss the noise the bath fan makes when you are sitting on the throne. No problem, add a clock radio. As far as moisture from the shower, bath fans really need to run for at least 2 hours after a shower to be effective. Your HRV/ERV runs continuously and gets the job done silently.

## **WILL FRESH AIR REALLY HELP ME THINK BETTER?**

Yes! Think about how many times you've said, "I can't think clearly, I need some fresh air." Turns out you were right and now there is research to support the adage! The most significant studies of Indoor Air Quality (IAQ) and performance have been conducted by the T.H. Chan School for Public Health at Harvard. While their studies over the last few years have focused on the office environment, you can see the impact similar changes would make in a home.

Their research showed when air quality was improved participants taking a standardized test measuring 9 categories of cognition improved 60-200% in the optimum air environment. Productivity improved 20%. Further studies showed that working in optimum air during the day, even improved sleep by 20% at night. Just think what improved IAQ could do for you at home.

For more information visit:

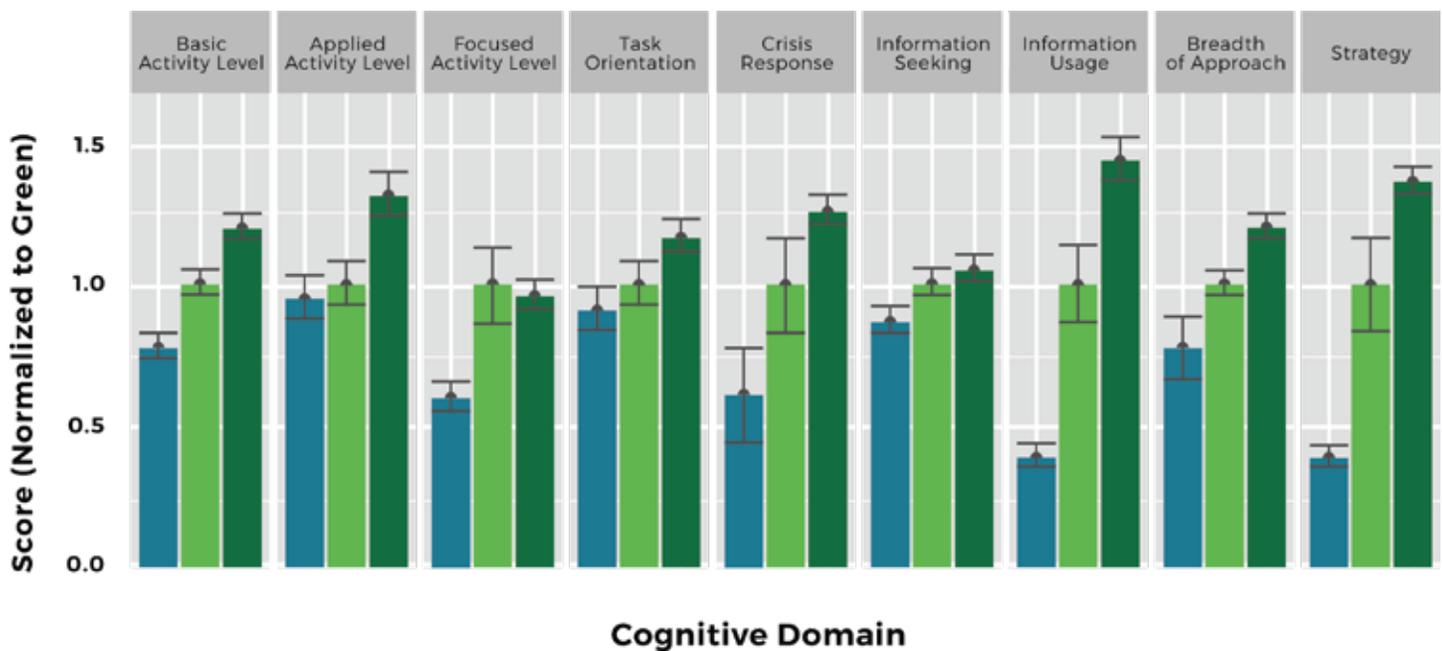
[HTTPS://NATURALLEADER.COM/THECOGFXSTUDY/](https://naturalleader.com/thecogfxstudy/)

# “WHAT LEVEL OF COGNITION DOES YOUR HOME PROMOTE.”

Blue = Average Office Air

Light Green = Green or LEED buildings

Dark Green = Optimum Air Quality



- Conventional
- Green
- Green+

## **WILL AN HRV/ERV BE REALLY NOISY?**

Not all HRV/ERV's are equal. This is especially true when it comes to noise. Experience demonstrates that if the system makes too much noise home owners turn them off, especially at night when you need fresh air the most. You want to select a system that is capable of delivering air silently (not just quietly) throughout the house in normal operating mode which means a fan speed of 60% of capacity or less. It is OK to experience a small amount of noise in temporary boost mode which you might activate after using the bathroom or when you have a large crowd at the house but that should dissipate quickly.

Systems tend not to use sheet metal ducting to move air throughout the house. Sheet metal ducting can create a drumming effect transferring noise. They also offer silencers to be installed within the system to eliminate noise.

## **WHEN DESIGNING A SYSTEM, DO I NEED TO THINK ABOUT MY PETS?**

Some factors to consider are how many pets you have. Typical dogs create twice as much CO<sub>2</sub> than an adult. If you happen to have your pets sleep in your room then that CO<sub>2</sub> load is probably impacting you at night and degrading your sleep when the windows are closed. Pets in the bedroom merit more air flow to keep CO<sub>2</sub> under 800 ppb for optimal sleep quality.

# MAINTENANCE MANUAL

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## OVERVIEW

The good news is that HRV/ERV systems require very little maintenance once installed.

Over time you'll learn how your system performs in your home and how local conditions vary throughout the year. This will help you determine whether you need to change filters or clean the intake somewhat more or less often than usual.

These can be listed as the maintenance sections:

## CHANGE FILTERS

- Set up a schedule in your calendar to remind you to replace the filters on your HRV/ERV regularly.
- We recommend changing the filters 2-6 times per year. The rate at which you need to change your filter will depend on filter type, the conditions in your neighborhood, and your personal sensitivity.

## **CHANGE INTAKE**

Set a reminder to clean the outdoor air intake regularly. Outdoor debris such as leaves, bugs, and dirt can accumulate on the protection grate and impact functioning of your system. We recommend clearing debris 2-4 times a year. You may find you need to clear more often depending on conditions in your area.

## **TIP**

Local air conditions can change, so pay attention to what is going on in your neighborhood. For example, if you have a neighbor who is doing a construction project or landscaping the increased amount of dust/dirt stirred up may cause you to need to replace your filters monthly.

## **CAUTION**

Ventilation and Internal sources of pollution. If internal sources of contaminants are too high no amount of ventilation will be enough to offset the source. For this reason it is very important to understand the chemical off gassing of all the building materials and furniture you install in your house. It is also very important to insure the air pathways between the garage and house are completely sealed as that is how a lot of pollutants get into your home. If in doubt, have your home tested by a building performance contractor for \$200-\$300.

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