Energy Efficiency Improvement Options

Property: Sample Property

Soldotna, AK 99669

House: Single Family
Living Floor Area: 4,386 sq.ft
2-Car Attached Garage

Rater: Robert Moss
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ID: RJM94

Initial Rating: Two Star Plus, 67.6 points
Additional Rating Points needed to reach higher Rating Levels:
0.4 more points needed to reach **3 Stars** (a minimum 5 point increase is required to receive an AHFC rebate)
5.4 more points needed to reach **3+ Stars**
10.4 more points needed to reach **4 Stars**
15.4 more points needed to reach **4+ Stars**
21.4 more points needed to reach **5 Stars**
24.4 more points needed to reach **5+ Stars**
27.4 more points needed to reach **6 Stars**
Fuel Prices used in this Analysis: Electricity = $0.2546/kWh, Natural Gas = $1/ccf

The maximum Carbon Monoxide (CO) leakage of a combustion appliance should be less than 25 ppm at steady state conditions.
The Heater test result was 53 ppm.
The Heater test result was 28 ppm.
The DHW test result was 2 ppm.
The DHW test result was 1 ppm.
The GarageHeater test result was 122 ppm.

The following are possible energy-saving improvements for your home.
Notes: The Rating points you receive for each improvement depend upon the other measures you install. In the report below, the points indicated for each measure assume that you install all prior measures on the list. The Break-Even cost is the *most* you could pay for the improvement and still have it be cost-effective based on energy savings over the life of the measure.

Improvement Description / Location	Annual Savings[1]	Break-Even Cost[2]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]	Design Heat Loss, Btu/hr[5]
Install a programmable thermostat; zone controls will cost extra.	$201	$2,517	0.9	68.5 points 3 Stars Increase: 0.9 pts, 1 step	114,356
Install 2' of R-10 rigid board insulation around perimeter of Slab (vertical or horizontal installation). Location - On- or Below-Grade Floor, Perimeter: House/Basement Daylight Edge	$64	$1,407	0.4	68.9 points 3 Stars Increase: 1.3 pts, 1 step	113,433
Install 4' of R-20 rigid board insulation on perimeter of Crawl Space Floor. Location - On- or Below-Grade Floor, Perimeter: House/Crawlspace	$177	$3,868	1.2	70.1 points 3 Stars Increase: 2.5 pts, 1 step	111,259
Install 2' of R-10 rigid board insulation around perimeter of Slab (vertical or horizontal installation). Location - On- or Below-Grade Floor, Perimeter: Garage	$57	$1,235	0.6	70.7 points 3 Stars Increase: 3.1 pts, 1 step	110,283
Caulk and Seal so that Home Air Leakage is Reduced by 1000 CFM at 50 Pascals.	$284	$2,429	2.1	72.8 points 3 Stars Increase: 5.2 pts, 1 step	102,915

Improvement Description / Location	Annual Savings[1]	Break-Even Cost[2]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]	Design Heat Loss, Btu/hr[5]
Replace Heating System with a Furnace having an AFUE of 95%. Location - Primary Heating System	$673	$10,881	5.6	78.4 points 4 Stars Increase: 10.8 pts, 3 steps	102,915
Replace existing garage door with R-7, 2" polyurethane core replacement door. Location - Garage Door: Garage	$102	$1,635	1.1	79.5 points 4 Stars Increase: 11.9 pts, 3 steps	99,633
Replace sliding glass door with R-2.8 door. Location - Window/Skylight: House/Sliding Glass Doors	$340	$5,434	2.3	81.8 points 4 Stars Increase: 14.2 pts, 3 steps	93,568
Replace Gas/Propane Water Heater with a Unit having an Energy Factor of .6 or better.	$44	$488	0.2	82.0 points 4 Stars Increase: 14.4 pts, 3 steps	93,568
Replace existing window with U-0.30 vinyl window. Location - Window/Skylight: House/Broken Panes	$51	$816	0.3	82.3 points 4 Stars Increase: 14.7 pts, 3 steps	92,662
Install R-10 rigid board insulation. No cost included for covering insulation. Location - Cathedral Ceiling: House	$63	$1,377	0.4	82.7 points 4 Stars Increase: 15.1 pts, 3 steps	91,076
Install a Heat Recovery Ventilation system. * Under Weatherization, ventilation is a H&S measure regardless of SIR. *	$0	$0	0.0	82.7 points 4 Stars Increase: 15.1 pts, 3 steps	91,076
Total, All Measures	**$2,057**	**$32,087**	**15.1**		

Annual CO2 Reduction after all improvements: 22,689 pounds per year

Notes:

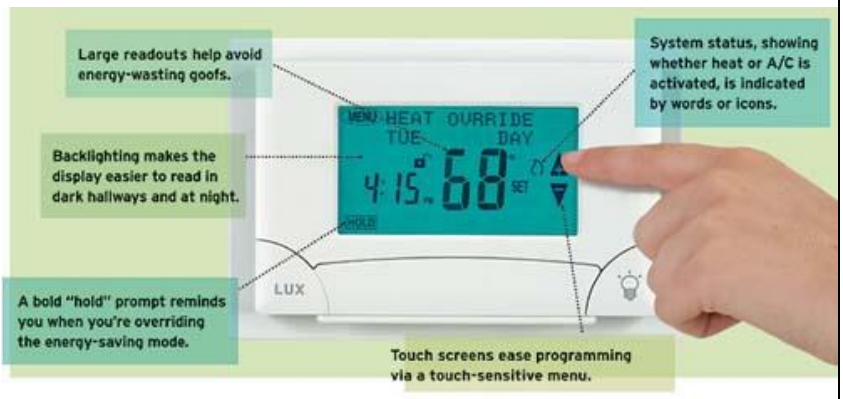
***1**. Annual Savings* is the potential savings in your home's energy cost per year.
***2**. Break-Even Cost* is the most you could pay for this improvement and still have it be cost-effective based on energy savings over the life of the measure.
***3**. Rating Points Gained* are the estimated rating points that would be added to your As-Is Rating score if the measure were installed. Actual points gained will only be determined by completing a post rating.
***4**. Rating, after all Improvements thru this one:* This column shows the estimated energy rating that would result if all improvements prior to and including this one were done. As well as showing the estimated final rating, the column shows how much the rating will improve in terms of rating points and in terms of rating steps. For example, an increase from a 2 star rating to a 2 star plus rating is one step. The actual final rating will only be determined by completing a post rating.
***5**. Design Heat Loss, Btu/hr:* This Design Heat Loss value shows the design heat loss in Btu/hour after this improvement and all before it are implemented. The Design Heat Loss is the amount of heat required to be delivered to the conditioned spaces during heating design conditions. If the heating system serves Domestic Hot Water loads in addition to space heating, you must increase this value to account for the domestic hot water load. When determining the size of the required heating system, you should also add capacity for distribution losses, pick-up requirements, and a safety margin. If you are determining the input rating of the heating system, you must also add capacity for the inefficiency of the furnace or boiler.

Detailed Improvement Information

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]
Install a programmable thermostat; zone controls will cost extra.		**$201**	**0.9**	**68.5 points 3 Stars Increase: 0.9 pts, 1 step**

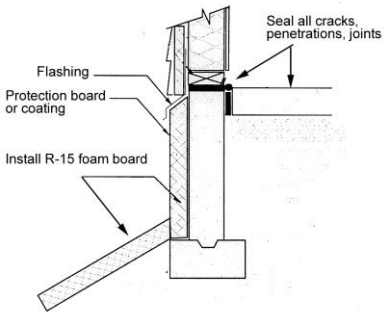
A thermostat that adjusts the temperature at different times during the day saves energy, compared with a simple room thermostat. *Setback* or *programmable thermostats* can automatically reduce the house temperature for certain periods such as when the home is unoccupied or during sleeping hours. Thermostats generally have only two low-voltage wires and are easy to install. You will need one thermostat for each zone.

Confusing controls on some programmable thermostats may make it difficult to save energy. When choosing a programmable thermostat look for one that is easily programmed with a display that is easy to read at arm's length. All programmable thermostats let you override their energy-saving modes. Some use bold letters or lights to tell you the override is on. Others have override prompts that are relatively easy to miss, and you may not realize you are not saving energy.



Install 2' of R-10 rigid board insulation around perimeter of Slab (vertical or horizontal installation).	**On- or Below-Grade Floor, Perimeter: House/Basement Daylight Edge**	**$64**	**0.4**	**68.9 points 3 Stars Increase: 1.3 pts, 1 step**

With a slab foundation, the energy loss is greatest at the edge. Excavate to a depth of 2' around the slab and attach rigid insulation to the foundation wall. Make sure the insulation comes all up to the bottom of the siding. Cover the above grade portion of the insulation with flashing. Then backfill. You can stop more energy loss by adding 2' of insulation, extending out from the foundation wall.



Install 4' of R-20 rigid board insulation on perimeter of Crawl Space Floor.	**On- or Below-Grade Floor, Perimeter: House/Crawlspace**	**$177**	**1.2**	**70.1 points 3 Stars Increase: 2.5 pts, 1 step**

Simply lay insulation around the perimeter of the crawlspace floor. **Caution**: Minor water intrusion will likely damage batt-type insulation. Foam board may be a better solution. Check with your local code official for cover requirements.

Install 2' of R-10 rigid board insulation around perimeter of Slab (vertical or horizontal installation).	**On- or Below-Grade Floor, Perimeter: Garage**	**$57**	**0.6**	**70.7 points 3 Stars Increase:**

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]
				3.1 pts, 1 step
See the Description above for the Improvement: *Install 2' of R-10 rigid board insulation around perimeter of Slab (vertical or horizontal installation).*				
Caulk and Seal so that Home Air Leakage is Reduced by 1000 CFM at 50 Pascals.		**$284**	**2.1**	**72.8 points 3 Stars Increase: 5.2 pts, 1 step**

Air sealing tasks:

- Seal joints and penetrations in the crawlspace rim joist.
- Remove baseboard trim and seal the wall/floor joints at the wood floors. Replace the baseboards.
- Seal wall/ceiling joints
- Seal window and door frame/wall joints if windows are not replaced. Remove trim and seal the gaps with caulk or low-expanding foam.
- Seal window sash/frame joints if the windows are not replaced.
- Seal around plumbing, mechanical, and electrical penetrations into the attics.
- Seal around the old fireplace flue at the ceiling level. If possible, remove the old chimney and seal up the hole. You may need to get access to this area from the outside.
- Outlet and switch plates. Use foam gaskets and child protector plugs to seal these items. If leakage is still a problem caulk the wiring penetrations through the box (turn off the breakers first!).
- Install brush quality weather-stripping on exterior doors if they are not replaced.
- Replace or seal around recessed lights. Optimally the lights could be removed, the penetrations sealed, and new, surface-mount lighting installed. The second option is to replace the existing unsealed recessed fixtures with air-tight, sealed recessed fixtures that are rated for insulation contact. Finally, the existing fixtures could be covered with insulated boxes. The boxes can be made with rigid insulation (Thermax, R-Max, or extruded polystyrene) and the joints sealed with foil or plastic tape. Seal the box to the vapor retarder with an adhesive sealant. Caution: boxes must be large enough to allow heat dissipation from the fixture. Use CFL lights to reduce overheating risk.
- Seal over kitchen soffit. Use rigid insulation (same types as noted above) to create a vapor retarder at the top of the kitchen soffit. It should be in the same plane as the main ceiling and be sealed to the polyethylene vapor retarder and/or the bottom chord of the trusses. The existing fiberglass insulation can be placed on top of the rigid (not in the soffit).

The best material for sealing these hidden air leaks depends on the size of the gaps and where they are located. Caulk is best for cracks and gaps less than about 1/4" wide.

Expanding foam sealant is an excellent material to use for sealing larger cracks and holes that are protected from sunlight and moisture. Today's products are safe for atmospheric ozone. Backer rod or crack filler is a flexible foam material, usually round in cross-section (1/4" to 1" in diameter), and sold in long coils. Use it for sealing large cracks and to provide a backing in very deep cracks that are to be sealed with caulk.

Use rigid foam insulation for sealing very large openings such as plumbing chases and attic hatch covers. Fiberglass insulation can also be used for sealing large holes, but it will work better if wrapped in plastic or stuffed in plastic bags, because air can leak through exposed fiberglass. Specialized materials such as metal flashing and high-temperature silicone sealants may be required for sealing around chimneys and flue pipes. Check with your building inspector or fire marshal if unsure about fire-safe details in these locations.

Additional air sealing benefits will come from replacing the boiler and water heater with a sealed combustion system. This will eliminate both the need for a combustion air supply and the flues.

Replace Heating System with a Furnace having an AFUE of 95%.	**Primary Heating System**	**$673**	**5.6**	**78.4 points 4 Stars Increase:**

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]
				10.8 pts, 3 steps
The home's existing heating system efficiency is below what is available today. AFUE (annual fuel utilization efficiency) measures a furnace's seasonal performance. Furnaces today are between 78% AFUE and 96% AFUE. Consider the following when selecting a new furnace: **Sealed Combustion System** (this reduces the need for a separate combustion air supply as well as the associated air leakage) **Condensing Furnace** (AFUE 90% or higher). Traditional "power combustion" furnaces are 80-82% AFUE. Above 90% AFUE, a furnace is "condensing," which means it recaptures some of the heat wasted by condensing escaping water vapor. **High Electrical Efficiency**. A furnace can use a significant amount of electricity, mostly to power the fan motor. Variable speed fan motors are generally more efficient than standard ("PSC") motors and may save you hundreds of dollars per year. Electrically efficient furnaces can be found on the Gas Appliance Manufacturers Association's website (www.gamanet.org). **Proper Sizing.** Make sure the heating capacity of the furnace is not too high for your home. Some mechanical contractors do not use proper heating load calculations to size heating systems and, as a result, oversized systems are often installed. Oversized systems operate inefficiently. The heating load for your home (prior to other retrofits) is available with your energy rating. The new system's output should not be significantly larger than that. The size requirement will be even less after building envelope retrofits are completed, and it may make sense to recalculate the design heating load when these are done.				
Replace existing garage door with R-7, 2" polyurethane core replacement door.	**Garage Door: Garage**	**$102**	**1.1**	**79.5 points 4 Stars Increase: 11.9 pts, 3 steps**
The existing garage is poorly insulated. The R-value of garage doors has increased over the years, so when you replace your garage door you could be increasing the energy efficiency of the garage itself. Most garage doors today feature a steel sandwich construction. It is a layer of steel over a urethane foam-filled core with core R values up to R-17 or greater. Note: Composite R-value will be lower than this because of the thermal breaks at each door panel. Most manufacturers provide core R-value only. In addition, new garage doors should be installed with a tight fitting weather seal which prevents air infiltration, and eliminates drafts. When considering a new garage door purchase, you may also need to update your garage door opener. The current safety standard for garage door openers is a photo eye sensor. A light beam is projected parallel to the garage door and if the beam is broken, the door will not close. If the door is not replaced, install one of the overhead door insulation kits.				
Replace sliding glass door with R-2.8 door.	**Window/Skylight: House/Sliding Glass Doors**	**$340**	**2.3**	**81.8 points 4 Stars Increase: 14.2 pts, 3 steps**
Old sliding glass doors often do no seal well because there is no compressive seal on the mating surfaces. Replacing the doors with French doors or newer sliding glass doors (make sure they glazing is Low E/Argon filled) will increase the R-value and reduce air leakage.				
Replace Gas/Propane Water Heater with a Unit having an Energy Factor of .6 or better.		**$44**	**0.2**	**82.0 points 4 Stars Increase: 14.4 pts, 3 steps**
Tank-type water heaters transfer heat from a burner or coil to water in an insulated tank. Because heat is lost through				

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]

the flue and through the walls of the storage tank, energy is consumed even when no hot water is being used.

New energy-efficient gas-fired storage water heaters are a good, cost-effective replacement option for your current water heater if you have a gas line in your house. They have higher levels of insulation around the tank and one-way valves where pipes connect to the tank, substantially reducing standby heat loss. Keep an eye out for the price to come down for newer super-efficient "condensing" and "near-condensing" gas water heaters, which save much more energy compared to traditional models but are currently niche products.

For safety as well as energy efficiency, fuel-burning water heaters should be installed with sealed combustion ("direct-vented" or "power-vented). Sealed combustion means that outside air is brought in directly to the water heater and exhaust gases are vented directly outside, keeping combustion totally separate from the house air.

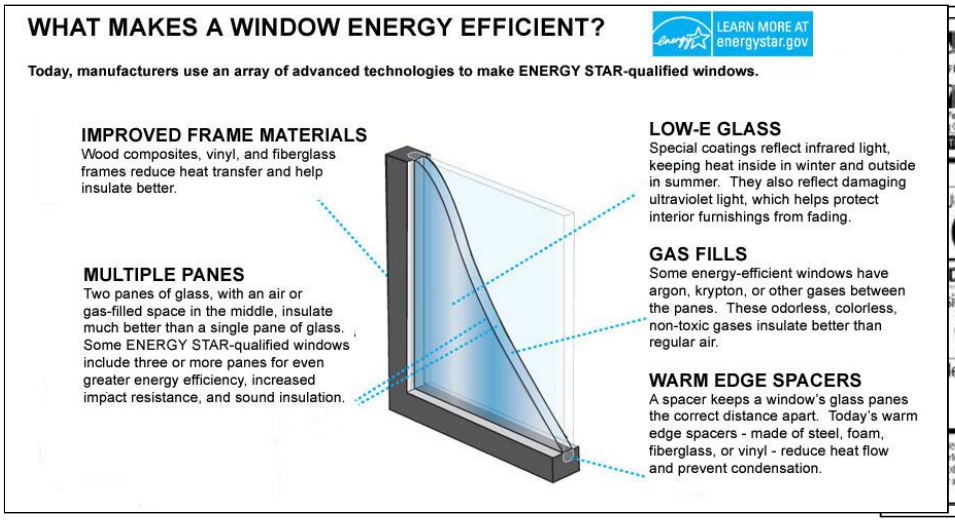
Gas Storage Recommendation (typical 40-gallon tank)

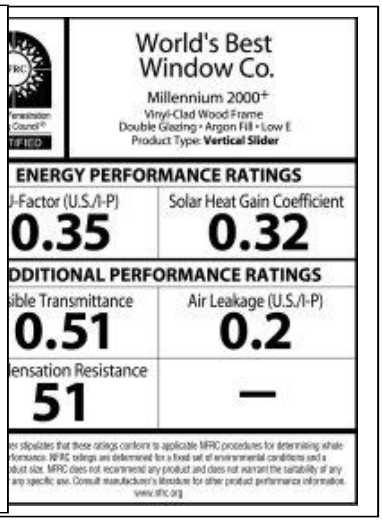
- Look for a **minimum Energy Factor (EF):** 0.63 (Highest available is 0.67)
- Ask for a direct-vented (sealed combustion) model.

Replace existing window with U-0.30 vinyl window.	**Window/Skylight: House/Broken Panes**	**$51**	**0.3**	**82.3 points 4 Stars Increase: 14.7 pts, 3 steps**

Look for the NFRC label to compare energy performance of different windows. In Alaska, U-factor (less than 0.35), Air Leakage (the lower the better) and Condensation Resistance (the higher the better) are the most important.

Wood, vinyl, wood-clad, and hybrid/composite windows have very similar R-values for the same type of glass and spacers. Insulated vinyl and fiberglass have similar thermal values that are higher than the others, and better condensation prevention. They will cost more initially, but should require very little maintenance.





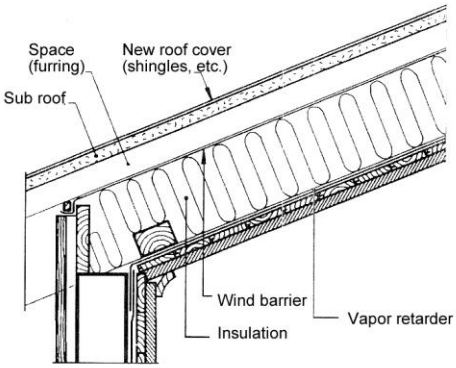
Install R-10 rigid board insulation. No cost included for covering insulation.	**Cathedral Ceiling: House**	**$63**	**0.4**	**82.7 points 4 Stars Increase: 15.1 pts, 3 steps**

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]

Many homeowners prefer the design and style of cathedral ceilings. However, insulating an existing vaulted or flat roof system to recommended standards can be a challenge. To meet the energy efficiency requirements of the latest energy codes, cathedral ceilings should achieve an R-value of at least R-38 in Alaska. The higher the R-value, the greater the insulating power.

Air Seal. Moisture damage to roof sheathing, framing members, and finished ceilings can result from some combination of air leakage, insulation, and ventilation problems. Air leakage through ceilings (including the top of walls) is a major source of attic moisture (and heat loss) in many homes.

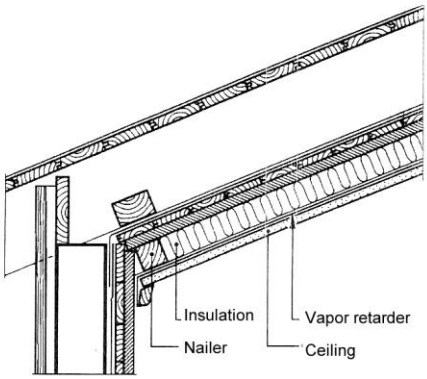
Flat and cathedral ceilings should first be air sealed to prevent entry of warm, moist air from the house and should also be well ventilated and then, well insulated. Ice dams form most commonly where there is excessive air leakage and inadequate insulation (which warms the attic/roof, causing snow to melt). Inadequate ventilation may also play a role in the creation of ice dams. However, if heat loss to the attic is reduced by addressing air leakage and insulation, saving money as well as preventing ice dams, you may find that additional ventilation is not needed.



Roof with cathedral ceiling insulated from above.

Insulate. There are two recommended ways to achieve a higher R-value in a cathedral/flat ceiling where it cannot be achieved by adding a fiber glass insulation batt to the stud/joist cavity.

- Exterior Insulation (new roof): Foam insulation can be added in the roof system. This is not a feasible means of retrofit if the roof is not going to be replaced.
- Interior Insulation (new ceiling): A combination of fiber glass insulation and rigid foam insulation. First, place an unfaced fiber glass insulation batt in the cavity. Choose the fiber glass insulation product that will give the highest R-value for the designed cavity space. Since fiber glass is designed to fit between standard joist or stud spacing, it will completely fill the space ensuring no voids, which could lead to other problems. It is too difficult to cut the rigid foam product to the exact spacing of the studs or joists. Second, install a foil faced rigid insulation to the inside of the fiber glass filled stud cavity. The thickness of the rigid insulation will be dependent upon the R-value of insulation in the stud cavity and the overall R-value desired. The two R-values can be added together to achieve the final R-value. The foil faced rigid insulation will provide a vapor barrier to the warm in winter side of the structure while only compromising a small amount of space. Cover the rigid insulation with a 15 minute fire barrier such as 1/2" Gypsum board. The Gypsum board must be fastened through the foam and into the framing.



Roof with cathedral ceiling insulated from below.

Caution: Dense-packing, or completely filling the roof space is not generally recommended. The risks in dense-packing are that (1) air leaks from interior partitions don't end up sealed (cellulose is not an air barrier, although it slows it down a bit)--and moisture can get to the cold side as air leaks into the roof cavity. Moisture can be very localized. (2) it can be very hard to dense-pack properly in a previously-insulated cavity--there is legitimate disagreement even among the dense-packing experts as to whether it's even possible to do it.

Risk can be mitigated by really good dense-packing, air sealing (hard to do in retrofit), and indoor humidity control (source control and mechanical ventilation). Also, having one or both ends of the cathedral (like the slopes in a cape) open to an attic helps--provides a drying pathway. If an established manufacturer will warranty his material as well as anything in direct contact with it, as some do, that might also mitigate risk.

Install a Heat Recovery Ventilation system. * Under Weatherization, ventilation is a H&S measure regardless of SIR. *		**$0**	**0.0**	**82.7 points 4 Stars Increase: 15.1 pts, 3 steps**

Whole-House Ventilation Systems

Tight buildings reduce energy costs by keeping in the heated air, but tight buildings without adequate ventilation trap

Improvement Description	Location in Home	Annual Savings[1]	Rating Points Gained[3]	Rating, after all Improvements thru this one[4]

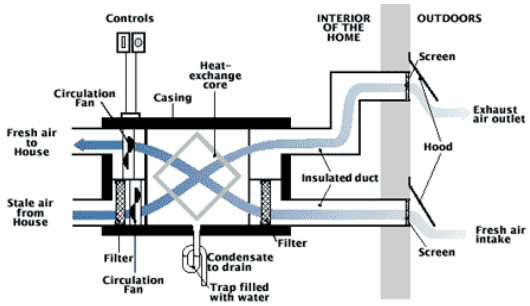
humidity and pollutants so they feel "stuffy", aggravate allergies and cause general discomfort for you and your family. Moisture damage to windows and other parts of the building shell can result when humidity is too high. A properly designed and installed ventilation system is the key to positive moisture control and will help ensure a healthy indoor environment.

You may have a "spot ventilation system" in your home if you have a fan in your bathroom or a hood over your range. These are both small units which attempt to solve the problem of removing moist air from the bathroom and hot air and cooking smells from your kitchen. However, these are not adequate for most newly constructed homes and all well-sealed homes. They only solve half the problem: they remove moist air or cooking odors but they draw in replacement air in ways you may not like: dusty, pollen-filled air from outside, radon and water vapor from the soil, fumes from an attached garage, smelly air from within walls and attic.

To provide just the amount of ventilation you need for comfort and safety while avoiding expensive and uncomfortably excessive ventilation, install a "whole house mechanical ventilation system" that provides continuous fresh air to living spaces and exhausts stale air from kitchen and bath areas. An "energy recovery ventilating system" can help make mechanical ventilation more cost effective by reclaiming energy from exhaust airflows.

There are two general types of energy recovery units, those called heat recovery ventilators (HRVs) and those called energy recovery ventilators (ERVs). HRVs and ERVs are similar devices in that both supply air to the home and exhaust stale air while recovering energy from the exhaust air in the process. The primary difference between the two is that an HRV transfers heat while an ERV transfers both heat and moisture. HRV's are usually recommended for colder climates with longer heating seasons. ERVs are used for warmer more humid climates with longer cooling seasons. There is still a lot of discussion regarding these recommendations. In most of Alaska an HRV is the preferred option.

An HRV uses fans to maintain a **low-velocity** flow of fresh outdoor air into the house while exhausting out an equal amount of stale indoor air. Fresh air is supplied to all levels of the house while stale air is removed from areas with high levels of pollutants and moisture



The heart of an HRV system is the heat recovery ventilation unit which houses the heat exchange core. Most heating, ventilating, and air conditioning dealers can sell and install heat recovery ventilators.

The most common HRVs are duct-connected house units. Other types of HRVs are wall or window room units. These are more often found in multifamily dwellings than in single family dwellings. The duct-connected units are more effective because they provide for a better distribution/pickup of air. The HRV unit can be retrofitted in homes with ducted heating systems.

1. One set of ducts collects stale moist air from the kitchen, laundry and bathrooms. This stale contaminated air passes through the HRV unit and is exhausted to the outside.

2. The other ducting system draws in fresh clean air from outdoors through the HRV unit.

3. As the two air streams pass each other within the heat exchanger core, heat is transferred from the outgoing stale air to the fresh incoming air. There is no mixing of air streams.

4. The HRV unit is able to capture up to 85% of the energy from the outgoing stale air. Filtered, preconditioned fresh air is delivered where you need it - in the living areas of your home.

The fan component of the duct-connected system is commonly installed in the utility or furnace room. It should be easily accessible for regular cleaning, air filter replacement, and servicing. Most contain air filters, some have dehumidifiers built in.

Costs can vary a lot depending on the type and complexity of the installation, as well as on the size and features of the HRV. For new construction, the costs would normally run from $1,000 to $2,500. It will generally cost more for a retrofit, due to the difficulty of running ductwork to the source points. Volume (or non-source point) ventilation systems can be installed at a lower cost, but may not be as effective and will require the furnace fan to run continuously.

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